European Commission

Preparatory study on commercial and industrial laundry appliances

Final report of Tasks 1-7 of the Preparatory Study
(Phase II)
Version 1

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List of Abbreviations

% v/v	volume per volume
% w/w	weight per weight
A	Ampere
ABS	Acrylonitrile Butadiene Styrene
AC	Alternating Current
ACA	accelerated capital allowance
AHL	Apartment Household Laundry
AI	Artificial intelligence
AISE	International Association for Soaps, Detergents and Maintenance Products
B2B	Business-to-Business
BAT	Best Available Technology
BAU	Business As Usual
BC	Base Case
BDEW	Bundesverband der Energie- und Wasserwirtschaft (German Association of Energy and Water Industries)
BEMP	Best Environmental Management Practices
BEP	Break-Even Point
BGR	Berufsgenossenschaftliche Regeln (Occupational health and safety regulations)
BNAT	Best Not (yet) Available Technologies
BOM	Bill of Material
BRC	British Retail Consortium
BSI	British Standards Institution
BTO	Building Technologies Office
CAGR	Compound Annual Growth Rate
CAS	Chemical Abstracts Service
CBI	Confidential Business Information
CCL	Coin & Card Laundry
CE	Conformité Européenne
CEC	Canadian Electrical Code
CELEX	Communitatis Europae Lex
CEN	Comité Européen de Normalisation
CENELEC	Comité Européen de Normalisation Électrotechnique
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
ch	central heating
CIL	Commercial Industrial Laundry
CISPR	Comité international spécial des perturbations radioélectriques
CL	Commercial Laundry
CLC	cf.: CENELEC
CLP	Classification, Labelling and Packaging
cm	centimetre
CN	Combined Nomenclature
COB	Close Of Business
COMEXT	Commerce Extérieur (Eurostat reference database for international trade in goods)
CRM	Critical Raw Materials
CSC	China Standard Certification

CSRD	Corporate Sustainability Reporting Directive
CTUh	Comparative Toxic Unit for human
cu.	cubic
DC	Direct current
DH	Degree of Hardness
DIN	Deutsches Institut für Normung
DIY	Do-it yourself
DK	Denmark
DO	Design Option
DoC	Declaration of Conformity
DOE	Department Of Energy
DPP	Digital Product Passport
EAF	Electric Arc Furniture
EC	European Commission
ECGT	Empowering Consumers for the Green Transition
ECHA	European Chemicals Agency
ECMA	European Computer Manufacturers Association
EDTA	Ethylenediaminetetraacetic acid
EEA	European Economic Area
EEC	European Economic Community
EEE	Electrical and Electronic Equipment
EF	Environmental Footprint
EFCEM	European Federation of Catering Equipment Manufacturers
EINECS	European Inventory of Existing Commercial Chemical Substances
ELINCS	European List of Notified Chemical Substances
EMAS	Eco- Management and Audit Scheme
EMC	Electromagnetic Compatibility
EMPA	Eidgenössische Materialprüfungs- und Forschungsanstalt
EMU	Economic and Monetary Union
EN	Europäische Norm (European Standard)
EOL	End Of Life
EORI	Economic Operators´ Registration and Identification
EPA	Environmental Protection Agency
EPDM	Ethylene Propylene Diene Monomer
EPREL	European Product Registry for Energy Labelling
EPRS	European Parliamentary Research Service
EPS	Expandable Polystyrene
eq	equivalent
ERT	EcoReport Tool
ESPR	Ecodesign for Sustainable Products Regulation
ETCT	European Textile Care Technology
ETSA	European Textile Services Association
ETSI	European Telecommunications Standards Institute
EU	European Union
EuP	Energy-using Product
EUR	Euro
EUROSTAT	Statistical Office of the EU
FAQ	Frequently Asked Questions
FMC	Final Moisture Content
ft	Feet
GAD	Gas Appliance Directive

gal.	Gallon
GCL	Generic Concentration Limit
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GHS	Globally Harmonised System
GHz	Giga Hertz
GJ	Giga Joule
GPP	Green Public Procurement
GTIN	Global Trade Item Number
H	Hydrogen
HACCP	Hazard Analysis and Critical Control Points
HCL	Healthcare Laundry
HDPE	High-density Polyethylene
HH	Healthcare Hospital
HICP	Harmonised Index of Consumer Prices
HN	Healthcare Nursing Home
HPL	Hospitality Laundry
HS	Harmonised Commodity Description and Coding System
Hz	Hertz
IA	Impact Assessment
IAS	Intentionally Added Substances
IBNET	International Benchmarking Network for Water and Sanitation
IEC	International Electrotechnical Commission
IED	Industrial Emissions Directive
IFS	International Featured Standards
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
IT	Italy
IUPAC	International Union of Pure and Applied Chemistry
JRC	Joint Research Centre
kBq	Kilobecquerel
kg	Kilogramme
kHz	Kilohertz
kt	Kilotonne
kW	Kilowatt
kWh	Kilowatt-hour
l	Litre
LAS	Linear Alkylbenzene Sulfonate (Tensid)
LCA	LCA
LCC	LCC
LCI	Life Cycle Inventory
LLCC	Least LCC
LVD	Low Voltage Directive
m	Metre
MD	Machinery Directive
MEErP	Methodology for Ecodesign of Energy-related Products
MEF	Modified Energy Factor
MEUR	Million Euro
MJ	Megajoule
MS	Member State
N	Nitrate

NACE	Nomenclature statistique des Activités économiques dans la Communauté Européenne (statistical classification of economic activities)
NDA	Non-Disclosure Agreement
NEC	National Electrical Code
NF	Norme Française (French Standard)
Nf	Normalisation Factor
NFC	Near Field Communication
NFPA	National Fire Protection Association
NIAS	Non-Intentionally Added Substances
NLP	No-Longer Polymers
NMVOC	Non-Methane Volatile Organic Compounds
OCU	Organización de Consumidores y Usuarios
OJ	Official Journal
P	Phosphorus
PA	Polyamide
PAS	Publicly Available Specification
PBT	Polybutylene Terephthalate
PBT substances	Persistent, Bioaccumulative, and Toxic substances
PC	Polycarbonate
PCM	Phase-Change Materials
PE	Polyethylene
PEF	Product Environmental Footprint
PEFCR	Product Environmental Footprint Category Rules
PET	Polyethylene Terephthalate
PMT substances	Persistent, Mobile, and Toxic substances
POP	Persistent Organic Pollutant
PP	Polypropylene
PPWR	Packaging and Packaging Waste Regulation
PRIMES	Price-Induced Market Equilibrium System
PRODCOM	Production Communautaire
PRODQNT	Production quantity
PRODVAL	Production value
PS	Polystyrene
PVC	Polyvinyl Chloride
PWB	Printed Wiring Board
QA	Quality Assurance
QR	Quick Response
RABC	Risk Analysis and Biocontamination Control
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RED	Radio Equipment Directive
RFID	Radio-Frequency Identification
RKI	Robert Koch-Institut
RMC	Residual Moisture Content
RoHS	Restriction of Hazardous Substances
Sb	Antimony
SCIP	Substances of Concern In articles as such or in complex objects (Products)
SDS	Safety Data Sheet
SEAI	Sustainable Energy Authority of Ireland
SMT	Surface-Mount Technology

SoC	Substance of Concern
SP	Speciality Laundry
SVHC	Substances of Very High Concern
TARIC	Tarif Intégré des Communautés Européennes
THT	Through-Hole Technology
TRL	Technology Readiness Level
UBA	Umweltbundesamt
UK	United Kingdom
UL	Underwriters Laboratories
UN	United Nations
US	United States
USD	United States dollar
UV	Ultraviolet
V	Volt
VAT	Value Added Tax
VDE	Verband Deutscher Elektrotechniker (Association of German Electrical Engineers)
VDMA	Verband Deutscher Maschinen- und Anlagenbau (Mechanical Engineering Industry Association)
vPvB subtances	very Persistent and very Bioaccumulative substances
WCO	World Customs Organisation
WEEE	Waste Electrical and Electronic Equipment
WF	Water Factor
Wf	Weighting factor
WFD	Waste Framework Directive
WFD (2000/60/EC)	Water Framework Directive (2000/60/EC)
WLAN	Wireless Local Area Network
WM	Washing Machine
ZVEI	Zentralverband Elektrotechnik- und Elektronikindustrie (German Electrical and Electronic Manufacturers' Association)

1. Introduction

This preparatory study describes the results of the assessment of commercial and industrial laundry equipment as part of the regulatory process under the Ecodesign for Sustainable Products Regulation (ESPR). The structure of this report adheres to the Methodology for Ecodesign for Energy-related Products (MEErP) (Kemna 2011), takes into account the 2024 revision of MEErP (Gama Caldas et al. 2024) and is complemented by elements of the Digital Product Passport (DPP) methodology. The aims and objectives of the project and a general methodological overview are detailed below.

1.1. General remarks to this preparatory study within the ESPR work stream

The Ecodesign and Energy Labelling Working Plan 2022-2024 is a key part of the EU's energy efficiency and wider 'European Green Deal' objectives, including the Circular Economy agenda. It was adopted by the Commission on 30 March 2022 and builds on the work carried out since the adoption of the first Ecodesign Directive (European Commission 2022). It also covers the work required under the Energy Labelling Framework Regulation (EU/2017/1369) and takes into account the progress made with the European Product Registry for Energy Labelling (EPREL). The plan focuses on the ecodesign of energy-related products and lays out the priorities and planning for future regulation.

The plan strengthens the focus on the circularity aspects of ecodesign, following the example set in the previous Working Plan. It sets harmonised rules for 'energy-related products' on aspects such as energy consumption, water consumption, emission levels, and material efficiency. These rules stimulate both demand for and supply of more sustainable products while reducing energy consumption significantly.

Together with the 2022-2024 Working Plan, the proposal of the ESPR was published in March 2022. ESPR was adopted and entered into force on 18 July 2024.

ESPR builds on the previously existing Ecodesign Directive, expanding the ecodesign requirements for specific product groups as it enables the setting of performance and information requirements for almost all categories of physical goods placed on the EU market. The framework will allow for the setting of a wide range of requirements, including on:

- product durability, reusability, upgradability and reparability
- presence of substances that inhibit circularity
- energy and resource efficiency
- recycled content
- remanufacturing and recycling
- carbon and environmental footprints

- information requirements, including a DPP

With ESPR, the Commission is preparing to address specific measures for 'professional' laundry appliances by means of delegated act. The preparatory study to be conducted in this project is the first step towards the development of a ESPR Delegated Act for this product group.

The Ecodesign policy cycle at the product level, as shown in **Figure 1-1,** starts with a preparatory study. A preparatory study is a technical study carried out on specific product groups to determine environmental impacts and recommend policy options for new Ecodesign regulations under the ESPR framework. It is based on a standardised procedure, the Methodology for Ecodesign of Energy-related Products (MEErP) (Kemna 2011).

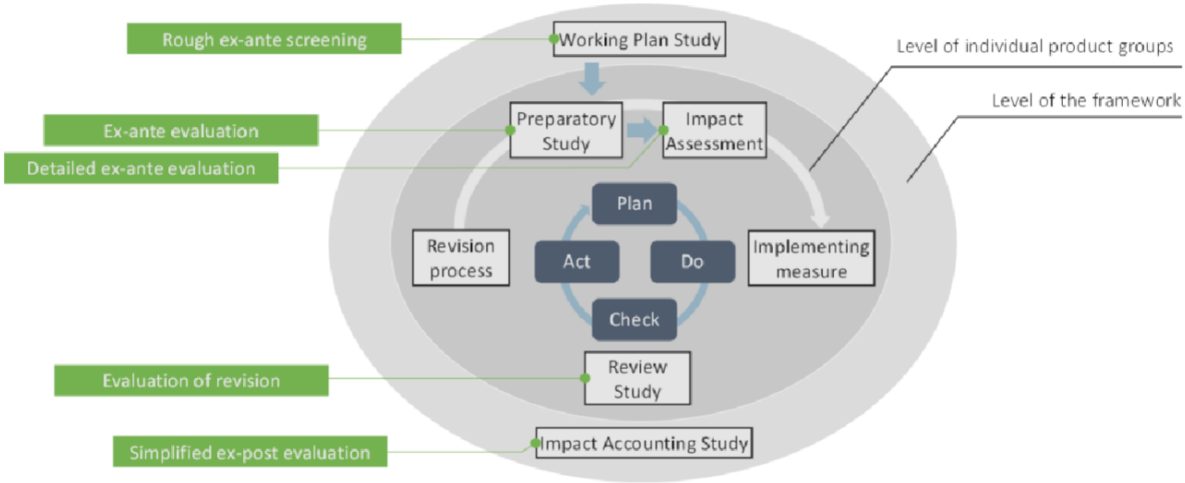


Figure 1-1: Policy cycle in the Ecodesign context.

Source: (Durand et al. 2022)

Figure 1-2 gives an overview of the different phases within the regulatory process resulting in a draft for potential regulatory ecodesign and energy labelling measure(s) and the expected contributions under this study for 'professional' laundry appliances. The flow chart still applies to the current Ecodesign Directive and Energy label Regulation, with potentially slight changes under the ESPR.

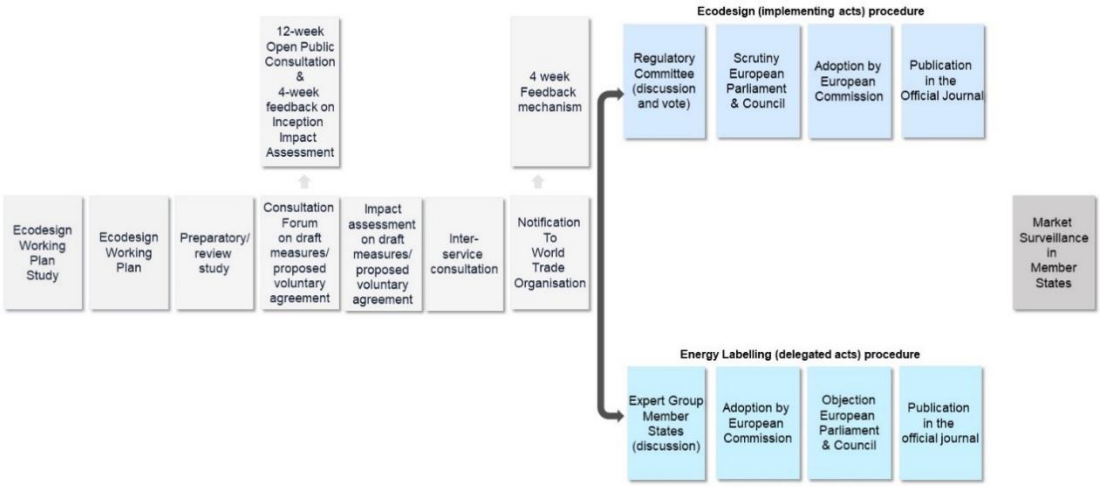


Figure 1-2: Stages of this preparatory study in advance of the subsequent impact assessment study.

Source: based on (Graulich et al. 2011)

1.2. Objective of the preparatory study on commercial and industrial laundry appliances

Directorate-General Environment (DG Env) has launched a preparatory study on 'professional laundry appliances` to assess the feasibility of proposing ESPR requirements (e.g. Ecodesign and/or (Energy) Labelling or mandatory public procurement criteria) for this product group. The study investigates the potential environmental improvements that can be introduced to the product, including relevant aspects to the circular economy (upgradability, durability, reparability...). This study provides the necessary information for the identification of the policy options to be considered in the subsequent impact assessment.

Objectives

The overall objective of the preparatory study is stated as follows: "Conduct an ecodesign preparatory study analysing the technical, economic, environmental, market and societal aspects of professional laundry appliances following the MEErP methodology Tasks 1-7."

Specific challenges of the preparatory study.

Commercial and industrial laundry appliances constitute a very heterogeneous product group compared to household laundry appliances. On the one hand, this heterogeneity is due to a kind of division of the market, where manufacturers can be categorised as either belonging to the electrical engineering sector ('commercial appliances') or to the mechanical and plant engineering sector ('industrial appliances') on the other side.

This was also the reason that industry has developed various standards for measuring the appliances' performance. Partly, they overlap in terms of their scope; however, at the same time they are based on different measurement methods. Further, in the former preparatory

study completed in 2011, draft categorisations and attempts to delimitate the product subcategories were made; initial discussion with experts on these product groups suggests that these categorisations and former base cases including definitions need to be reviewed extensively against the background of these correlations and the experience that they are not completely suitable in practice.

In addition, there have been interesting technological developments in the past five to ten years that need to be considered in the present preparatory study; this includes, for example, heat recovery, alternating heat supply depending on the availability of renewable energy, or improved measurement and control technology. Finally, the 2011 study did not systematically analyse circular economy related ecodesign measures for the repair, durability and refurbishment of appliances, as the Ecodesign regulation at that time focused on energy-related aspects.

A particular challenge exists in examining whether and to what extent the implementation of possible design options is in proportion to the performance requirements in various customer segments and which flexibility options exist in terms of customer requirements. This is relevant for commercial and industrial dryers, for example, as heat pump dryers require a significantly longer process time than conventional air vented dryers, which perform poorly in terms of efficiency. Dealing with potential conflicts of objectives with individual requirements and ecodesign measures is also a challenge.

1.3. Prior work: Preparatory Study 2011 for Ecodesign Requirements of Energy-using Products - Lot 24: Professional Washing Machines, Dryers and Dishwashers

As part of the preparatory study Energy-using Products (EuP) Lot 24 (Graulich et al. 2011), fundamental considerations had to be made to define the scope of the investigation in a comprehensive and well-founded manner. This included the following aspects, among others:

- The consideration of the individual process steps of the professional washing process.
- The differentiation from dry cleaning.
- The differentiation of semi-professional and professional appliances from each other and from household appliances.

In addition, due to the large variety of commercial and industrial appliances, a proposal for categorisation was made on the basis of various possible classifications, which differentiates between the functional principle (washer extractor, washer dryer and tunnel washer) and design features (barrier washer) on the one hand and the range of load capacities on the other. On this basis, the scope of the investigation of the 2011 preparatory study was defined and categorised as follows.

- Professional washing machine categories (WM) of the Lot 24 study (Graulich et al. 2011):
  - WM1: Semi-professional washer extractor

  - WM2: Professional washer extractor, <15 kg
  - WM3: Professional washer extractor, 15-40 kg
  - WM4: Professional washer extractor, >40 kg
  - WM5: Professional washer dryer
  - WM6: Professional barrier washer
  - WM7: Washing tunnel machine
- Professional dryer categories (D) of the Lot 24 study (Graulich et al. 2011):
  - D1: Semi-professional dryer, condenser
  - D2: Semi-professional dryer, air vented
  - D3: Professional cabinet dryer
  - D4: Professional tumble dryer, <15 kg
  - D5: Professional tumble dryer, 15-40 kg
  - D6: Professional tumble dryer, >40 kg
  - D7: Pass-through (transfer) tumble dryer

Initial discussion with experts on these product groups suggests that these categorisations of former base cases including definitions and the scope of the study need to be reviewed extensively due to the following reasons:

For example, washing tunnel machines (WM7) and pass-through (transfer) tumble dryers (D7) are highly specialised appliances that are adapted to customer-specific requirements and the on-site and local infrastructure. This raises the questions regarding the comparability and classification possibilities of appliances, e.g. in relation to their energy efficiency.

In the 2011 preparatory study (Graulich et al. 2011), a distinction was made between semi-professional, professional and industrial appliances. However, this categorisation was not technically based but corresponded to the designations used by the relevant manufacturer groups: While manufacturers from the electrical engineering sector favoured the term ‘professional’, those from the plant and mechanical engineering sector referred to the appliances as ‘industrial’. A clear and unambiguous definition and delimitation of these terms was still missing, even in the meanwhile developed standards.

2. Methodology

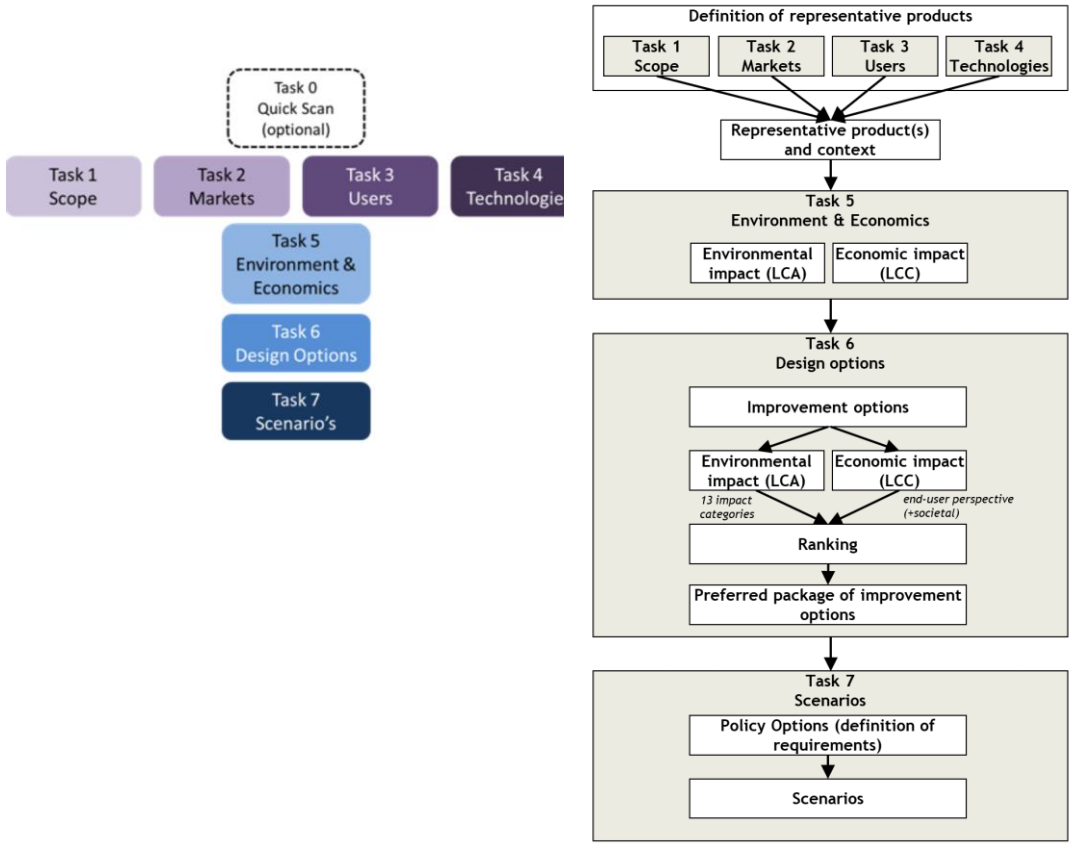
2.1. Background - MEErP Approach and EcoReportTool

The ESPR Ecodesign regulation provides a harmonised methodological approach termed Methodology for the Ecodesign of Products (MEErP) that serves as a framework for the assessment of products. This has been applied to approximately 40 groups of energy-related products.

In accordance with the provisions stipulated within the MEErP framework, a preparatory study constitutes the foundational element for the potential implementation of a regulatory framework pertaining to ecodesign requirements. This preparatory study is delineated by seven distinct tasks.

- **Task 1**: Scope (definitions, standards and legislation);
- **Task 2:** Market (volumes and prices);
- **Task 3:** Users (product demand side);
- **Task 4:** Technologies (product supply side, includes both, Best Available Technology (BAT) and Best NOT yet Available Technology (BNAT);
- **Task 5:** Environment & Economics (LCA and LCC assessment (LCC) of representative products (Base Cases);
- **Task 6:** Design options;
- **Task 7:** Scenarios (policy, scenario, impact and sensitivity analysis).

Figure 2-1 shows the structure of the MEErP.



a) b)

Figure 2-1: Basic structure of MEErP (a) (note 1), detailed structure of MEErP (b).

A new version of the MEErP has recently been published (Gama Caldas et al. 2024). The revised MEErP is intended to incorporate material efficiency and environmental aspects more systematically and to update the EcoReport tool (ERT). The 2024 MEErP method considers the 16 impact categories used in the Environmental Footprint (EF) method, in an effort to harmonise the ERT with the Product Environmental Footprint Category Rules (PEFCRs). Additional potential environmental impacts can be included and by default, the primary energy consumption is included since the methodology is used to analyse energy-related products in which energy consumption plays a vital role. For instance, recyclability and recycled content will be input parameters and can be modelled in the end-of-life (EoL) scenario. Furthermore, material efficiency aspects are planned to be modelled consistently and systematically by introducing a discrete scoring system where the specific values are calculated.

[1] The studies can include a Task 0 "Quickscan". According to MEErP 2011 "Where appropriate, the first step in a preparatory study is an initial quick scan (Task 0), which aims to set research priorities within the product scope which can already be identified at the outset." From the background of the preexisting Lot 24 study (Graulich et al. 2011), no Quickscan was performed in this preparatory study.

2.2. Approach of the preparatory study and stakeholder consultation

To collect data and exchange with stakeholders, different forms of consultation were implemented in this preparatory study.

An online platform was established to allow sharing information on the study with stakeholders. This platform can be found under https://ecodesign-commlaundryappliances.eu/en. Among others, a registration option was provided to stakeholders on the platform to allow collecting data on interested stakeholders so that they could be informed of the project proceedings.

At the on-set of the study, a few initial interviews with stakeholders were held to allow a first identification of aspects that had changed since the 2011 preparatory study. In this context, a manufacturer of domestic laundry appliances was interviewed as well as a manufacturer of domestic and commercial appliances. Upon approach, the study team also held a short meeting with one of the manufacturer associations.

To collect information regarding MEErP Tasks 1-4, two stakeholder consultations have been held:

- A first online consultation was held between 17 May 2024 and 21 June 2024 to collect information on the scope of appliances addressed in this study and resulting legislation. The consultation used an online survey tool to collect information on a set of questions. See **Annex I: Questionnaire of 1st stakeholder consultation**, for the questions asked.
- A second consultation was held between 12 July 2024 and 30 August 2024 with its focus being the collection of data for MEErP Tasks 2-4. Newly proposed changes to the scope of the study were presented as part of the consultation (new definitions and categorisations for commercial and industrial laundry appliances). These resulted from considerations of the data collected through the first consultation. To this end, a few questions were also posed in relation to the proposed changes and to MEErP Task 1. Here too, an online survey tool was used to collect information for a set of questions. Furthermore, an excel file was used to collect more detailed numerical data in tabular form for some of the questions. See **Annex II: Questionnaire of 2nd stakeholder consultation**, for the questions asked.

A stakeholder meeting was held on 30 September 2024 in Brussels to discuss and collect feedback on the first results. The meeting focused on the preliminary results of MEErP Tasks 1-4. A 2nd stakeholder meeting took place in Brussels on 10 April 2025. It focused on the updated product categorisation and the results of Task 5. As Tasks 6 and 7 could not be finalised at this stage, it also included a presentation of the design options under consideration at the time and the approach towards developing policy options for the Task 7 analysis.

To ensure that stakeholders have the chance to provide feedback for the newly included Task 6 and Task 7 results, an online stakeholder interaction was finally conducted on 15 September 2025 followed by a consultation period to collect written feedback.

3. Results

General note on terms to be used in this study

The Terms of Reference (ToR) of this study refers its title as "Preparatory Study and Impact Assessment support study on **industrial** and **professional** laundry appliances" and in some cases omits the term industrial from the title. Nonetheless, the ToR itself mentions among others the standard series EN 50640:2018 developed for inter alia washing machines and tumbler dryers intended for **commercial** use and thus commercial appliances are also considered to fall in the scope of this study as was the case in the 2011 preparatory study on which this study is to build.

Various exchanges have taken place with stakeholders during this study. In such exchanges, manufacturers have contended that though the people operating laundry appliances can be referred to as professional, and though some manufacturers of such appliances have the term professional in their names, technically speaking, laundry appliances are intended by their manufacturers for:

- the household or domestic market,
- the commercial market, or
- the industrial market.

The term 'professional laundry appliances or machinery' is not used in standards and neither it is understood to reflect a specific segment of the laundry appliance sector.

Initially, the term 'professional' laundry appliance/s was sometimes used in this report to address both commercial and industrial laundry appliances, also referred to as 'non-household appliances. Both terms are aimed at making a clear distinction of the appliances addressed in this study from household laundry appliances that are already addressed by existing Ecodesign and Energy Label Regulations (respectively Regulation 2019/2023/EU and 2019/2014/EU) and thus considered out of scope of the current study.

Following persistent feedback from stakeholders, it was decided during the final revision of this report to no longer use the terms 'non-household' or 'professional' (as a summary for both commercial and industrial) laundry equipment. The term 'professional' will therefore only be used in relation to the previous preparatory study from 2011 or in connection with the professional users of the equipment.

3.1. MEErP Task 1 – Scope, definitions, standards, legislation

The aim of MEErP Task 1 is to define the product category and the system boundaries of the 'playing field' for Ecodesign. The preparatory study provides a detailed overview of existing legislation, voluntary schemes, and standards for the product group of commercial and industrial laundry equipment with the aim to define the functional unit of the product group and

the possible scope of a potential regulation. Task 1 is one of the most important work steps within a preparatory study, as the scope, its exceptions, the definitions as well as existing standards, the links with the existing legislation and the elimination of remaining gaps form the basis for drafting the delegated acts and standardisation mandates in a coherent and effective way and shall provide economic operators with a precise and legally secure basis. Among others as part of this task it shall also be investigated whether accurate, reliable, and reproducible methods exist for testing the performance of the appliances in question and whether the methods are suitable for their purpose or are in need of revision. Through the review of existing legislation, this task shall enable an understanding of measures that exist for the product group, as well as areas where there is a gap or a regulatory failure.

3.1.1. The professional laundry process

This section is based on the 2011 preparatory study (Graulich et al. 2011) and has been reproduced to provide general information on appliances included in the scope of this study (as well as those which are not) as a form of providing a first context.

3.1.1.1. Wet-cleaning process

The entire washing and drying process, e.g. in a commercial laundry, consists of several steps which are depicted in the following figure and specified subsequently.

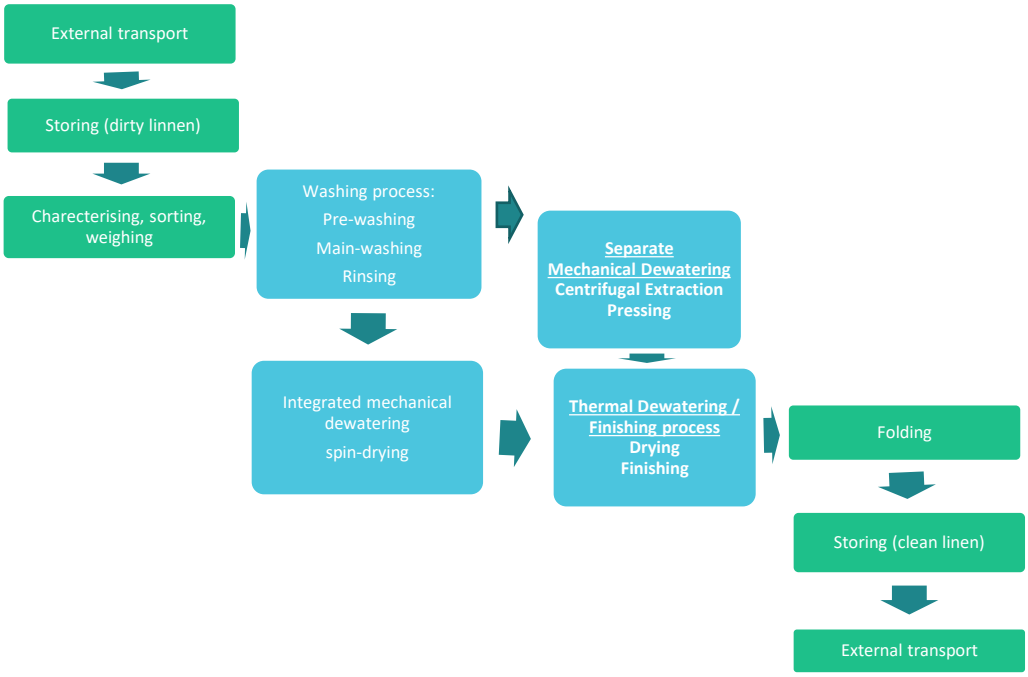


Figure 3-1: Different steps of a commercial laundry process (Graulich et al. 2011).

Sorting: Before loading a washing machine, laundry has to be sorted to avoid failures in the washing process. This can be done according to the different types of textiles (characterised by washing symbols in the garment labelling, textile materials, and colour of the laundry), and/or according to the type of dirt and degree of soiling.

Washing: The purpose of washing laundry is to loosen dirt from the textile fibres and to rinse it off by using water as solvent. Depending on the laundry type and the degree of soiling, commercial washing machines often provide a large number of different either adjustable or pre-defined washing programmes. They vary e.g. in terms of using pre-washing, the number of rinsing cycles, the temperature or the programme duration.

Dewatering: After the laundry has been washed, it has to be dewatered to achieve a faster drying process at a later stage. This can be realised either by mechanical or thermal energy at different stages in the laundry process.

- Mechanical dewatering can be done by different appliances:
  - Spin-dryer being integrated in the washing machine ('washer-extractor').
  - Separate hydro-extractor or pressing appliances.
    - Squeeze press: Machine for the mechanical extraction of moisture from textile fabrics by the application of pressure.
    - Centrifugal extraction machine = spin-extractor: Machine containing a perforated cage to and from which successive loads are transferred and within which the loads are subjected to a centrifugal force due to the rotation of the cage for the purpose of extracting moisture.
  - Thermal dewatering / drying: After mechanically dewatering the linen, the remaining moisture has to be evaporated to fully dry the laundry. Functions to be delivered by these processes are to dry, to soften and/or flatten as well as to stretch the fabrics. Depending on the type of textile, thermal evaporation of the remaining moisture is done in a tumble dryer, flatwork ironer, utility press or garment finisher.

Drying by rotating or tilting tumble dryers: They are used to dry garments, mostly for terry garments. The water evaporates due to the high temperature caused by hot air injected through the perforated shell of the drum.

Finishing by ironing, pressing or garment finishing: irons and presses generally have the same function: To soften and flatten the damp fabric, as well as to remove creases. At the same time, the fabric is dried.

- Ironing: This process is performed by contact drying and calendaring of flat linen. The flat pieces are led, either manually or automatically by a feeding machine, be-tween the rotating rolls and stable heated beds of the ironer. The evaporated water is vacuumed out through the perforation holes on the rolls. Due to the rotation the flat linen pieces are conveyed further into the machine.
- Pressing: This process is used for most garments like shirts, overall, coats etc. A piece of garment is steamed and dried between two pressing plates. The steam and evaporated water are removed by an integrated suction system.
- Garment finishers: Garments have to be de-wrinkled and re-shaped. This process is called 'conditioning'. While domestic washing will normally utilise an iron to finish shirts and the like, for industrial purposes this process is performed with several kinds of steam air finishers. To soften the fabric, steam is injected either directly into the garment

or into the bag on which the garments are dressed. After that, hot air inflates the bag which presses the garment from the inside while also drying the fabric.

Folding: The linen can be folded by hand or automatically using a folding machine. Small and big pieces of flat linen, once ironed, are length and cross folded by synchronised units.

Storing: The finished and folded laundry is stacked on shelves or hung on garment racks or similar. Before using the linen, the textiles have to re-absorb a certain amount of moisture to smooth out creases.

According to industrial manufacturers (Industrial stakeholder 2024) additional "efficiency tools are often used together with larger machines, which tend to be less efficient than smaller machines in a standalone setting. For instance:

- Parameters like residual humidity after mechanical extraction (either press or spinning) have a very large effect on the thermal dewatering step, which is one of the most energy intensive steps of the laundry process.
- Water recuperators improve the water efficiency of the process but are explicitly left out of the reference standard (EN17116).
- Energy efficient / renewable heat systems are also penalised by not being accounted for. E.g.: Installing solar heating panels improves the environmental performance of the laundry.
- All these factors disproportionally affect larger machinery that relies on external efficiency systems to improve the process efficiency and distort the comparison between the environmental impact of machinery of different sizes."

This is illustrated more clearly in **Figure 3-2,** specifying such additional equipment.

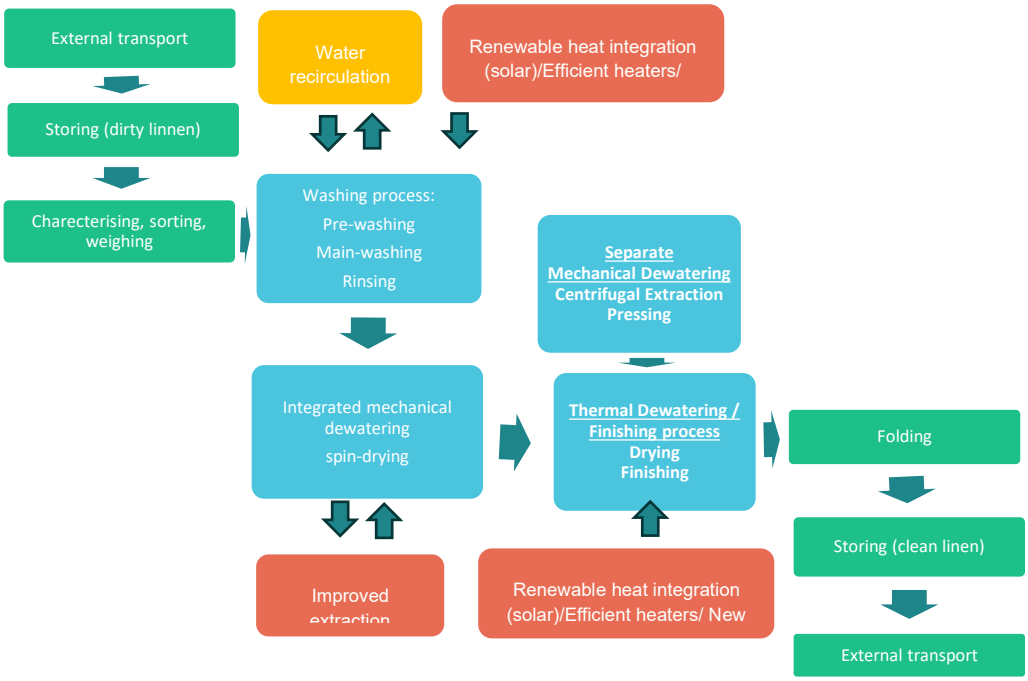


Figure 3-2: Different steps of an industrial laundry process.

Source: Industrial stakeholder 2024

In an industrial laundry, continuous tunnel washer systems are installed which usually consist of a load conveyor/monorail bag system, washer, extraction press/centrifuge, shuttle conveyor, tumble driers, and a discharge conveyor/monorail bag system.

As a first objective, the terms of reference of this study require that a Preparatory Study be carried out on the potential for Ecodesign requirements, and energy labelling requirements if appropriate, based on the **previous preparatory study** (Graulich et al. 2011) but updating it in line with the current policy context. Respectively, within the different steps of an entire laundry process as described above, commercial and industrial washing machines and dryers – the formal focus of the previous preparatory study (Lot 24) according to the technical specifications of Tender No TREN/D3/91-2007 – only come into operation within the sub-processes washing and dewatering. The processes storing, sorting and folding were considered to be out of the scope of the 2011 study and will be considered out of scope in this study as well.

Further, according to (Porter et al. 1984), 'drying' generally refers to the removal of a liquid from a solid by evaporation. Mechanical methods for separating a liquid from a solid are generally not considered as drying, although they often precede a drying operation, since it is less expensive and frequently easier to use mechanical methods than to use thermal methods. Thus, only the technical washing and thermal drying processes, including the spinning phase, and the machines used for these were within the scope of the 2011 preparatory study (Graulich et al. 2011) and shall be included in the scope of the current study. Further, systems for softening the water by reducing the concentration of calcium, magnesium, and other ions in hard water, are not in the scope of the study as they are not part of the laundry machinery but separate processes.

In the professional context, a variety of items may be cleaned by a commercial or industrial washing machine or dried by a commercial or industrial dryer, e.g. clothes including workwear, shoes, tablecloths, napkins, hand towel rolls, towels, bed clothes, pillows, mattress toppers, sleeping bags, surgical scrubs, mats, mops, etc. Their shape and material must be suitable for wet-cleaning or drying by machine.

In our study, we will use the term 'laundry' as a superordinated term for these different kinds of items to be washed and dried in a commercial or industrial washing machine or dryer.

3.1.1.2. The dry-cleaning process

The dry-cleaning process was reviewed in the 2011 preparatory study (Graulich et al. 2011) in detail. As cleaning in respective processes is chemical based and not water based, it was excluded from the scope of the past study as is also the case in the current study. This is related to dry cleaning machines and the machines in the scope of this study not being comparable in terms of performance. In dry cleaning machines, the cleaning process is chemical based, whereas in appliances in scope of this study, cleaning processes are water based. Nonetheless, this should not be interpreted to mean that dedicated ESPR requirements could not be developed for dry cleaning in the future.

3.1.1.3. Detergents for commercial and industrial washing machines and dryers

Laundry detergents for professional use mean products intended for laundering textiles in water by professional users like institutional or industrial users and other large-scale consumers. Generally, various types of textile detergents exist – acid or alkaline.

This covers complete powders and liquid detergents as well as multi-component systems. A multi-component system is a detergent system based on components used to build up a complete detergent, a stock solution or a laundering mixture for automatic dosing. This system incorporates basic detergents plus a number of auxiliary products (Nordic Ecolabelling 2024a).

Textile detergents in the professional context are dosed both manually and automatically. Achieving the correct dosage is essential, as is maintaining the dosage devices so that they function efficiently and provide the optimum dose.

Some applications (speciality laundry) have more specific requirements than others, i.e. reference washer, clean room, hygiene, specific temperature requirements, time requirements etc. (APPLiA 2024).

Though the proper composition and proper dosing of detergents are important for the function and cleaning performance of laundry appliances, in the consultants' view, they are beyond the scope of this study. Manufacturers of laundry appliances usually have no influence on the composition of detergents, whereas influence on dosing is only relevant when automatic dosing systems are included in these appliances. Furthermore, the consultants are not aware of existing Ecodesign Regulation for detergents. However, the ESP(R) Regulation (EU) 2024/1781 makes clear in its recital 49 that among other product groups, the Commission should prioritise detergents in the first ESPR Working Plan "for which ecodesign requirements are to be set for the first time". Detergents are also mentioned in Article 18 of the Regulation that refers to "Prioritisation and planning" and refers to product groups to be prioritised for the first ESPR working plan. The consultant views this as a confirmation that ESPR for detergents shall be addressed separately and are out of scope of the current study.

3.1.2. Product category and performance assessment

The following classification schemes and documents have been analysed to define the product categories for this study:

- PRODCOM category or categories (Eurostat),
- Harmonised Commodity Description and Coding System,
- Categories according to EN- or ISO-standard(s),
- Labelling categories (EU Energy Label or Eco-label), if not defined by the above.

Feedback has also been collected from stakeholders and in particular manufacturers of laundry appliances as to possible categories of laundry appliances.

Categorisation will often be linked to the assessment of the primary product performance parameters (the 'functional unit'). If needed, a further segmentation can be applied on the basis of secondary product performance parameters, referring to functional performance characteristics but not to technology.

3.1.2.1. PRODCOM category or categories (Eurostat) and the classification of commercial and industrial washing machines and dryers

PRODCOM is a system for the collection and dissemination of statistics on the production of manufactured goods. It is based on a product classification called the PRODCOM List of the European Community which consists of about 4,500 headings relating to manufactured products. The products are detailed on an 8-digit level; digits 1 to 4 refer to the NACE classification in which the producing enterprise is normally classified. In 2023, the NACE codes were revised, the following table contains both code classifications of 2023 and those of 2008 (referred to in the 2011 preparatory study). New codes or revised texts appear in bold, whereas for codes that no longer appear, this is specified in the description column.

Table 3-1: Extract from PRODCOM lists 2023.

Codes from 2023	Description
28.94	Manufacture of machinery for textile, apparel and leather production
28.94.21	Machinery for washing, cleaning, wringing, ironing, pressing, dyeing, reeling and the like of textile yarn and fabrics; machinery for finishing of felt
28.94.21.10 Newly added!	Machinery for the manufacture or finishing of felt or non-wovens in the piece or in shapes (including machinery for making felt hats, blocks for making hats)
28.94.21.30	Ironing machines and presses (including fusing presses; excluding calendaring machines)
28.94.21.50	Washing, bleaching or dyeing machines (including wringers and mangles, shaker-tumblers; excluding household or laundry-type washing machines)
28.94.21.70	Machines for reeling, unreeling, folding, cutting or pinking textile fabrics
28.94.21.80	Machines used in the manufacture of linoleum or other floor coverings for applying the paste to the base fabric or other support; machines for dressing, finishing, wringing, drying, coating or impregnating textile yarns, fabrics or made-up textile articles
28.94.22	Laundry-type washing machines; dry-cleaning machines; drying machines, with a capacity > 10 kg
28.94.22.30	28.94.22.30 Household or laundry-type washing machines of a dry linen capacity > 10 kg (including machines that both wash and dry)
28.94.22.50 Newly added!	Dry-cleaning machines
28.94.22.70	Drying machines, of a dry linen capacity > 10 kg

Codes from 2023	Description
28.94.23	Centrifugal clothes dryers
28.94.23.00	Centrifugal clothes-dryers
28.94.52	Code no longer appears
28.94.52.10	Code no longer appears

Source: Eurostat

From a practical point of view and against the overall aim of the preparatory study, the table shows that PRODCOM categorisations will be too rough to provide a basis for defining a clear scope of commercial and industrial washing machines and dryers. For example, among the washing machines or dryers there is no further differentiation regarding capacity or other functional performance parameters.

3.1.2.2. The Combined Nomenclature

The Harmonised Commodity Description and Coding System (HS) is an internationally standardised system for trade statistics, specifying names and numbers for classifying traded products developed and maintained by the World Customs Organisation (WCO). The HS Nomenclature comprises about 5,000 commodity groups. The HS is a six-digit nomenclature. The first four digits are referred to as the heading. The first six digits are known as a subheading. Individual countries may extend a HS number by additional digits. In the EU the combined nomenclature (CN) is comprised based on the Harmonised System nomenclature and is used to classify goods when being declared to customs in the EU and for trade statistics. Each CN subdivision has an eight-digit code number, the CN code, followed by a description. The CN also include preliminary provisions, section and chapter notes, footnotes and annexes.

Table 3-2: Classification of washing machines and dryers according to the HS-Classification.

Code	Description
8419	Machinery, plant or laboratory equipment, whether or not electrically heated (excluding furnaces, ovens and other equipment of heading 8514), for the treatment of materials by a process involving a change of temperature such as heating, cooking, roasting, distilling, rectifying, sterilising, pasteurising, steaming, drying, evaporating, vaporising, condensing or cooling, other than machinery or plant of a kind used for domestic purposes; instantaneous or storage water heaters, non-electric
8419.3[3...5]	Dryers
8419.39	Other dryers
8420	Calendaring or other rolling machines, other than for metals or glass, and cylinders therefore
8420.10	Calendaring or other rolling machines
8420.91 / 8420.99	Parts: Cylinders / Other

Code	Description
8421	Centrifuges, including centrifugal dryers; filtering or purifying machinery and apparatus, for liquids or gases
8421.12	-- Centrifuges, including centrifugal dryers
8421.91	- Parts -- Of centrifuges, including centrifugal dryers
8450	Household or laundry-type washing machines, including machines which both wash and dry
8450.1x	Machines, each of a dry linen capacity not exceeding 10 kg
8450.11	Fully automatic machines
8450.11.11	- Each of a dry linen capacity not exceeding 6 kg
8450.11.11	- Front-loading machines
8450.11.19	- Top-loading machines
8450.11.90	- Each of a dry linen capacity exceeding 6 kg but not exceeding 10 kg
8450.12	Other machines, with built-in centrifugal dryer
8450.19	Other
8450.20	Machines, each of a dry linen capacity exceeding 10 kg
8450.90	Parts
8451	Machinery (other than machines of heading 84.50) for washing, cleaning, wringing, drying, ironing, pressing (including fusing presses), bleaching, dyeing, dressing, finishing, coating or impregnating textile yarns, fabrics or made up textile articles and machines for applying the paste to the base fabric or other support used in the manufacture of floor coverings such as linoleum; machines for reeling, unreeling, folding, cutting or pinking textile fabrics.
8451.10	- Dry-cleaning machines - Drying machines:
8451.21	-- each of a dry linen capacity not exceeding 10 kg
8451.29	Other
8451.30	-Ironing machines and presses (including fusing presses)
8451.40	-Washing, bleaching or dyeing machines
8451.50	-Machines for reeling, unreeling, folding, cutting or pinking textile fabrics
8451.80	Other machinery
8451.90	Parts

Source: World Customs Organisation

The EU CN is also too rough to provide a basis for defining a clear scope of commercial and industrial washing machines and dryers. For example, there is no further differentiation related to capacity or to other functional performance parameters. In addition, certain categories considered to be in scope, like tumble dryers and batch system dryers are merged into the category ‘Other’.

3.1.2.3. Categories according to EN- or ISO-standard(s)

Following the mandate given by the Commission to develop standards during the 2011 preparatory study (Graulich et al. 2011), a few standards were developed regarding the performance and related test procedures for commercial and industrial washing and drying appliances.

Standard EN 17116-4:2019 addresses "Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics – Part 4_Washer extractors". From its title it is concluded that the standard addresses industrial washers. Based on the description specified in the Section 1 of the standard (i.e., Scope), it can be understood that industrial washing machines are considered to have "*a net usable cage volume of 400 dm^3 (litres), respectively 40 kg and above*". In its definitions it includes the following terms of relevance for categorisation:

Table 3-3: Terms and definitions included in EN 17116-4:2019 that are relevant for categorisation.

Term	Definition
3.1.1 Washer extractor	Machine for cleaning and rinsing of textiles by means of water and having an extraction process for dewatering the textiles at the end of the washing programme or by intermediate
3.1.4 Top loaded machine	Washer extractor where the load is placed into the cage from the top (vertical position)
3.1.5 Front loaded machine	Washer extractor where the load is placed into the cage in direction of the axis
3.1.6 Side loaded machine	Washer extractor where the load is placed into the cage perpendicular to the direction of the cage axis
3.1.7 Barrier washer	Washer-extractor which can be built in a wall and where the load is placed from one side (unclean section) of the machine and taken out from another side [clean section), mostly combined with spatial separation of clean and unclean section for disinfection processes, etc.
3.1.8 Pullman machine	Washer-extractor where the horizontal inner drum is divided in two
3.1.9 Y pocket machine	Washer-extractor where the inner cage is divided in three compartments

The standard provides for clarity as to the different functioning types of washer extractors and also specifies its applicability to washing machines with a load above 40 kg. Nonetheless, there is no actual definition for industrial washing machines and from exchanges with manufacturers, the 40 kg threshold was seen by one manufacturer (Baron 5/14/2024) as arbitrary and not necessarily providing a clear delimitation between commercial and industrial washing machines. Considering this aspect in relation to inputs provided by manufacturers during the online stakeholder consultations (see **Section 2.2**) shows this aspect in a different light. While manufacturers of commercial laundry devices tend to argue that the differentiation between categories should be solely technology based, industrial appliance manufacturers refer to 40 kg as a threshold for differentiating between commercial and industrial appliances. It is, however, understood that there are commercial devices with a loading capacity above this threshold.

Similarly, EN 17116-2:2018 covers “Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics - Part 2: Batch drying tumblers”. Based on it scopes, it also sets a threshold for tumble dryers of 40 kg above which the standard applies. As explained above for industrial washer extractors, here too, it appears that the threshold is somewhat arbitrary insofar as according to (commercial) manufacturers, there are also non-industrial tumble dryers with a load capacity above this threshold.

In contrast, part 3 of the same series, EN 17116-3, provides “Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics – Part 3: Continuous tunnel washer”. Such machines which have a continuous batch are indeed understood to all be covered by the industrial segment.

Standard EN 50640:2018 addresses “Household and similar electric appliances – Methods for measuring the performance of clothes washing machines intended for commercial use”. Despite the initial reference to household appliances in its title, the standard addresses clothes washing machines intended for commercial use or in other words commercial washing machines. The description specified in Section 1 of the standard (i.e., Scope), states that commercial washing machines are “*intended to be used by trained users e.g., in hotels, hospitals, factories, in light industry and on farms*. *It also covers washing machines declared for commercial use in public areas and operated by lay persons e.g. in launderettes, apartment houses and communal laundry rooms*”. Regarding the source of water and energy, the description clarifies that this can vary, with the machine being able to utilise cold and/or hot water supply with or without use of heating devices for the electricity, steam or gas. The standard covers various functioning models, including top-loaded, side-loaded with horizontal or vertical axis and with one or more washing components. Aside from washing machines, it also deals with machines that also (thermally) dry the laundry following the washing programme (e.g. washer-dryers) and machines that only perform a separate (mechanical) dewatering of laundry washed separately (spin extractors). The standard clarifies that it does not apply to machines operating with continuous batch or dependent on the automatic loading and unloading (e.g., tunnel machines and installations).

In its definitions, it includes the following terms of relevance for categorisation – some of the terms in **Table 3-4** below are described very similarly to those specified in **Table 3-3** above:

Table 3-4: Terms and definitions included in EN 50640:2018 that are relevant for categorisation.

Term	Definition
3.1.1 Washing machine	Appliance for cleaning and rinsing of textiles using water which may also have a means of extracting excess water from the textiles
3.1.4 Washer-dryer	Washing machine which includes means for drying the textiles, usually by heating and tumbling
3.1.5 Spin extractor	Separate water-extracting appliance in which water is removed from textiles by centrifugal action (spin-extraction)
3.1.6 Horizontal axis washing machine	Washing machine in which the load is placed in a drum which rotates around an axis with an angle less than 45° to horizontal

Term	Definition
3.1.7 Vertical axis washing machine	Washing machine in which the load is placed in a drum which rotates around an axis which rotates with an angle of 45° or more related to horizontal
3.1.8 Automatic machine	Washing machine where the load is fully treated by the machine without the need for user intervention at any point during the cycle prior to its completion
3.1.9 Top loaded machine	Washing machine where the load is placed in the wash compartment from the top, and which may be of a horizontal or vertical axis type
3.1.10 Side loaded machine	Washing machine where the load is placed into the wash compartment from the side, and which is of a horizontal axis type
3.1.11 Pullman machine	Washing machine where the wash compartment is divided in two compartments
3.1.9 Y pocket machine	Washing machine where the wash compartment is divided in three compartments

This standard's descriptions and terms clarify the diversity of machine types that can be intended by the manufacturer for commercial use. Aside from the purpose intended by the manufacturer, it specifies no technical parameters that can be applied to differentiate between stand-alone machines intended for commercial use and those intended for industrial (or domestic use).

Standard EN 50594 covers "Household and similar electric appliances - Methods for measuring the performance of tumble dryers intended for commercial use". It applies to tumble dryers intended to be used by trained users as also to those tumble dryers declared for commercial use in public areas and operated by lay persons. It furthermore applies to tumble dryers of all sizes on the market. It states that it is not applicable to pass-through tumble dryers which have a continuous operation rather than the batch operation of the appliances covered by the standard. The same is true for tumble dryers only possible to operate with automatic loading and unloading. This again makes the threshold set in EN 17116-2:2018 questionable.

There are two ISO standards for industrial washing machines and dryers: ISO 9398: Specifications for industrial laundry machines – definitions and testing of capacity and consumption characteristics, and ISO 10472: Safety requirements. Both standards provide different product categories according to the function they offer (for details, see **Section 3.1.4**).

ISO 9398 distinguishes four different categories of industrial washing machines and dryers:

- Washer extractors,
- Washing tunnels,
- Batch drying tumblers,
- Flatwork ironing machines.

ISO 9398-1:2003 refers to flatwork ironing machines which based on the 2011 preparatory study are understood to be outside the scope of this study.

ISO 9398-2:2003 covers batch drying tumblers referring to appliances with a net usable cage volume greater than 160 dm^3 (litres or 16 kg). It is not clear if this covers installations such as pass-through dryers and/or stand-alone appliances similar to commercial tumble dryers in build.

ISO 9398-3:2003 covers washing tunnels and defines them as automatic washing plants that process laundry in continuous operation or in batches. A minimum load capacity is not specified; however, the construction of such appliances differs significantly from commercial washers which are 'stand-alone' devices. In so far, the consultant does not see a load capacity threshold as necessary for delimiting between this type of industrial washing machines and commercial ones, nor for identifying technical parameters to further differentiate between tunnel washing machines and other categories.

ISO 9398-4:2003 covers washer extractors, referring to appliances whose net usable cage volume is greater than 60 dm^3 (litres or 6 kg). The consultant assumes that this load capacity would be relevant for both industrial and commercial appliances as also for household ones.

The ISO 10472 series has 6 parts (all standard parts are from 1997), also distinguishing between different categories of washing and drying machines:

- Part 1: Common requirements
- Part 2: Washing machines and washer-extractors
- Part 3: Washing tunnel lines including component machines
- Part 4: Air dryers
- Part 5: Flatwork ironers, feeders and folders
- Part 6: Ironing and fusing presses

Table 3-5 provides an overview of product categories being in the scope of ISO 10472.

Table 3-5: Classification of washing machines and dryers according to ISO 10472.

Washing machines and washer extractors > 60 litres (ISO 10472-2) with definitions for the following sub-categories:	
Washing machine	Washing machine: Machines performing only those operations required for washing textiles.
Washer extractor	Machines which combine the functions of textile washing and moisture extraction by centrifugal action.
Fixed washer-extractor	Washer-extractor in which the drum is rigidly mounted in the frame.
Suspended washer-extractor	Washer-extractor in which the drum is not rigidly connected to the frame but is secured by means of a vibration-reducing system.
Tilting washer-extractor	Fixed or suspended washer-extractor in which the drum tilts during loading and/or unloading.
Drawer-type washer-extractor	Fixed or suspended washer-extractor in which two half-cages slide horizontally out from the frame, in the low position for loading and the high position for unloading.

Top-loading, vertical axis washer-extractor	Washer-extractor in which the plane of the loading door is at a right angle to the vertical axis of the rotation of the cage.
Front-loading machine	Washing machine or washer-extractor in which the plane of the loading door is at a right angle to the horizontal axis of rotation of the cage.
Side-loading machine	Washing machine or washer-extractor in which the plane of the loading door is parallel to the horizontal axis of rotation of the cage.
Barrier machine	Washing machine or washer-extractor without direct contact between the loading and unloading positions (e.g. separated by a wall).
Aseptic machine	Washing machine or washer-extractor used for processing infected work.
Washing tunnel lines including component machines (ISO 10472-3) with definitions for the following sub-categories	
Washing tunnel line	Complete integrated systems of linked machines for the washing, moisture extraction and drying or disentangling of discrete batches of textile fabric, including all necessary equipment for supply of water, steam, gas, electricity and chemicals.
Continuous tunnel washing machine	Machines designed to wash items in successive loads as a continuous process. NOTE: These machines may consist of one cage rotating around a longitudinal axis and subdivided into separate compartments, or several cages or several machines linked by means of a transfer system.
Squeeze press	Machine for the mechanical extraction of moisture from textile fabrics by the application of pressure (component machine within a washing tunnel line) Note: It is designed to receive loads of textile material automatically from a tunnel washing machine and to remove moisture by applying pressure (e.g. by a flexible membrane). Such a machine may with one or two pressure stations where the pressure may be applied hydraulically, mechanically or pneumatically
Centrifugal extraction machine	Machine containing a perforated cage to and from which successive loads are transferred and within which the loads are subjected to a centrifugal force due to the rotation of the cage the purpose of extracting moisture (component machine within a washing tunnel line)
Automatic transfer tumble dryer	Machine for moisture extraction from a load of damp textile material by tumbling in a rotating cage in an atmosphere of hot air (component machine within a washing tunnel line).
Air dryers > 160 litres (ISO 10472-4) with definitions for the following sub-categories	
Tumble dryer	Machine for moisture extraction from a load of damp textile material by tumbling in a rotating cage in an atmosphere of hot air produced by the tumble dryer.
Front-loaded tumble dryer	Tumble dryer in which the plane of the loading door is at a right angle to the axis of rotation of the cage.
Pass-through tumble dryer	Tumble dryer having the loading and unloading doors on opposite sides.
Tilting tumble dryer	Tumble dryer, which tilts for loading and/or unloading.
Automatic tilting tumble dryer	Tilting tumble dryer with the tilting motion to load and unload, and opening and closing doors, under automatic (not manual) control.

Tunnel finisher	Machine for the drying and finishing of shaped garments within which damp garments arranged on hangers are loaded onto an overhead conveyor for transport through the machine in an atmosphere of high humidity followed by an atmosphere of hot dry air produced by the tunnel finisher.
Cabinet dryer	Heated cabinet within which shaped garments are suspended on hangers for the purpose of drying, without being conveyed during the drying cycle.
Flatwork ironers, feeders and folders (ISO 10472-5) with definitions for the following sub-categories	
Bed ironer	Machine for the ironing of flatwork generally providing a heated bed against which the work is pressed by one or several fabric-covered roller(s).
Cylinder ironer	Machine for the ironing of flatwork in which the work to be treated is drawn against one or more heated cylinder(s) where it is held by means of an appropriate system, for example by bands.
Flatwork feeding machine	Machine, into which operator(s) load damp unfinished flatwork items, that presents the items, tensioned and spread to the feed-bands of an ironer or to a folding machine.
Flatwork folding machine	Machine generally fitted in conjunction with an ironer which will automatically fold flatwork items. NOTE: This machine is also used for folding blankets, polyester sheets and similar items.
Folding machine for small pieces	Machine for automatically folding towels, pillow cases and similar items.
Multi-function	machine which combines feeding, ironing and folding in one unit
Ironing and fusing presses (ISO 10472-6) with definitions for the following sub-categories	
Ironing press	Machine for the smoothing or shaping of fabric items by pressing them between two components, at least one of which is heated and, if required, equipped with a steaming device.
Fusing press	Machine for the fusing of two textile layers by pressing them between two components, at least one of which is heated to a temperature such that the coating of one layer becomes adhesive.
Scissor press	Ironing or fusing press whose head is moved on a circular path or a combination of circular and linear paths against a stationary buck.
Cabinet press	Machine into which a garment is placed on a vertical buck (or former) which is moved to a position between two or more vertical press heads which move horizontally to press the garment against the buck. NOTE: A cabinet press may have one or more vertical bucks which travel horizontally such that the entire equipment may be operated by two or more operators in concert.
Drawer press	Ironing or fusing press whose horizontal buck is moved on a horizontal linear path under the head, then the buck (or head) is pressed against the head (or buck) on a vertical, linear path.
Rotary press	Press in which the loading, unloading and pressing operations are assigned to different positions of the movement of a turntable carrying the bucks.
Upstroke press	Press comprising an upper head and a lower buck, upon which the fabric item is prepared, after which the action of the press raises the lower buck to the press head either mechanically or pneumatically.
Multiple-buck press	Press similar to a rotary press in which the bucks can travel in a straight path.

From a practical point of view and considering the overall aim of the preparatory study, the table shows that ISO categorisation provides a good basis for defining a categorisation of washing machines and dryers within this study.

3.1.2.4. Labelling categories (EU Energy Label or Eco-label), if not defined by the above.

The U.S. ENERGY STAR scheme has requirements for clothes washers that apply among others to commercial washers (see **Section 3.1.5.3**). The last version of eligibility criteria (version 8.1 (Energy Star 2018)) defines a commercial clothes washer as follows:

> *"A soft-mounted front-loading or soft-mounted top-loading clothes washer that is designed for use in applications in which the occupants of more than one household will be using the clothes washer, such as multi-family housing common areas and coin laundries".*

ENERGY STAR distinguishes the following categorisations of commercial washing machines (there are no ENERGY STAR requirements for commercial dryers nor for industrial laundry machines): front and top loader clothes. The criteria apply to both residential and commercial clothes washers with capacities of greater than 1.6 ft^3 (45.3 litres). Washer dryers with water-cooled drying are excluded. Commercial clothes washers not eligible for certification include clothes washers with a clothes container volume larger than 8.0 ft^3 (226.5 litres) and those with a top-loading design. It is not clear how the latter reflects upon the definition for a commercial clothes washer. As for the former, based on Table 6 of the eligibility criteria (V. 8.1) "Test Load Sizes for Commercial Clothes Washers with Capacities > 6.0 cubic feet", an appliance with a container volume of 8.0 ft^3 would have a load capacity between 1.36-14.79 kg (assumed to depend on the textiles loaded). This is understood not to mean that there are not commercial machines with a higher capacity, but rather that they would not be eligible for certification according to this Energy Star scheme.

To conclude, the Energy Star categories do not provide insight as to how to differentiate between industrial, commercial and household appliances. According to Another stakeholder (2024), though Energy-Star measures on water and energy consumption may be fit for purpose, measures for wash performance are not. This is explained by the possibility to technically pass Energy Star certification without washing the garment.

3.1.2.5. Aspects related to categorisation raised by stakeholders

In the first stakeholder consultation, as in a number of interviews with manufacturers and associations, an effort was made to clarify various aspects related to the scope of this study and resulting legislation. This effort concerned the following aspects:

- Identification of technical features that would allow a clear-cut differentiation between 'household laundry appliances' and those laundry appliances in the scope of 'commercial and industrial appliances',

- Identification of technical features that would allow a clear-cut differentiation between 'commercial' and 'industrial' laundry appliances,
- Identification of sub-categories of commercial and industrial laundry appliances that could be of relevance when developing design and performance requirements in future ESPR legislation,
- Considerations on the scope of appliances to be included in this study and in resulting legislation.

Regarding the categorisations proposed in the 2011 study (Graulich et al. 2011) (see **Annex III: Categorisation of 2011 study**), almost all stakeholders expressed their concern, that it was not fit for regulatory purpose. Multiple stakeholders proposed:

- In the 1st stage: to differentiate between **Household and Commercial/Industrial appliances** (possible through reference to Low Voltage Directive (LVD) and Machinery Directive (MD)),
- As a 2nd stage to split the appliances between **continuous and batch operation**,

To some degree this seems to also be reflected in standards that specify testing procedures for appliance performance. Four stakeholders explained that:

- WM1, WM2, WM3, WM4 and, D1, D2, D3 are covered by the batch testing respective procedures.
- WM5 and D4 are covered by continuous testing procedures.
- There is no standard for testing WM3 appliances (washer-dryers) though, standards 50640:2018 and 50594:2018 could be applied in some way in combination.
- There is no standard for testing D3 appliances (commercial cabinet dryers). The existing standard 50594 will not be applicable. Nonetheless this category was explained to have a very small market share.

Though it remains to be seen to what degree this level of differentiation could align with future legislation requirements and its correspondence with laundry appliance sub-groups this starting point is at least well integrated with the standards for performance measuring. Nonetheless, a standard covering industrial pass-through tumble dryers was not found and the related stakeholder reference needs to be confirmed. A suitable standard was also not found for commercial cabinet dryers as also claimed in the statement above. Within its scope, standard 50640:2018 is stated to apply to washer extractors, washer dryers (the washing function), and washing machines with more than one compartment, which are assumed to represent barrier washers. In this context, the standardisation of washing machines is understood to encompass all the above categories. However, for dryers, specifically commercial cabinet dryers and industrial pass-through tumble dryers, standardisation appears to be lacking.

A few stakeholders suggested to refer to the **user type** (domestic, commercial, industrial) and thus to the need or lack of need for training, however it was not explained why this would have an advantage, i.e., seeing as these groups are not exclusive to each other. Though

stakeholders refer to the term 'professional appliances' as used in the former preparatory study as misleading, one stakeholder explained that differentiation between light duty-commercial and commercial appliances could be relevant in terms of durability and should be kept if there are to be durability requirements. The aspect of durability could also be more relevant in relation to the user type and its training level as for example appliances used in professional laundries, where operators have been trained, which have a more intensive operation and need to be more durable and vice versa. According to APPLiA (2024), durability will typically be different for light duty-commercial machines as compared to commercial ones. They proposed to also include it in future declaration of performance.

Another stakeholder (2024) explains that durability could be more relevant in relation to the type of business as for example appliances used in laundromats, or professional laundries have a more intensive operation and need to be more durable as opposed to smaller businesses such as hair salons and bed and breakfasts where a commercial machine would be too costly and the use of the machine does not warrant the cost. At the same time a household machine would be operated more frequently than it's designed for and would thus need to be replaced every couple of years. The solution is the light duty-commercial machine that has a durability between the household machines and commercial ones.

A few stakeholders provided the following categories using the **loading capacity** as a parameter that could allow a differentiation between appliance segments:

- household use: <15 kg,
- commercial: 15 kg to <40 kg,
- industrial: ≥40 kg.

Nonetheless, the three stakeholders that support this categorisation all represent the industrial laundry segment[2], also arguing that industrial appliances should be excluded from scope. Commercial manufacturers in contrast explained that these ranges are not applied in standards and nor is the differentiation necessary as the specific weight of the load does not result in a direct difference in terms of testing standards. Furthermore, 16 of the stakeholders in the 1st consultation did not think that this categorisation was suitable for the development of group specific performance requirements. Furthermore, though it can be followed that there are difficulties measuring performance of industrial appliances due to their level of customisation, in the 1st consultation, 5 stakeholders supported their inclusion in scope "so that all equipment is regulated". They explained that "*regulation is not limited to efficiency and performance but includes different sustainability aspects which might be applicable*".

A few appliance types were mentioned as possibly not being covered by the above categorisations, however in most of these cases it seems that clarifications could be introduced in future legislation to solve such uncertainties:

[2] It is noted that of the 13 manufacturers that participated in the 1st consultation, only 3 manufacturers produce both commercial and industrial appliances. 3 additional manufacturers produce only industrial appliances while 7 other additional manufacturers produce commercial appliances only (3 of which are also active in the household segment).

- Continuous Tunnel Washer and tunnel washers – Seeing as WM7 is specified as 'Washing tunnel machine' and seeing as such appliances are understood to have a continuous (as opposed to batch) operation, the consultant assumes that a continuous tunnel washer would be covered by this category. The category is also assumed to cover tunnel washers.
- Drying cabinets – D3 was specified as 'Professional cabinet dryer' in the former preparatory study of 2011. The consultant assumes that all drying cabinets would fall under this category, though the reference to professional may cause confusion.
- Heat pump tumble dryers – None of the above categories refers to heat pumps and thus in the 2nd consultation a proposal was made to include two new categories for drying appliances equipped with a heat pump (for cabinet dryers and tumble dryers). At present however, stakeholders have argued against this option. This is in part understood to relate to the integration of a heat pump in a washing or drying machine still being considered a technology in development for commercial and industrial laundry appliances. One stakeholder mentioned that a heat pump could also be used with industrial laundry machines that would not be addressed by the two proposed categories. Furthermore, stakeholders explained that machines equipped with a heat pump currently only reflect a small part of the market. Seeing as the use of a heat pump has a strong influence on the energy consumption, such equipment would have an advantage in fulfilling future performance requirements. However, it does not seem necessary to address equipment, containing heat pumps, in a separate category for this reason, though data will still need to be collected on such appliances separately.
- Wall barrier washers – Seeing as WM6 was specified as 'Professional barrier washers' in the former preparatory study of 2011. The consultant assumes that a wall barrier washer would be covered by this category, in particular if the word professional were omitted or clarified.
- Partition wall for washing machines – the consultant understands this term to also be related to the category WM6 'Professional barrier washers' as specified in the former preparatory study of 2011, possibly requiring some clarification as explained in the last point.
- Multi-drum machines – uncertainties as to whether such appliances exist in the commercial and industrial segment arose already in the 2011 study. In the 1st consultation some stakeholders assumed this was a type of barrier washer. In the 2nd consultation one stakeholder referred to a "machine with a double drum called 'pullman separation' which is normally used to separate soiled from cleaned linen in a barrier wall". This too is understood by the consultants to fall under the category WM6 'Professional barrier washers' as specified in the former preparatory study of 2011: in barrier washers there are understood to be two openings to ensure that there is no contamination of washed laundry removed from the drum after a cycle. A further stakeholder referred in this respect to tunnel washers, however these are also understood to be covered by WM5. As for machines with multiple drums that have a parallel washing cycle, stakeholders claim that such appliances are not placed on the market in the commercial and industrial segment. Assuming this will not be refuted,

multi-drum appliances could be excluded from scope with a clarification that they are to be regulated through the household appliance legislation.

Quite a few stakeholders mentioned that the reference machines ('FOM 71 CLS'), used for the tests according to the standards, need to be excluded. It was explained that the highest priority for the reference machines is maximum repeatability and accuracy, to secure repeatable results that can be compared to previous tests. This was explained to be in contradiction to optimised performance.

3.1.3. Delimitation of commercial and industrial washing machines and dryers

This study focuses on commercial and industrial laundry appliances. They are used to clean, rinse and dry textiles in professional customer and market segments. Commercial and industrial washing machines and dryers are always connected to the mains (electricity used for motor and electronics). The heating of the water or air can be realised by electricity or by other alternative energy sources like steam or gas. Commercial and industrial washing machines may or may not have a specific drying operation at the end of the washing phase of a washing programme resulting in different kinds of machinery (washing machines, washer extractors, washer dryers).

The 2011 preparatory study (Graulich et al. 2011) specified the following definitions in relation to the product group at hand:

> *'Professional washing machine' means a machine which cleans and rinses laundry like clothes, tablecloths, bedclothes, towels, and other textiles or items by using water, chemical, mechanical, and thermal means; which might also have a spin extraction or drying function and which is designed to be used principally for commercial and industrial purposes as stated by the manufacturer in the Declaration of Conformity (DoC).*
>
> *'Professional dryer' means a machine which dries laundry like clothes, tablecloths, bedclothes, towels, and other textiles or items by thermally removing the moisture (evaporation) and which is designed to be used principally for commercial and industrial purposes as stated by the manufacturer in the Declaration of Conformity (DoC).*

In both cases, the distinction between domestic and non-domestic machines was determined based on the 'intended use' (domestic versus commercial / industrial use) as declared by the manufacturer in the product information or the DoC which is also reflected in the distinction between the Household and commercial/industrial segments that is based on their relation to the scope of the Machinery Directive and the low Voltage Directive (see below for more details).

Various points were raised by stakeholders as to the suitability of the scope and definitions proposed in the past (see last section). Hence, the past definitions and categorisations have

been taken as a starting point for the current study to consider in terms of suitability and will be revised and refined as necessary. The following sub-sections thus discuss some of the aspects behind these categorisations and options for how they could be reviewed.

3.1.3.1. Distinction between household and commercial/industrial laundry machines.

Whereas the 2011 study (Graulich et al. 2011) refers in its categorisation to 'professional' washers and dryers, the term 'professional' is not clearly defined and does not allow a clear delimitation of which machines are in scope of the current study and which would be in scope of regulation developed for domestic machines. Though the past study looked among others at the category of use of various machines (e.g., coin and card laundries, apartment household laundries, hospitality laundry and commercial and industrial laundries), this parameter does not allow a clear cut between domestic or household appliances and commercial/industrial ones either.

In practice, though manufacturers classify their machines for commercial or industrial use, a domestic appliance can also be retrofitted with a card or coin dispenser and used in commercial laundries as is sometimes the case at camping grounds (according to Another stakeholder (2024) it is not clear if this is practiced). In parallel, for various reasons, some private users may decide to purchase and operate a (light duty) commercial machine which has been intended for commercial use. In this sense, future regulations cannot apply to a product based on where it is used but must achieve a clear delimitation between household machines and commercial/industrial machines. Some manufacturers have also explained that they may have separate approbations for an appliance that is basically the same, meaning that it may be placed on the market as a household appliance under one model name and as a commercial appliance under a separate model name, despite the basic equivalence of the devices.

Similarly, categories must also be clearly defined and exclusive for the case that some categories are to be excluded from scope or from certain requirements in future legislation. Such is the case for example with the above reference to dry-cleaning machines, which can be categorised based on the use of chemicals instead of water as a cleaning medium (see **Section 3.1.1.3**).

A possible general differentiation is given in the amended version of the Machinery Directive 2006/42/EC (European Parliament and Council 2006), in force since 29th December 2009. It clarifies the borderline between machinery for households (domestic) and for use by professionals (non-domestic, i.e., commercial and industrial use) in order to provide greater legal certainty. Whereas machinery used by professionals falls in the scope of the Machinery Directive, Article 1(2)k excludes 'electrical and electronic products [falling under the area…] household appliances intended for domestic use', meaning that the Machinery Directive does not apply to such domestic equipment, as long as it is in the voltage rate considered to be low (between 50-1000 V AC or between 75-1500 V DC). Such household appliances are covered

by the former Low Voltage Directive (LVD) 2006/95/EC, recasted as Directive 2014/35/EU (European Parliament and Council 2014b)[3], i.e., must fulfil the safety objectives of the LVD.

It could be interpreted that as long as laundry machinery would have a voltage rating within the above limits, it would be subject to the LVD requirements, regardless of whether it is domestic equipment or not. However, the Commission interprets that whether a machine is to be considered a "household appliance intended for domestic use" would depend on how the manufacturer has specified the machine in its DoC or product information (European Commission 2024b). In contrast, for commercial and industrial appliances, in its guidance document, the EC states that "appliances for the housekeeping functions […] that are intended for commercial or industrial use are not excluded from the scope of the Machinery Directive" (European Commission 2024b). It is thus concluded that appliances intended by the manufacturer for household use would be covered by the LVD, as long as they are within the relevant voltage rating. Furthermore, regardless of voltage rating, appliances intended for commercial or industrial use would be covered by the Machinery Directive. Following this logic, the intention specified by the manufacturer in the approbation of laundry appliances and specifically in the DoC provides a clear cut-differentiation between household appliances and those intended for commercial or industrial use.

To further strengthen this interpretation, the new Machinery Regulation can be considered. Following the last review of the Machinery Directive it was replaced by a Regulation[4] and has a similar exclusion from scope for household (laundry) appliances in article 2(2)(p)(i). Additionally, in its recital 18 the Regulation also specifically refers to the ambiguity and it is clear that its intention is to exclude household appliances such as washing machines from the Regulation, thus creating a clear separation between the household segment and other segments in the market:

"(18) Household appliances intended for domestic use which are not electrically operated furniture, audio and video equipment, information technology equipment, office machinery, low-voltage switchgear and control gear and electric motors fall within the scope of Directive 2014/35/EU of the European Parliament and of the Council (11) and should therefore be excluded from the scope of this Regulation. Some of those products, for example washing machines, are progressively incorporating Wi-Fi functions and are therefore covered by Directive 2014/53/EU of the European Parliament and of the Council (12) as radio equipment. Those products should also be excluded from the scope of this Regulation."

This change makes clear that laundry appliances would either be in the scope of the Machinery Regulation or of the LVD but not of both.

In the 1st consultation (see **Section 2.2**), stakeholders were asked as to the suitability of different technical parameters of equipment for better differentiation of the categories. The following list is a summary of the argumentation raised against the suitability of various parameters mentioned:

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[3] Directive 2006/95/EC was reviewed and recast as Directive 2014/35/EU which is still in force.

[4] Based on its Article 54, the Regulation shall apply from 20 January 2027 and thus the discussion includes the reference to the Machinery Directive. Corrigendum: http://data.europa.eu/eli/reg/2023/1230/corrigendum/2023-07-04/oj

- **Reference to load ranges in categorisation:** this option was viewed differently by commercial and industrial manufacturers; however, the former raised the compelling argument that such ranges are not applied in practice nor is it considered necessary as the specific weight does not result in a direct difference in terms of the testing standard to be used for measuring appliance performance. In the consultant's view, it remains to be seen, if the difference of performance of appliances with larger or smaller loads could render differentiation of load capacity relevant in terms of fulfilment of future performance requirements e.g., related to labelling categorisation. APPLiA (2024) agree with this view and suggest investigating this by requiring manufacturers to use the standards and declare performance values in Product Information Sheets as well as collecting these data in a database (e.g. EPREL). This was also supported by Another stakeholder (2024).
- **Detergent dosage or detergent type** – stakeholders agreed that this parameter was not relevant. Some raised the option of automatic dosing as function prevalent in commercial and industrial appliances; however, the consultants are aware that such functions are also integrated in some household appliances.
- **Power cable connection**: most stakeholders do not see this parameter as useful: power connection is often dependent on the socket type and electric supply available on site, and both plug, and direct connection are relevant for commercial and industrial appliances.
- **Level of programmability**: most stakeholders agreed that this parameter is not suitable: "programmability is not provided by all commercial appliances", in some cases only the manufacturer will be able to re-programme and programmability may become increasingly available in domestic machines in the future.
- **Durability** and related specifications of materials and components: though stakeholders agree that commercial and industrial machines will often have a higher durability, they do not see this as a parameter suitable for differentiation – listing all materials and parts is not practical and it does not provide a clean-cut-off anyway. Another stakeholder (2024) suggests instead that the number of cycles the machine is rated for should be used for differentiating between light duty commercial and commercial.
- **Warranty**: stakeholders explained that warranty can differ due to national law making and thus its use for differentiation would be complex. Typically, the warranty for household appliances will be 2 years by law, whereas for commercial and industrial appliances, warranty is often based on the contractual agreement between the manufacturer and the customer. Contracts may also address the availability of spare parts, the maximum response time of technicians in case of fault as well as provision of maintenance services.
- Additional parameters raised but not considered exclusive for a specific segment of appliances: Productivity of the machines; rated power; programme duration or cycle time due to productivity demands of professional users.

Though different parameters were investigated in this manner, none of them would provide clear differentiation between household and commercial equipment, nor between commercial

and industrial equipment. Another stakeholder (2024) claimed that “Such technical features do not exist in front loaded washers”. This could mean that top-loaded washers are only made available in the household segment.

A few stakeholders specified the following definitions for differentiating between household, commercial and industrial appliances:

- **Washing machine**: an automatic machine for washing textiles, which cleans and rinses them using water, chemical, mechanical and thermal means and also has an extraction function by rotation.
- **Commercial washing machine**: a washing machine as described in point 1, which is not used in the household and which meets the requirements of the Machinery Regulation (EU) 2023/1230, regardless of the size or the technology used.
- **Tunnel washer**: a continuous washing machine consisting of several modules, each module corresponding to a sequence of the washing cycle. The washing process is ensured by mechanical action, water, chemicals and temperature. The water is removed at the end of the wash cycle by pressing.

Subsequently, a household appliance would be considered to comply with the first definition but not with the second definition. The difficulty that the consultants see with this definition is that from exchanges with manufacturers, it can be understood that certain appliances that do not fall under the third definition are nonetheless intended for industrial use. This would also follow the differentiation that some industrial manufacturers have provided in load capacity, according to which industrial appliances would have a load above 40 kg. This would for example cover washer extractors with a load above this threshold, however it can be understood that some appliances of this kind would be specified by the manufacturer for commercial use. In other words, to accept these definitions would require manufacturers to agree that all washer extractors are to be intended for commercial use in the future.

3.1.4. Test standards of commercial and industrial washing machines and dryers

This subtask aims to specify the relevant test standards for commercial and industrial washing machines and dryers concerning test procedures for functional performance parameters, resource use, safety and hygiene as well as noise and vibration and (if any) other specific test procedures.

3.1.4.1. Performance

Following a mandate given by the Commission to CENELEC and CEN to develop new performance standards for commercial and industrial laundry machines, a few new standards were developed regarding the performance and related tests procedures for commercial and industrial washing and drying appliances. The standards differ for industrial laundry machines (EN 17116 series) and commercial ones (EN 50640 and EN 50594) and are presented below.

Standard EN 17116-2:2018

EN 17116-2:2018 covers "Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics - Part 2: Batch drying tumblers". As already explained above, the scope is limited to tumble dryers with a load capacity of 40 kg and above. The standard describes standard methods for measuring principal performance characteristics of tumble dryers. Among others, it includes procedures for measuring:

- bone dry weight,
- initial and residual moisture content,
- drying temperature and duration for achieving final moisture content,
- energy consumption,
- hourly productivity.

Standard EN 17116-3:2019

This standard contains "Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics - Part 3: Continuous tunnel washer". It details test methods with regard to machine capacity, power consumption and productivity. Among others, it includes procedures for measuring:

- wash performance (primary and secondary),
- rinse performance,
- energy consumption:
  - electrical energy,
  - steam consumption,
  - and gas consumption,
- water consumption,
- detergent consumption,
- hourly production input.

From the various specifications on how the performance testing should be performed it is concluded that the programme should be a cotton wash with a temperature of 70 °C that should be achieved at least through 10 minutes of the cycle. Details are also given as to the types of textiles and their soiling level, to be included in the test cycles.

Standard EN 17116-4:2019

This standard addresses "Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics – Part 4: Washer extractors". From its title it is concluded that the standard addresses industrial washers considered to have "a net usable cage volume of 400 dm^3 (litres), respectively 40 kg and above". The standard lays

down procedures for the testing of the following performance parameters of washing machines that are in its scope. For this purpose, general test conditions including specification of the reference machine, test load and number of test runs and others are given. For the same purpose, the standard also specifies ambient temperature and humidity, water supply and water properties (hardness, temperature, pressure), energy and electricity supply, compressed air supply, steam supply. The parameters for which test procedures are specified include:

- Wash performance, including:
  - Moisture content of the soiled load,
  - Corrected weight of the nominal load,
  - Primary wash performance,
  - Secondary wash performance,
  - Rinse performance.
- Energy consumption, including:
  - Determination of electrical energy,
  - Determination of steam and gas consumption;
- Water consumption,
- Detergent consumption,
- Hourly productivity,
- Residual moisture after extraction.

Standard EN 50640:2018

The standard addresses “Household and similar electric appliances – Methods for measuring the performance of clothes washing machines intended for commercial use”. The name is a bit misleading, but the specific standard is actually intended to detail performance testing procedures for commercial appliances. In the scope section, it is verified that the standard covers clothes washing machines intended to be used by trained users in commercial facilities, as well as washing machines declared for commercial use in public areas and operated by lay persons. Machines using cold or hot water supply are covered as well as those equipped with heating devices for electricity, gas or steam and those not equipped with such devices. Top, front and side loaded machines are covered with horizontal or vertical axis and with one or more washing compartments. Washer dryers are also in scope with respect of their washing functions, as well as washing machines with more than one component (the consultant assumes this refers to barrier washers) and also spin extractors.

The parameters for which test procedures are specified include (based on Articles 7-9 of the standard):

- Washing performance,
- Maximum spin speed,

- Water extraction performance, including:
  - Moisture content after extraction
- Total energy consumption, including:
  - Determination of energy supplied by electricity,
  - Determination of energy supplied by gas,
  - Determination of energy supplied by hot water,
  - Determination of energy supplied by steam,
  - Determination of energy consumed via compressed air,
- Bath temperature,
- Water consumption,
- Cycle time.

The above list includes parameters to be collected for the purpose of reporting the parameters of test conditions as well as parameters collected for reporting performance data.

The standard can be used to test any type of programme, and it is specified how the temperature range should be chosen. Details are also given as to the types of textiles and their soiling level, to be included in the test cycles. The test load is composed of a specified base load of 50 % cotton, 50 % polyester, and soil strips. The number of textile pieces is specified in tabular form in relation to the load mass of the machine, starting at 2 kg and going up to 300 kg. This again clarifies that the standard is usable by commercial laundry machines with a significantly higher load than the 40 kg threshold specified in Standard EN 17116-4:2019 for industrial washer extractors.

Standard EN 50594:2019

The standard is applicable to tumble dryers intended to be used by trained users. Nonetheless, it covers also tumble dryers declared for commercial use in public areas and operated by lay persons. The standard covers tumble dryers which use electricity, gas or steam as a heating source. It does not cover dryers with automatic loading or with continuous operation (pass through). Separate preparation requirements are provided for the measurement of heat pump equipped tumble dryers as opposed to those provided for other heating alternatives.

The parameters for which test procedures are specified include:

- Water consumption (corrected water consumption),
- Energy consumption (total and corrected energy),
- Cycle time (corrected cycle time),
- Evaporation capacity,
- Condensation efficiency,
- Exhaust air volume and duct pressure,

- Textile drying temperature,
- Final moisture content of load.

Stakeholder feedback on performance standards:

A few stakeholders stated that EN 50640 and EN 50594, are fit for the purpose of measuring commercial batch laundry appliance performance. However, as there is currently no legislation requiring testing for commercial appliances, it is unclear how common testing according to them is performed for commercial appliances. A few manufacturers said that they use these standards on a regular basis to test their products, however that they haven't tested the whole product range to date. Also based on comments raised in the second consultation, the consultants understand that these standards are not used by all manufacturers and in any case, they are not used to measure performance values to be specified in appliance information on websites and brochures.

For batch equipment, stakeholders have explained that the procedure for the Round Robin Tests would need revision to ensure that it returns repeatable and accurate results when applied. Currently, results can differ between one laboratory to another. Such revisions would be necessary before introducing legislation based on related performance data.

On this last aspect, Another stakeholder (2024) stated that the procedure for the Round Robin Test does not need to be revised. Rather, labs need more experience in using standards and access to the right load materials, which were not available to all labs at the time the Round Robin Test was checked. For industrial machines the case is different as continuous installations cannot be shipped between laboratories to allow performing this test. The same stakeholder also stated that EN 50640 needs to be revised to include rinse performance.

The CLC standards EN 50640 and EN 50594 can be used to determine some consumption data (water and energy consumption). However, stakeholders mentioned that these two CLC standards need to be revised (change of reference detergent and inaccuracies found during application). Both the rinse and spin performance have an impact on the efficiency indicators. The minimum rinse performance must be defined for the determination of water and energy efficiency.

It was specified that tests for Industrial Laundry Machines are performed according to:

- EN 17116-2: Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics - Part 2: Batch drying tumblers
- EN 17116-3: Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics - Part 3: Continuous tunnel washer
- EN 17116-4: Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics - Part 4: Washer-extractors

Though stakeholders generally think that the standards are fit for purpose, it has been explained that for (continuous) tunnel washers the testing methods do not return repeatable

results, showing a high variance in results (±10 %). Round Robin Tests are not possible for continuous equipment which is site specific and cannot be shipped to different laboratories.

ISO 9398 (International)

The standard has four separate standards or parts. These four standards for industrial laundry machinery define the measurement method for the energy and water consumption; the standards do not include the washing and rinsing performance measurement and are thus not used by most manufacturers.

Instead, manufacturers use internal test procedures which allow direct comparison between models of similar performance characteristic. These are not suitable for a performance classification of industrial washing machines and dryers due to insufficient reproducibility.

- ISO 9398-1:2003 Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics, Part 1: Flatwork ironing machines: Part 1 defines the characteristics of flatwork ironing machines and gives the usual test methods for determining these characteristics with regard to machine capacity power consumption and hourly productivity. It is applicable for use as a reference in the drafting of purchasing orders for flatwork ironing machines having a contact surface area greater than 0.25 m^2. It does not cover safety requirements (see ISO 10472-5). The energy consumption of a flatwork ironing machine is defined as the number of kilojoules or kilowatt hours of steam, gas, electricity or heat-transport fluid energy required for flat-ironing one test load having a residual moisture level on discharge from the flat-work ironing machine.
- ISO 9398-2:2003 Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics, Part 2: Batch drying tumblers: Part 2 defines the characteristics of a batch drying tumbler and gives the usual test methods for these characteristics with regard to machine capacity, power consumption and productivity. It is applicable for use as a reference in the drafting of purchasing orders for batch drying tumblers whose net usable cage volume is greater than 160 dm^3 (litres) (corresponding 6 kg to 7 kg dry linen capacity). It does not cover safety requirements (see ISO 10472-4). The energy consumption of batch drying tumblers is defined as the number of kilojoules or kilowatt hours of steam, gas, electricity or heat-transport fluid energy required for the drying of a test load to obtain residual moisture content after drying.
- ISO 9398-3:2003 Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics, Part 3: Washing tunnels: Part 3 defines the characteristics of washing tunnels and gives test methods for determining machine power consumption and hourly productivity. It is applicable for use as a reference in the drafting of purchasing orders for washing tunnels. It does not cover safety requirements (see ISO 10472-3). The energy consumption of a washing tunnel is defined as the number of kilojoules or kilowatt hours of steam, gas, electricity or heat-transport fluid energy required for the washing of one test load in machine operating at its nominal capacity during one cycle.

- ISO 9398-4:2003 Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics, Part 4: Washer-extractors: Part 4 defines the characteristics of washer-extractors and gives test methods for these characteristics with regard to machine capacity, power and water consumption, and hourly productivity. Parameters are measured in three specified programmes (programmable timers needed); no measurement method for the washing and rinsing performance is available in the test standard (e.g. no types of soiling are given), see also Table 14. The energy for the test shall be supplied by steam, gas, electricity or heat-transport fluid, as specified by the manufacturer. The standard is applicable for use as a reference in the drafting of purchasing orders for washer-extractors whose net usable cage volume is greater than 60 dm^3 (litres). It does not cover safety requirements (see ISO 10472-2). The energy consumption of a washer-extractor is defined as the number of kilojoules or kilowatt hours of steam, gas, electricity or heat-transport fluid energy required during washing and extraction of a test load in machine operating at its nominal capacity during the time corresponding to three different described cycles.

IEC and European harmonised standards EN 60456 and EN 61121 (household use)

EN 60456:2005 Clothes washing machines for household use – Methods for measuring the performance (IEC 60456:2010): This standard deals with methods for measuring the performance of clothes washing machines for household use, with or without heating devices and for cold and/or hot water supply. Also included are appliances for water extraction by centrifugal force and appliances for both washing and drying textiles (called washer-dryers) with respect to their washing performance. The object is to state and define the principal performance characteristics of household electric washing machines and spin extractors and to describe the standard methods for the measuring of the performance.

EN 61121:2005 Tumble dryers for household use – Methods for measuring the performance (IEC 61121:2005): This international standard is applicable to household electric tumble dryers of the automatic and non-automatic type, with or without a cold-water supply and incorporating a heating device. The object is to state and define the principal performance characteristics of household electric tumble dryers of interest to users and to describe standard methods for measuring the performance.

These two standards are the main harmonised international standards regarding the performance measurement of washing machines and tumble dryers for household use. They are valid for electric mains-operated household washing machines and tumble dryers. The standards are used to measure the information required by Commission Directives with regard to energy labelling of household washing machines and tumble dryers. In summary these standards define the general test conditions and specific test methods for the following information:

- Household washing machines:
  - Washing performance, rinsing performance, spin extraction performance,
  - Energy consumption, water consumption, programme time, and

  - Shrinkage during the wool wash programme.
- Household tumble dryers:
  - Drying performance, condensation efficiency (for condenser dryers),
  - Energy consumption, programme time, and
  - Evenness of drying.

For measuring each of the information, the same programme has to be used.

Since adoption of IEC 60456 and 61121, the standards have repeatedly been amended and modified, currently IEC 60456 edition 6.0 from November 2024 and IEC 61121 edition 4 from February 2012 are in effect.

Conclusion: Comparison of different performance standards

To the consultants understanding, there is currently still no commonly applied performance measurement standard for commercial and industrial washing machines and dryers in Europe.

ISO 9398 series for industrial laundry machinery defines a measurement method for the energy and water consumption; however, it does not include a performance measurement (washing and spin extraction performance for washing machines, drying performance and condensation efficiency for dryers). IEC/EN standards 60456 and 61121 currently only apply to washing machines and dryers for household use. They might be the basis for performance standards for light duty commercial or commercial appliances, however, the condition parameters and measurement methods would have to be adapted accordingly.

Standards have been developed by the CENELEC and have been published; however, their application is still voluntary and based on feedback from various stakeholders they are not applied by all manufacturers and thus also not applied in promotional information as this would affect competitiveness[5]. Both manufacturers and associations see merit in making the use of these standards mandatory and it is assumed that future ESPR legislation to be developed would make use of these standards where results of performance testing are needed.

3.1.4.2. Safety

According to the Convenor of TC27/SC5/WG3 all machines constructed in accordance with the standard series EN 10472, in combination with EN 60204-1, fall into the industrial sector. All machines constructed in accordance with EN 60335-1, in combination with the machine-specific parts of this standard series, fall into the commercial sector. EN ISO 10472-1 points this fact out in 5.2: “The electrical equipment of machines shall be designed in accordance with EN 60204-1 … or IEC 60335 …, depending on the intended use of the machine.” This

[5] This is understood to mean that the performance level calculated based on the new standards would create an impression of being inferior to the performance calculated by other stakeholders for their promotional material. Though a manufacturer explained that most companies use an adjustment of an older household appliance standard for calculations used in promotional material, it is not clear whether each company makes different adjustments or if the same method is applied by all manufacturers.

normative specification, which refers to the different scopes of the before-mentioned standards, results in a clear distinction of the industrial sector.

ISO 10472 (International)

ISO 10472 Safety requirements for industrial laundry machinery: These standards give the most relevant product definitions of all sources identified, providing a first basis for conclusion of the products classification (see **Section 3.1.2.3**). The ISO standards 10472 are also widely used by manufacturers.

- ISO 10472-1:1997 Safety requirements for industrial laundry machinery, Part 1: Common requirements (see also EN ISO 10472-1:2008; DIN EN ISO 10472-1 with publication date 10/2009). The individual parts of ISO 10472 identify all significant hazards (mechanical, electrical, thermal hazards, hazards generated by noise; hazards associated with materials and substances processed, used or exhausted by machinery; hazards due to neglect of ergonomic principles in machine design; failure of energy supply, breakdown of machinery parts and other malfunction; hazards arising during maintenance and/or elimination of process faults) associated with laundry machinery designed for use in industrial laundry premises, which includes hotels, hospitals, nursing homes, prisons and similar premises, as well as machines designed for use in self-service establishments subject to the minimum capacities stated in the separate parts of ISO 10472. Dry-cleaning presses and garment presses are also included.
- ISO 10472-2:1997 Safety requirements for industrial laundry machinery, Part 2: Washing machines and washer-extractors (see also EN ISO 10472-2:2008; DIN EN ISO 10472-2 with publication date 10/2009): This part of ISO 10472 covers, together with ISO 10472-1, most significant hazards associated with washing machines and washer-extractors of all configurations having a net usable cage volume > 60 l (i.e. capacity of 6 kg of dry linen). This part of ISO 10472 does not cover particular hazards for drawer-type washer-extractors as well the hazards caused by processing work may create an explosive or flammable atmosphere inside the machine. Furthermore, it does not apply to ancillary equipment, e.g. chemical supply pumps, steam valves and supply pipe work, vent systems, work feed systems and discharge systems and ducting to the atmosphere.
- ISO 10472-3:1997 Safety requirements for industrial laundry machinery, Part 3: Washing tunnel lines including component machines (see also EN ISO 10472-3:2008; DIN EN ISO 10472-3 with publication date 10/2009): This part of ISO 10472 covers, together with ISO 10472-1, most significant hazards associated with washing tunnel lines including component machines such as:
  - continuous tunnel washing machines,
  - squeeze presses or centrifugal extraction machines,
  - transfer conveyor systems,
  - automatic transfer tumblers,
  - loading or unloading system interfaces,
  - access platform and ladders.

This part of ISO 10472 does not cover particular hazards for continuous stand-alone washing lines for endless towels as well the hazards caused by processing work may create an explosive or flammable atmosphere inside the machine.

- ISO 10472-4:1997 Safety requirements for industrial laundry machinery, Part 4: Air dryers (EN ISO 10472-4:2008; DIN EN ISO 10472-4 with publication date 09/2009): This part of ISO 10472 covers, together with ISO 10472-1, most significant hazards associated with air dryers, and in particular with tumble dryers having a net usable cage volume > 160 l (i.e. capacity of 6 to 7 kg of dry linen) and tunnel finishers including associated conveyors and cabinet dryers. This part of ISO 10472 does not apply to ancillary equipment.
- ISO 10472-5:1997 Safety requirements for industrial laundry machinery, Part 5: Flatwork ironers, feeders and folders (see also EN ISO 10472-5:2008; DIN EN ISO 10472-5 with publication date 09/2009): This part of ISO 10472 covers, together with ISO 10472-1, most significant hazards associated with flatwork ironers, feeders and folders, such as:
  - cylinder and bed ironers for flatwork finishing having a contact area (for bed ironers under pressure) > 0.25 m²,
  - flatwork feeding machines for the automatic feeding of flatwork into bed or cylinder ironers, or directly to folders,
  - flatwork folding machines for the automatic folding of flatwork in association with cylinder and bed ironers,
  - folding machines for the automatic folding of small pieces (excluding endless towels),
  - multi-function machines.
- ISO 10472-6:1997 Safety requirements for industrial laundry machinery, Part 6: Ironing and fusing presses (see also EN ISO 10472-6:2008; DIN EN ISO 10472-6 with publication date 10/2009): This part of ISO 10472 covers, together with ISO 10472-1, most significant hazards associated with ironing and fusing presses used in the laundry, garment and dry-cleaning industry, and in particular:
  - scissor presses,
  - cabinet presses,
  - drawer presses,
  - rotary presses (carousel) and other presses with multiple bucks.

IEC 60335 Household and similar electrical appliances – Safety (International)

IEC 60335-1: Household and similar electrical appliances – Safety, Part 1: General requirements

- The Standard covers safety issues of household and similar electrical appliances. Part 1 defines general elements and is common to all electric motor appliances. Product

specific issues are addressed in the Part 2-series. The relevant Standards of Part 2 washing machines and dryers are listed in the following.

IEC 60335-2: Household and similar electrical appliances – Safety, Part 2

- IEC 60335-2-4:2008: Household and similar electrical appliances – Safety, Part 2-4: Particular requirements for spin extractors: Deals with the safety of spin extractors incorporated in washing machines that have separate containers for washing and spin extraction for household and similar purposes that have a capacity not exceeding 10 kg of dry cloth and a drum peripheral speed not exceeding 50 m/s, their rated voltages being not more than 250 V for single-phase appliances and 480 V for other appliances.
- IEC 60335-2-7:2008: Household and similar electrical appliances – Safety, Part 2-7: Particular requirements for washing machines: Deals with the safety of electric washing machines for household and similar use, that are intended for washing clothes and textiles, their rated voltage being not more than 250 V for single-phase appliances and 480 V for other appliances. This standard also deals with the safety of electric washing machines for household and simi-lar use employing an electrolyte instead of detergent. Additional requirements for these appliances are given in Annex CC of the standard.
- IEC 60335-2-11:2008: Household and similar electrical appliances – Safety, Part 2-11: Particular requirements for tumble dryers: Deals with the safety of electric tumble dryers intended for household and similar purposes, their rated voltage being not more than 250 V for single-phase appliances and 480 V for other appliances. This standard also applies to the drying function of washing machines having a drying cycle, as well as the safety of tumble dryers that use a refrigerating system incorporating sealed motor-compressors, for drying textile material. These appliances may use flammable refrigerants.
- IEC 60335-2-43:2008 Household and similar electrical appliances – Safety, Part 2-43: Particular requirements for clothes dryers and towel rails: Deals with the safety of electric clothes dryers for drying textiles on racks located in a warm airflow and to electric towel rails, for household and similar purposes, their rated voltage being not more than 250 V. Appliances not intended for normal household use but that nevertheless may be a source of danger to the public, such as appliances intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.
- IEC 60335-2-44:2008 Household and similar electrical appliances – Safety, Part 2-44: Particular requirements for ironers: This International Standard deals with the safety of electric ironers for household and similar purposes, their rated voltage being not more than 250 V for single-phase appliances and 480 V for other appliances. Appliances not intended for normal household use, but which nevertheless may be a source of danger to the public, such as appliances intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard. Examples of appliances within the scope of this standard are ironing presses for one-person operation; mangles; rotary ironers for one-person operation; trouser presses.
- IEC 60335-2-85:2008 Household and similar electrical appliances – Safety, Part 2-85: Particular requirements for fabric steamers: Deals with the safety of electric fabric

steamers intended for household and similar purposes, their rated voltage being not more than 250 V. Appliances not intended for normal household use, such as appliances to be used by laymen in laundries and dry cleaners, are within the scope of this standard.

IEC 60204 Safety of machinery – Electrical equipment of machines (International)

- IEC 60204-1:2005 Safety of machinery – Electrical equipment of machines – Part 1: General requirements: This part of IEC 60204 applies to the application of electrical, electronic and programmable electronic equipment and systems to machines not portable by hand while working, including a group of machines working together in a co-ordinated manner. This standard is applicable to the electrical equipment or parts of the electrical equipment that operate with nominal supply voltages not exceeding 1,000 V for alternating current (AC) and not exceeding 1,500 V for direct current (DC), and with nominal supply frequencies not exceeding 200 Hz.
- The standard sets out requirements and recommendations concerning the electrical equipment of machines, with the aim of promoting the safety of persons and property, ensuring consistency in control responses, and facilitating ease of maintenance.

BGR 500 (German)

- BGR 500 (Berufsgenossenschaftliche Regeln für Sicherheit und Gesundheit bei der Arbeit) provides safety regulations for the operation of laundries.

UL 1206 / 1240 / 2157 / 2158 (USA / Canada)

- Test standards for household equipment around the world are mostly based on EN standards (which in turn are mostly based on IEC standards) whereas in North America (USA/CANADA) they are based on UL-standards. The UL-standards are usually slightly modified to suit local conditions and set requirements in the areas of construction, safety and mainly for on hard-ware issues. These standards provide no relevant product definitions for providing a good basis for a product classification:
  - UL 1206 Electric Commercial Clothes-Washing Equipment (USA / Canada): These requirements cover electric commercial, industrial, and institutional clothes-washing equipment intended for use in accordance with the National Electrical Code. Equipment covered by this Standard is not intended for use by the general public, but only by trained or supervised personnel. These requirements do not cover clothes dryers, coin-operated clothes washing appliances, flatirons, ironing machines, water heaters, water softeners, dry-cleaning machines, garment-finishing machines, appliances employing wringer mechanisms, or other equipment covered by requirements separate from this standard.
  - UL 1240 Electric Commercial Clothes-Drying Equipment (USA / Canada): These requirements cover electric commercial, industrial, and institutional clothes-drying equipment intended for use in accordance with the National Electrical Code, NFPA 70. Equipment covered by this Standard is not intended for use by the general public, but only by trained or supervised personnel. These requirements do not cover coin-operated clothes-drying equipment, flatirons, ironing machines, water

heaters, water softeners, dry-cleaning machines, garment-finishing machines, clothes washers, or other equipment covered by requirements separate from this standard.

- UL 2157 Electric Clothes Washing Machines and Extractors (USA / Canada): This Standard applies to electric clothes washing machines and extractors intended to be used in non-hazardous locations in accordance with the Canadian Electrical Code, Part I (CEC), and the (U.S.) National Electrical Code (NEC), on circuits having a nominal voltage not exceeding 600 V. Note: Wherever practical, for convenience, the term 'appliance' has been used in lieu of 'clothes washer' or 'machine'. This standard applies to both cord-connected and permanently connected appliances. The appliances covered by this standard are intended for use by the general public not specifically trained in the use of the appliance, regardless of the mode by which its operation is initiated. They are for use in household and commercial purposes, including appliances provided with coin-, ticket-, or card-operated mechanisms, wringer washers, tumbler, agitator and spinner machines, combination washer-dryers, and extractors of the centrifugal type. This Standard does not apply to industrial and institutional type appliances. Industrial or institutional appliances are covered under the scope of Electric Commercial Clothes-Washing Equipment, UL 1206.
- UL 2158 Electric Clothes Dryers (USA / Canada): This standard applies to electric clothes dryers intended to be used in non-hazardous locations in accordance with the Canadian Electrical Code, Part I (CEC), and the (U.S.) National Electrical Code (NEC), on circuits having a nominal voltage not exceeding 600 Note: Wherever practical, for convenience, the term 'appliance' has been used in lieu of 'clothes dryer' or 'machine'. This standard applies to both cord-connected and permanently connected appliances. The appliances covered by this standard are intended for use by the general public not specifically trained in the use of the appliance, regardless of the mode by which its operation is initiated. They are for use in households and for commercial purposes, including appliances provided with coin, ticket-, or card-operated mechanisms, and combination washer-dryers. This standard does not apply to industrial and institutional type appliances. Industrial or institutional appliances are covered under the scope of Electric Commercial Clothes-Drying Equipment, UL 1240.

3.1.4.3. Hygiene

Laundry from medical services (e.g. operation material, bed linen or work wear of nurses) as well as laundry from food businesses underlies several regulations for its hygienic treatment. The soiled textiles delivered to the laundries are contaminated with a multitude of micro-organisms.

The aim of reprocessing is for example to decontaminate the textiles in a disinfecting process (= to reduce microorganisms in a way that there is no more risk of infection) and protect it against recontamination (re-soiling with microorganisms) until they go back to the customers. According to the field of application, different requirements exist for the processing (washing, drying and finishing) and microbiological quality of the textiles. However, not only the textiles but also the surroundings within and the personnel of the laundry services have to fulfil

hygienic regimentations. Objective for the appropriate handling of textiles from medical services is to avoid infectious diseases and to minimise the risk of infections, respectively. Objective for the handling of textiles from food businesses is to avoid any harmful impact on the food caused by inappropriate work wear.

IFS – International Food Standard (International)

The IFS Food (Version 8 which is applicable since 1st January 2024) is a standard for auditing retailer and wholesaler branded food product suppliers and only concerns food processing companies or companies that pack loose food products. The IFS Food can only be used when a product is 'processed' or when there is a hazard for product contamination during the primary packing. The food processing industry generally requires evidence of hygienic harmlessness of the processed textiles (used for packaging) from laundry services. As of Version 5, the International Food Standard contains requirements regarding the hygiene of textiles.

EN 13795 (European)

EN 13795 Surgical drapes, gowns and clean air suits, used as medical devices, for patients, clinical staff and equipment:

- EN 13795-1+A1 2009-07: Surgical drapes, gowns and clean air suits, used as medical devices, for patients, clinical staff and equipment, Part 1: General requirements for manufacturers, processors and products.
- EN 13795-2+A1 2009-07: Surgical drapes, gowns and clean air suits, used as medical devices for patients, clinical staff and equipment, Part 2: Test methods.
- EN 13795-3+A1 2009-07: Surgical drapes, gowns and clean air suits, used as medical devices for patients, clinical staff and equipment, Part 3: Performance requirements and performance levels.

EN 14065 (European)

EN 14065 Textiles – Laundry processed textiles – Biocontamination control system

This European standard describes a system for Risk Analysis and Biocontamination Control (so-called RABC system) during the processing of textiles in laundries. Prevention of microbiological contamination is of significant importance in all steps of the reprocessing of textiles. The so-called RABC system ensures that a pre-agreed level of microbiological quality will be set to match the needs of the intended use. The RABC-System is a hygiene- and quality-management-system respectively, with risk analysis, comparable to the HACCP (Hazard Analysis and Critical Control Points) concept for the food area. The EN 14065 was developed according to the worldwide approved HACCP concept (developed 1959 and published 1971). Laundries and textile service enterprises which reprocess hospital textiles have to fulfil the requirements of the Robert-Koch-Institut (RKI) and among others have to

establish a hygiene management system according EN 14065 which fulfils the requirements of the IFS, the BRC and the DIN 10524 (RABC)[6].

DIN 10524 (German)

DIN 10524 Lebensmittelhygiene – Arbeitsbekleidung in Lebensmittelbetrieben (Food hygiene – Work wear in food business, German): Work wear in food businesses have to fulfil hygienic requirements during their whole expected useful life. According to DIN 10524, the textiles have to be treatable under the conditions of a professional laundry service, i.e. being able to wash, disinfect and finish. The DIN standard describes the hygienic requirements for work wear in food businesses. Further, it provides details for the selection, treatment and cleaning of the work wear.

RKI-Guidelines (German)

Guidelines for hospital hygiene and prevention of infectious diseases (Robert Koch Institute, Germany): The guidelines comprise hygienic requirements for textiles of medical service institutions, for the laundry, the washing process, and requirements for giving away textiles to professional laundry services.

3.1.4.4. Noise

IEC 60704 (International)

IEC 60704:1997 Household and similar electrical appliances – Test code for the determination of airborne acoustical noise

- IEC 60704-1:2021 Household and similar electrical appliances – Test code for the determination of airborne acoustical noise, Part 1, last update from 2021: General requirements: Applies to the methods of determination of airborne acoustical noise emitted by household and similar electrical appliances supplied from mains or from batteries.
- IEC 60704-2-4 Ed. 2.0 b:2011: Household and similar electrical appliances – Test code for the determination of airborne acoustical noise, Part 2-4: Particular requirements for washing machines and spin extractors: These particular requirements apply to single unit electric washing machines, the washing and spinning function of combined appliances for household and similar use, and to spin extractors.
- IEC 60704-2-6 2012: Household and similar electrical appliances – Test code for the de-termination of airborne acoustical noise, Part 2-6: Particular requirements for tumble dryers: Applies to the methods of determination of airborne acoustical noise emitted by tumble dryers for household and similar use. This standard applies to single unit electric tumble dryers intended for placing on the floor against a wall, for building in or placing under a counter, a kitchen work-top or under a sink, for wall-mounting or for mounting

See: https://wfk-iaf.de/en/hygiene-and-microbiology/certification-of-laundries/ last viewed 13.9.2024.

on a counter. For the purpose of this standard, washer-dryer combinations, when operated as a dryer, are considered as a tumble dryer.

ISO 3744 (International)

ISO 3744:2010 Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane.

ISO 3744:2010 specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured on a surface enveloping the noise source (machinery or equipment) in an environment that approximates to an acoustic free field near one or more reflecting planes. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands or with frequency A-weighting applied, is calculated using those measurements. The methods specified in ISO 3744:2010 are suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001.

ISO 3744:2010 is applicable to all types and sizes of noise source (e.g. stationary or slowly moving plant, installation, machine, component or sub-assembly), provided the conditions for the measurements can be met.

The test environments that are applicable for measurements made in accordance with ISO 3744:2010 can be located indoors or outdoors, with one or more sound-reflecting planes present on or near which the noise source under test is mounted. The ideal environment is a completely open space with no bounding or reflecting surfaces other than the reflecting plane(s) (such as that provided by a qualified hemi-anechoic chamber), but procedures are given for applying corrections (within limits that are specified) in the case of environments that are less than ideal.

Information is given on the uncertainty of the sound power levels and sound energy levels determined in accordance with ISO 3744:2010, for measurements made in limited bands of frequency and with frequency A-weighting applied. The uncertainty conforms to ISO 12001:1996, accuracy grade 2 (engineering grade).

ISO 3746 (International)

ISO 3746:2010 Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane.

ISO 3746:2010 specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured on a surface enveloping a noise source (machinery or equipment) in a test environment for which requirements are given. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source with frequency A-weighting applied is calculated using those measurements. The methods specified in ISO 3746:2010 are suitable for all types

of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001. ISO 3746:2010 is applicable to all types and sizes of noise source (e.g. stationary or slowly moving plant, installation, machine, component or sub-assembly), provided the conditions for the measurements can be met.

The test environments that are applicable for measurements made in accordance with ISO 3746:2010 can be located indoors or outdoors, with one or more sound-reflecting planes present on or near which the noise source under test is mounted.

Information is given on the uncertainty of the sound power levels and sound energy levels determined in accordance with ISO 3746:2010, for measurements made with frequency A-weighting applied. The uncertainty conforms to that of ISO 12001:1996, accuracy grade 3 (survey grade).

ISO 4871 (International)

ISO 4871:1996 Acoustics – Declaration and verification of noise emission values of machinery and equipment.

Gives information on the declaration of noise emission values, describes acoustical information to be presented in technical documents and specifies a method for verifying the noise emission declaration.

ISO 9614 (International)

ISO 9614-2:1996 Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning.

Specifies a method for measuring the component of sound intensity normal to a measurement surface which is chosen so as to enclose the noise source(s) of which the sound power level is to be determined.

ISO 11204 (International)

ISO 11204:2010 Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a workstation and at other specified positions applying accurate environmental corrections.

ISO 11204:2010 specifies a method for determining the emission sound pressure levels of machinery or equipment, at a workstation and at other specified positions nearby, in any environment which meets certain qualification requirements. A workstation is occupied by an operator and may be located in open space, in the room where the source under test operates, in a cab fixed to the source under test, or in an enclosure remote from the source under test. One or more specified positions may be located in the vicinity of a workstation, or in the vicinity of an attended or unattended machine. Such positions are sometimes referred to as bystander positions. Emission sound pressure levels are determined as A-weighted levels. Additionally,

levels in frequency bands and C-weighted peak emission sound pressure levels can be determined in accordance with ISO 11204:2010, if required.

A method is given for determining a local environmental correction (subject to a specified limiting maximum value) to be applied to the measured sound pressure levels to exclude the effects of reflections from reflecting surfaces other than the plane on which the source under test is placed. This correction is based upon the mean sound pressure level on a measurement surface, the sound pressure level measured at a specified position, and either an environmental correction or the equivalent absorption area of the test room.

With the method specified in ISO 11204:2010 results of accuracy grade 2 (engineering grade) or accuracy grade 3 (survey grade) are obtained. Corrections are applied for background noise and, as described above, for the acoustic environment. Instructions are given for the mounting and operation of the source under test and for the choice of microphone positions for the workstation and for other specified positions. One purpose of the measurements is to permit comparison of the performance of different units of a given family of machines, under defined environmental conditions and standardised mounting and operating conditions.

The method specified in ISO 11204:2010 is suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001. The method specified in ISO 11204:2010 is applicable to all types and sizes of noise sources.

The type of test environment influences the accuracy of the determination of emission sound pressure levels. ISO 11204:2010 is applicable to an indoor or outdoor environment with one or more reflecting planes present, meeting specified requirements. These requirements on the room are less strict than those of ISO 11201, in particular regarding the acoustical quality of the environment. ISO 11204:2010 is applicable to workstations and other specified positions where emission sound pressure levels are to be determined.

Appropriate positions where measurements may be made include the following: a) workstation located in the vicinity of the source under test; this is the case for many industrial ma-chines and domestic appliances; b) work station within a cab which is an integral part of the source under test; this is the case for many industrial trucks and earth-moving machines; c) work station within a partial or total enclosure (or behind a screen) supplied by the manufacturer as an integral part of the source under test; d) work station partially or totally enclosed by the source under test – this situation may be encountered with some large industrial machines; e) bystander positions occupied by individuals not responsible for the operation of the source under test, but who may be in its immediate vicinity, either occasionally or continuously; f) other specified positions, not necessarily work stations or bystander positions.

The workstation may also lie on a specified path along which an operator moves.

3.1.4.5. Electromagnetic fields / Electromagnetic compatibility (EMC)

IEC 62233 (International)

IEC 62233:2005 Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure

Deals with electromagnetic fields up to 300 GHz and defines methods for evaluating the electric field strength and magnetic flux density around household and similar electrical appliances, including the conditions during testing as well as measuring distances and positions. Appliances may incorporate motors, heating elements or their combination, may contain electric or electronic circuitry, and may be powered by the mains, by batteries, or by any other electrical power source. Appliances include such equipment as household electrical appliances, electric tools and electric toys. Appliances not intended for normal household use but which nevertheless may be approached by the public, or may be used by laymen, are within the scope of this standard. This standard includes specific elements to assess human exposure:

- definition of sensor,
- definition of measuring methods,
- definition of operating mode for appliance under test,
- definition of measuring distance and position.

The measurement methods specified are valid from 10 Hz to 400 kHz. In the frequency range above 400 kHz and below 10 Hz appliances in the scope of this standard are deemed to comply without testing unless otherwise specified in IEC 60335 series.

IEC 61000 (International)

IEC 61000 Electromagnetic compatibility

- IEC 61000-3-2 ed3.2 Consol. with am1&2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase).
- IEC 61000-3-3 ed2.0: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection.

EN 50366 (European)

EN 50366:2003 Household and similar electrical appliances – Electromagnetic fields – Methods for evaluation and measurement

Several test methods by which the magnetic field emissions from products can be compared to the general public restrictions and levels over the frequency range of 10 Hz to 400 kHz.

EN 55014 (European)

EN 55014 Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus

- EN 55014-1:2007 Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus, Part 1: Emission (IEC/CISPR 14-1:2005)
- EN 55014-2:2009 Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus, Part 2: Immunity – Product family standard (IEC/CISPR 14-2:1997 + A1:2001 + A2:2008)

3.1.4.6. Gas

DIN 30682 (Germany)

DIN 30682:2021 Gas-appliances for laundry-machinery.

NF G45-106 (France)

NF G45-106 1997 Laundry equipment: Drying and ironing machine, rotating dryers, spinner-washers, with atmospheric burners of output not exceeding 120 kW using gaseous fuels.

Provides product definitions, an equipment classification and specifications for construction characteristics, operating and performance testing of gas laundry equipment.

3.1.5. Existing legislation and environmental labelling

This task aims to identify and screen relevant legislation applicable to the product group. It is divided into three parts (European legislation, Member State legislation, and third-country legislation) and is structured accordingly.

3.1.5.1. European legislation

Apart from the obvious environmental directives (Restriction of Hazardous Substances (RoHS) and Waste from Electrical and Electronic Equipment (WEEE) Directives, Packaging and Packaging Waste Regulation), relevant regulations could be those on building (e.g. developed under the Performance of Buildings Directive), on health and labour conditions (e.g. for air conditioners, copiers), minimum efficiency directives (boilers, refrigerators, ballasts etc.), regulations on product liability, safety, EMC etc. Also, EU Voluntary Agreements and already existing ecodesign standards (e.g. ECMA) for the sector or related sectors need to be identified. Finally, especially in a Business-to-Business (B2B) context, it needs to be described which quality requirements (e.g. ‘proven design’, maximum failure rate) are customary.

Machinery Directive (MD) 2006/42/EC, being replaced by Machinery Regulation (EU) 2023/1230

The new Machinery Directive 2006/42/EC (European Parliament and Council 2006) is a revised version of Directive 98/37/EC and is applicable since 29th December 2009. The Directive has the aim of harmonising health and safety requirements applicable to machinery, while ensuring the free circulation of machinery on the community market. Machinery is defined as "an assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application"[7].

The manufacturer or his authorised representative shall ensure that "a risk assessment is carried out for the machinery which he wishes to place on the market. For this purpose, he should determine which are the essential health and safety requirements applicable to his machinery and in respect of which he must take measures." In addition, obligations regarding the provision of technical documentation and of necessary information such as instructions as well as obligations regarding the processes of the DoC are defined. The CE marking should be recognised "as being the only marking which guarantees that machinery conforms to the requirements of this Directive. All other markings which are likely to mislead third parties as to the meaning or the form of the CE marking, or both, should be prohibited".

One of the objectives of the review of the MD was to clarify the borderline between the scope of the MD and the former Low Voltage Directive (LVD) 2006/95/EC20[8] (see further details below), now recast as Directive 2014/35/EU, in order to provide greater legal certainty (European Commission 2024b). Article 1 (2) (k) of the Machinery Directive lists the categories of low voltage electrical and electronic machinery that are excluded from its scope, amongst others 'household appliances intended for domestic use'. When such machinery has an electrical supply within the voltage limits of the LVD (between 50 and 1000 V for alternating current or between 75 and 1500 V for direct current), it must fulfil the safety objectives of the LVD. Whether a machine is to be considered a 'household appliance intended for domestic use' would depend on how the manufacturer has specified the machine in its DoC or product information (European Commission 2024b). In contrast, within this power rating, a machine specified by the manufacturer as intended for commercial or industrial use as well as machinery beyond these voltage limits would need to comply with requirements of the Machinery Directive. This is clarified in the Commission's guidance document: "Thus appliances for the housekeeping functions […] that are intended for commercial or industrial use are not excluded from the scope of the Machinery Directive" (European Commission 2024b).

The Machinery Directive therefore applies to all commercial and industrial washing machine and dryer categories as long as they are not intended for use in households and are also within the voltage range of the LVD (for the delimitation between machinery intended for household and professional use, see also **Section 3.1.3.1**).

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7 There are some additions to this definition, but these are not relevant for the device group under consideration here, as this is covered by the first definition.

8 Formerly Directive 73/23/EEC as amended.

Due to inadequacies and inconsistencies in the product coverage and conformity assessment procedures, the provisions of the Directive were improved and adapted and will repeal Directive 2006/42/EC with effect from 20 January 2027. Since rules setting out requirements for products within the scope of the Directive should be of uniform application for all operators across the Union, and not give room for divergent implementation by Member States, the Directive was replaced by a regulation (Regulation (EU) 2023/1230; European Parliament and Council 2023a, 2023b). Under the new Regulation:

- Household appliances intended for domestic use that fall under the scope of the LVD (2014/35/EU) are excluded from the new regulation, which means that the regulation – like the current Machinery Directive – does not apply to washing machines or clothes dryers intended for domestic use.
- Washing machines and clothes dryers intended for commercial or industrial use will therefore be in the scope of the new regulation starting from 20 January 2027 (European Parliament and Council 2023a, 2023b).

The Commission's guidance document clarifies the differentiation between industrial and commercial equipment in a similar manner, stating that "the criterion to be taken into account for determining the intended use is the use intended and stated by the manufacturer of the appliance in his product information or his DoC. Evidently, this statement must accurately reflect the foreseeable use of the product." (European Commission 2024b).

Low Voltage Directive (LVD) 2014/35/EU

The initial Low Voltage Directive 73/23/EEC was revised and recast as 2006/95/EC and later again as Directive 2014/35/EU (European Parliament and Council 2014b). It seeks to ensure that electrical equipment within certain voltage limits both provides a high level of protection for European citizens and enjoys a Single Market in the European Union.

The Directive requires electrical equipment to have protection against hazards that could arise from within the electrical equipment itself or from external influences. These principal elements of the safety objectives are set in Annex I to the Directive.

The LVD covers electrical equipment designed for use with a voltage rating of between 50 V and 1000 V for alternating current and between 75 V and 1500 V for direct current except for equipment and phenomena listed in its Annex II. It should be noted that these voltage ratings refer to the voltage of the electrical input or output, not to voltages that may appear inside the equipment (European Commission 2018a).

All washing machines and clothes dryers – intended for domestic use – that are within the corresponding voltage rating of the directive are therefore subject to its requirements.

Electromagnetic Compatibility (EMC) 2014/30/EU

The initial Directive 2004/108/EC has been revised and recast as Directive 2014/30/EU (European Parliament and Council 2014a) on the harmonisation of the laws of the Member States relating to electromagnetic compatibility. It regulates the electromagnetic compatibility

(EMC) of both apparatus and fixed installations. The Directive applies to most electrical and electronic apparatuses including washing machines and dryers, which are finished products and systems that include electrical and electronic equipment that may generate or be affected by electromagnetic disturbance.

The main objective of the EMC Directive, thus, is to regulate the compatibility of equipment regarding EMC. To achieve this objective, provisions have been put in place so that equipment needs to comply with the requirements of the EMC Directive when it is placed on the market and/or taken into service. On the one hand it must be ensured that the electro-magnetic emissions of this equipment in its intended use do not disturb radio and telecommunication as well as other equipment. On the other hand, the Directive also governs the immunity of such equipment to interference and seeks to ensure that this equipment is not disturbed by radio emissions normally present used as intended.

Restriction of Hazardous Substances Directive (RoHS) 2011/65/EU

Directive 2002/95/EC was reviewed and recast as Directive 2011/65/EU (European Parliament and Council 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (commonly referred to as the Restriction of Hazardous Substances Directive or RoHS). The Directive restricts the presence of the hazardous substances specified in its Annex II in various types of electrical and electronic equipment (EEE). It currently restricts 10 substances while a few additional substances are under consideration for future restriction.

The restrictions apply to EEE belonging to the categories set out in RoHS Annex I, which differ somewhat from those covered by the related Directive 2012/19/EU (WEEE). One of the categories of Annex I in scope of the RoHS Directive is category 1 'Large Household Appliances', covering inter alia washing machines and clothes dryers. Commercial or industrial machines not considered to be under category 1 would be expected to fall under category 11 for 'Other EEE not covered by any of the categories above' and thus to still be in scope. This is confirmed through the Commission's *Frequently Asked Questions* document (European Commission 2012) on RoHS and WEEE Directives which clarifies that commercial and industrial equipment is covered by the RoHS Directive[9].

According to Article 4(6) of the Directive, the Article 4(1) substance restrictions do not apply to the applications listed in Annexes III and IV. 5(1)(a) of the Directive provides that materials and components can be exempted from the substance restrictions if "their elimination or substitution via design changes or materials and components which do not require any of the materials or substances listed in Annex II is scientifically or technically impracticable", if "the reliability of substitutes is not ensured" or where "the total negative environmental, health and consumer safety impacts caused by substitution are likely to outweigh the total environmental, health and consumer safety benefits thereof".

[9] Based on FAQ 6.3 "Does RoHS 2 apply to EEE for professional and industrial use?", Answer: "Yes. RoHS 2, just as RoHS 1, does not distinguish between EEE for consumer use and EEE for professional and industrial use. In some cases, however specific exclusions (Article 2(4)) or timelines (Article 4(3), 4(4) and 4(5)) may apply."

Currently, there are close to 100 exemptions listed in Annex III and IV of the RoHS Directive[10]. The importance of existing exemptions for the scope of this study shall be investigated in later tasks. The Directive was recently subjected to a review process; however, the process has not concluded (status September 2024), and it cannot yet be estimated whether changes shall be introduced to RoHS or not.

Waste Electrical and Electronic Equipment Directive (WEEE) 2012/19/EU

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) was introduced as European Community Directive 2002/96/EC. Following a review, it was recast as Directive 2012/19/EU (European Parliament and Council 2012a) and regulates the collection, treatment, recycling and disposal of WEEE as well as the financial provisions for this waste stream's treatment. The Directive assigns the responsibility for the management of waste electrical and electronic equipment to the manufacturers of such equipment and partly also to the distributors.

Since 15 August 2018, the Directive has applied to all electrical and electronic equipment with the exception of the appliances listed in Article 2(3) and 2(4). All electrical and electronic appliances concerned are assigned to different categories in Annex III, including the category 'Large equipment (any external dimension more than 50 cm)'. According to Annex IV, this category includes washing machines and clothes dryers.

Large and complex machines such as tunnel washing machines could possibly be exempted from the Directive if they can be considered as 'large-scale fixed installations'. There is no clear definition in the Directive as to the size above which this is the case. There are also no clear criteria in the FAQ document for the WEEE Directive (European Commission 2014), but reference is made to the FAQ document for the RoHS Directive (European Commission 2012). There it is emphasised that the decision as to whether an installation is to be classified as 'large-scale' must be examined on a case-by-case basis and that the burden of proof lies with the economic operator. However, various criteria for the decision are also provided, including the possibility of transporting the installation in an ISO 20-foot container (5.71 m x 2.35 m x 2.39 m). If the sum of the parts of the machine is too large to be transported in such a container, it can be considered 'large-scale'. This may apply to large industrial washing systems. The other criteria for 'large-scale fixed installations' are set out in Article 3(1)(c) of the Directive:

"'large-scale fixed installation' means a large-size combination of several types of apparatus and, where applicable, other devices, which:

(i) are assembled, installed and de-installed by professionals;

(ii) are intended to be used permanently as part of a building or a structure at a pre-defined and dedicated location; and

[10] Exemptions listed under Annex IV only apply to medical devices and/or monitoring and control equipment (Category 8 and 9 respectively) whereas exemptions listed under Annex III can apply to all EEE. In both cases, the scope of an exemption can be further restricted to specific EEE categories, devices or components.

(iii) can only be replaced by the same specifically designed equipment".

Article 4 stipulates that Member States shall "encourage cooperation between producers and recyclers and measures to promote the design and production of EEE, notably in view of facilitating re-use, dismantling and recovery of WEEE, its components and materials." Furthermore, they shall "take appropriate measures so that the ecodesign requirements facilitating re-use and treatment of WEEE established in the framework of Directive 2009/125/EC are applied and producers do not prevent, through specific design features or manufacturing processes, WEEE from being re-used, unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and/or safety requirements." These specifications are not very specific, but this could change as a result of the coming review of the WEEE Directive to be launched shortly.

Article 8 of the Directive requires Member States to ensure that proper treatment of all separately collected WEEE takes place. This includes, among other things, the removal of all liquids and a selective treatment in accordance with Annex VII. Annex VII lists substances, mixtures and components that must be removed from the collected WEEE (e.g., batteries, mercury containing components and external electric cables). The design of the appliances should ideally take this into account, but the Directive does not make any direct statements on this though in some cases it is under the regime of other legislation (e.g., RoHS regarding mercury or the Batteries Regulation for batteries). Minimum recovery targets to be achieved by producers in accordance with Article 11 are listed in Annex 5 of the Directive.

Articles 12 and 13 refer to the financing of waste management of equipment in scope of the Directive. At present this however does not include fee-modulation which could have a more substantial impact on design. It is thus not further detailed here.

Critical Raw Materials Act – Regulation (EU) 2024/1252

The Critical Raw Materials (CRM) Act is a regulation aimed "to improve the functioning of the internal market by establishing a framework to ensure the Union's access to a secure, resilient and sustainable supply of critical raw materials, including by fostering efficiency and circularity throughout the value chain" (European Parliament and Council 2024).

To achieve this goal, the regulation sets out measures to:

a) "lower the risk of supply disruptions related to critical raw materials likely to distort competition and fragment the internal market,

b) improve the Union's ability to monitor and mitigate the supply risk related to critical raw materials, and

c) ensure the free movement of critical raw materials and products containing critical raw materials placed on the Union market while ensuring a high level of environmental protection and sustainability, including by improving their circularity."

Washing machines and clothes dryers are affected by the Regulation as they may contain critical raw materials and in particular permanent magnets which are specifically addressed by the Regulation. According to Article 28, a conspicuous, clearly legible and indelible label shall indicate whether the products contain one or more permanent magnets and whether the magnets contained belong to one of the following types: (i) neodymium-iron-boron; (ii) samarium-cobalt; (iii) aluminium-nickel-cobalt; (iv) ferrite. In case one or more such are included, additional information must be provided on a data carrier present on or in the product, providing data on the responsible legal party, data on the magnet weight, type and location and instructions for its dismantling.[11]

The requirements set out in Article 28 shall apply from two years after the entry into force of the implementing act referred to in paragraph 2. If a product passport is required for a product in accordance with another Union legal act, the relevant information should be recorded therein. The information needs to be complete, up-to-date, and accurate and remain available for a period at least equal to the product's typical lifetime plus 10 years.

Article 29 contains provisions on the recycled content of permanent magnets. The requirements shall apply from 24 May 2027 or two years after the still pending entry into force of the delegated act referred to in paragraph 2, whichever is the later. Article 29 obliges operators who place on the market products containing one or more permanent magnets in accordance with Article 28 (1) to publish on a on a free-access website the content of neodymium, dysprosium, praseodymium, terbium, boron, samarium, nickel and cobalt recovered from post-consumer waste that is present in the incorporated permanent magnets. The information obligation applies from a total weight of all permanent magnets contained of 0.2 kg. By 24 May 2026, the Commission shall adopt rules for the calculation and verification of the share of corresponding raw materials. Furthermore, the Commission shall adopt rules as to minimum shares of the raw materials neodymium, dysprosium, praseodymium, terbium, boron, samarium, nickel and cobalt recovered from post-consumer waste that must be present in the permanent magnet incorporated in relevant products referred.

According to Article 33, the requirements of Articles 28 and 29 must be taken into account in the conformity assessment procedure and the associated required technical documentation.

According to Article 24, by 24 May 2025, Member States are to identify large companies operating on their territory that use strategic raw materials to manufacture various products, including heat pumps. The companies identified in this way are obliged to carry out a specific risk assessment of their raw material supply chain for strategic raw materials at least every three years. Depending on the result, companies may be obliged to take mitigation measures. They can also be obliged by the Member States to submit a report to their board of directors. As there is a trend to include heat pumps in laundry appliances, this requirement could apply in some cases.

[11] If the incorporated permanent magnets are exclusively contained in one or more electric motors incorporated in the product, the information referred to may be replaced by information on the location of those electric motors.

Packaging Directive 94/62/EC; Regulation (EU) 2025/40 on Packaging and Packaging Waste (PPWR)

The purpose of the Packaging Directive (European Parliament and Council 1994) is to harmonise the rules on packaging and packaging waste management in order to prevent or reduce the environmental impact of such waste, thereby ensuring a high level of environmental protection and the functioning of the internal market. The current version of the Directive (including the amendments up to 2018) sets out measures aimed at the prevention, reuse, recycling and other forms of recovery of packaging waste and, as a result, a reduction in the final disposal of waste. “The Directive covers all packaging placed on the European market and all packaging waste, whether it is used or released at industrial, commercial, office, shop, service, household or any other level, regardless of the material used” (EUR-Lex 2024). On this basis it is concluded that packaging of commercial and industrial laundry appliances would be in scope of this legislation.

Though Article 4 of the Directive addresses prevention, it remains vague for most packaging aside form carrier plastic bags for which specific requirements have been included through the 2015 amendment of the Directive. Among other things, the Directive defines basic requirements for packaging (in accordance with Article 9 and detailed in Annex II) and stipulates that Member States shall take further preventive measures to avoid the generation of packaging waste and to minimise its environmental impact (in accordance with Article 11). Measures also concern reuse, recovery and recycling as well as return, collection and recovery systems. There are also labelling requirements for identifying and classifying the materials. Further requirements are defined, for example concerning the concentration levels of heavy metals and the provision of information to packaging users.

In November 2022, the Commission proposed to revise the Packaging and Packaging Waste Directive and has published a proposal for a Regulation on packaging and packaging waste. The shift from a Directive to a Regulation means among others that manufacturers are directly obligated by the legislation, as opposed to a Directive which needs to be transferred to National Legislation, thus obliging Member States to ensure that e.g., manufacturers adhere to specific requirements. New articles require all packaging to be recyclable, set recycled content targets for packaging relevant for the use of plastics, require the amount of packaging to be reduced as well as a shift to reusable packaging. The requirements for the design of packaging are more specific, detailed in articles 5-10 whereas in the former Directive many requirements remain vague in nature. These requirements affect manufacturers of packaging directly as specified in Article 13 of the Directive.

Regulation (EU) 2025/40 on Packaging and Packaging Waste (PPWR) entered into force on 11 February 2025 and applies from 12 August 2026, repealing Directive 94/62/EC.

Biocide Directive 528/2012/EU

The Biocide Directive 98/8/EC was reviewed and recast as Regulation (EU) No 528/2012 (European Parliament and Council 2012b) concerning the making available on the market and use of biocidal products. This Directive concerns:

a) the establishment at Community level of a positive list of active substances which may be used in biocidal products;

b) the authorisation of biocidal products;

c) the mutual recognition of authorisations within the Community;

d) the placing on the market for use of biocidal products within one or more Member States; and

e) the placing on the market of treated articles.

Seeing as detergents are a separate prioritised product group under ESPR, these aspects are considered out of scope of this study, however for the case that biocidal products are used in wood materials used in the packaging of appliances (to be confirmed), a short summary has been included.

A biocidal product is defined as “any substance or mixture, in the form in which it is supplied to the user, consisting of, containing or generating one or more active substances, with the intention of destroying, deterring, rendering harmless, preventing the action of, or otherwise exerting a controlling effect on, any harmful organism by any means other than mere physical or mechanical action” or “any substance or mixture, generated from substances or mixtures which do not themselves fall under the first indent, to be used with the intention of destroying, deterring, rendering harmless, preventing the action of, or otherwise exerting a controlling effect on, any harmful organism by any means other than mere physical or mechanical action”. Treated articles that have a primary biocidal function shall be considered biocidal products as well.

Regulation (EU) 2016/426 – Gas Appliances

The former Gas Appliance Directive 2009/142/EC (GAD) was repealed by Regulation (EU) 2016/426 on appliances burning gaseous fuels (European Parliament and Council 2016). It regulates appliances burning gaseous fuels used for cooking, refrigeration, air-conditioning, space heating, hot water production, lighting or washing, and also forced draught burners and heating bodies to be equipped with such burners.

The Regulation applies to all gas heated and combined gas-heated applications. Although the Regulation mainly covers common consumer and commercial products, so-called fittings are covered too. Appliances “specifically designed for use in industrial processes carried out on industrial premises”, are excluded.

According to the Commission's guidance document, the regulation applies to washing machines and tumble dryers, with the exception of industrial laundry (European Commission 2024a). While appliances that are specifically intended for use in industrial processes in industrial plants have been excluded from the scope of the regulation, there are nevertheless numerous commercial applications that do not fall under industrial processes and are therefore affected by the regulation (e.g. laundries in hospitals, larger washing machines on camping sites, etc.).

The Regulation obliges manufacturers to ensure that appliances or fittings that they place on the market or appliances that they use for their own purposes are designed and manufactured in accordance with the essential requirements set out in Annex I. This includes, among other things, safety requirements including a risk analysis and corresponding risk minimisation measures as well as information obligations. In addition, there are requirements regarding technical documentation and processes for the DoC, as well as for the provision of information (e.g. the affixing of a type, batch or serial number or other identification mark, manufacturer's details, instructions for use and safety information).

Water Framework Directive 2000/60/EC

The Water Framework Directive 2000/60/EC (WFD (2000/60/EC)) establishes a legal framework to protect and restore clean water across Europe and ensure its long-term, sustainable use. The directive establishes an innovative approach for water management based on river basins, the natural geographical and hydrological units, and it sets specific deadlines for Member States to protect aquatic eco-systems. The directive addresses inland surface waters, transitional waters, coastal waters and groundwater, and it establishes innovative principles for water management, including public participation in planning and economic approaches, including the recovery of the cost of water services.

Inter alia, the WFD (2000/60/EC) introduces two key economic principles. First, it calls on water users – such as industries, farmers and households – to pay for the full costs of the water services they receive. This is established in Article 9 of the Directive.

Second, the Directive calls on Member States to use economic analysis in the management of their water resources and to assess both the cost-effectiveness and overall costs of alternatives when making key decisions. According to the Directive, the prices users pay for water should cover the operational and maintenance costs of its supply and treatment and the costs invested in infrastructure. The Directive further requires that prices also cover environmental and resource costs. This is a key step towards implementing the economic principle that polluters and users should pay for the natural resources they use and the damage they create.

Further, Articles 4, 10, 11 and 16 and Annexes V, VIII, IX and X of the Directive address chemical pollution. By targeting priority substances, the Water Framework Directive focuses on individual pollutants or groups of pollutants that present significant risk to or via the aquatic environment. The Member States and the European Parliament and the Council are required to implement measures to progressively reduce pollution from priority substances and to cease or phase out discharges, emissions and losses of priority hazardous substances. Priority hazardous substances are to be phased out completely within 20 years. It is assumed that these substances would only be contained in the discharges of laundry appliances if used in the detergents applied during washing processes. As explained above, it is assumed that detergents are out of scope of this review, thus the priority substances have not been checked to establish their use in detergents.

Commission Regulation (EC) No. 517/2014 – Fluorinated GHG

Fluorinated gases are powerful greenhouse gases (GHG) with global warming potentials many times that of natural greenhouse gases such as carbon dioxide. They also tend to remain much longer in the atmosphere than natural greenhouse gases. Because of this, they are included in the basket of gases controlled by the Montreal Protocol and all 197 Parties to the Protocol have strict consumption and production reduction targets.

Fluorinated gases are man-made substances and Regulation (EU) 517/2014 defines them as follows: 'fluorinated greenhouse gases' means "the hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and other greenhouse gases that contain fluorine, listed in Annex I, or mixtures containing any of those substances".

The former Regulation (EC) No. 842/2006 was repealed by Regulation (EU) 517/2014 (European Parliament and Council 2014d). In turn, a new Regulation applies from 11 March 2024 (Regulation (EU) No 2024/573).

The objective of this Regulation is to protect the environment by reducing emissions of fluorinated greenhouse gases. To achieve this objective, it

(a) "establishes rules on containment, use, recovery and destruction of fluorinated greenhouse gases, and on related ancillary measures;
(b) imposes conditions on the placing on the market of specific products and equipment that contain, or whose functioning relies upon, fluorinated greenhouse gases;
(c) imposes conditions on specific uses of fluorinated greenhouse gases; and
(d) establishes quantitative limits for the placing on the market of hydrofluorocarbons.".

This includes provisions concerning the labelling and disposal of products and equipment containing those gases; the reporting of information on those gases; the control of uses and the placing on the market prohibitions of the products and equipment; and the training and certification of personnel and companies involved in activities provided for by this Regulation. Annex I to this Regulation contains a list of the fluorinated greenhouse gases currently covered by this Regulation, together with their global warming potentials.

Requirements that are particularly relevant with regard to the design of devices are provisions on labelling. Article 12 specifies that "products and equipment that contain, or whose functioning relies upon, fluorinated greenhouse gases shall not be placed on the market unless they are labelled.". This only applies to certain products, including heat pumps. The required labelling must contain specific information detailed in article 12. For commercial and industrial washing machines and dryers, this Regulation applies in those cases when the appliances are equipped with heat pumps containing refrigerants.

Producers of fluorinated compounds are obliged to take all necessary precautions to limit emissions of fluorinated greenhouse gases to the greatest extent possible. This concerns production, transport and storage.

Article 11 prohibits the placing on the market of the products and equipment listed in Annex III. These include, inter alia: "Non-refillable containers for fluorinated greenhouse gases used to service, maintain or fill refrigeration, air-conditioning or heat-pump equipment, fire protection

systems or switchgear, or for use as solvents" (Date of prohibition: 4 July 2007)[12] The same article specifies that "non-hermetically sealed equipment charged with fluorinated greenhouse gases shall only be sold to the end user where evidence is provided that the installation is to be carried out by an undertaking certified in accordance with Article 10". Conversely, fluorinated greenhouse gases in heat pumps must be contained in hermetically sealed components if they are contained in appliances that are not installed by specialised personnel (this applies to household appliances, for example).

Article 12 lays down provisions on labelling as well as on product and equipment information. It specifies that "products and equipment that contain, or whose functioning relies upon, fluorinated greenhouse gases shall not be placed on the market unless they are labelled." This applies to certain products, including heat pumps. The mandatory labelling must include information on the presence of fluorinated greenhouse gases, the accepted industry designation or chemical name, quantities used or intended to be used, associated CO_2 equivalents and the global warming potential. Where applicable, it must also contain a reference that the fluorinated greenhouse gases are contained in hermetically sealed equipment and information on the tested leakage rate of electrical switchgears and compliance with limit values. This information must also be included in instruction manuals for the products and equipment concerned. If products and equipment contain fluorinated greenhouse gases with a global warming potential of 150 or more this information must also be included in descriptions used for advertising. There are also specifications as to where and how the labelling must be affixed.

Article 14 sets out requirements for the prefilling of equipment (e.g. heat pumps) with hydrofluorocarbons that are related to the quota system: "From 1 January 2017 refrigeration, air conditioning and heat pump equipment charged with hydrofluorocarbons shall not be placed on the market unless hydrofluorocarbons charged into the equipment are accounted for within the quota system referred to in Chapter IV." This results in documentation and control obligations for the manufacturers and importers of such equipment. By issuing the DoC, manufacturers and importers are responsible for compliance with the relevant regulations.

Chapter 4 defines requirements regarding the quantities of hydrofluorocarbons placed on the market, the associated quota system and the registration process and transfer of quotas.

Chapter 5 contains provisions on reporting obligations regarding production, import, export, feedstock use, and destruction of the substances listed in Annexes I or II.

Commission Regulation (EC) 1275/2008 – Standby

The Regulation (EC) No. 1275/2008 (European Commission 2008), according to its latest amendment of 1 March 2021, sets out eco-design requirements for the electric power consumption in standby and off mode and for networked standby. According to the latest

[12] The prohibition does not apply "to equipment for which it has been established in ecodesign requirements adopted under Directive 2009/125/EC that due to higher energy efficiency during its operation, its lifecycle CO2 equivalent emissions would be lower than those of equivalent equipment which meets relevant ecodesign requirements and does not contain hydrofluorocarbons.".

amendments, it applies to electrical and electronic household and office equipment. Equipment placed on the market with a low voltage external power supply (less than 6 volts)[13] to work as intended is excluded from the Regulation.

'Electrical and electronic household and office equipment' is defined as energy-using products which:

a) Are made commercially available as a single functional unit and are intended for the end-user,
b) Fall under the list of energy-using products of Annex I (inter alia clothes dryers),
c) Are dependent on energy input from the mains power source in order to work as intended, and
d) Are designed for use with a nominal voltage rating of 250 V or below, also when they are marketed for non-household or non-office use.

In the original version of the Regulation, washing machines and clothes dryers were listed in Annex I and therefore fell within the scope of the Regulation. However, following the amendment by Commission Regulation (EU) 2019/2023 of 1 October 2019, washing machines – unlike clothes dryers – are no longer listed in Annex I and are therefore no longer covered by the Regulation.

Clothes dryers for domestic use therefore remain within the scope of the regulation. They are therefore subject to the ecodesign requirements set out in Annex II (including the availability of off mode and/or standby mode and specifications on the corresponding power consumption). Commercial and industrial clothes dryers, on the other hand, are not intended for end users and therefore do not fall within the scope of application.

Regulation (EC) No 1275/2008 was repealed by Regulation (EU) 2023/826 of 17 April 2023 with effect from 9 May 2025. The new Regulation applies to 'tumble dryers and other laundry dryers' if they are designed, tested and placed on the market for household use and if they are not covered by Regulation (EU) 2019/2023 (concerning washer dryers). As for dryers intended for domestic use, even in cases where these are used for commercial or industrial purposes (e.g., in some cases at camping grounds), as they are intended by the manufacturer for domestic use, they would be out of scope of this study. In that sense it seems that the Regulation is not relevant for commercial and industrial laundry machines to fall under future ESPR legislation.

Regulation (EC) No. 1907/2006 – REACH

The REACH Regulation (EC) No 1907/2006 concerns the registration, evaluation, authorisation, and restriction of chemical substances. Its purpose is to ensure a high level of protection of human health and the environment, as well as the free circulation of substances on the internal market while enhancing competitiveness and innovation. It lays down provisions on certain substances as well as mixtures. The provisions shall apply "to the manufacture, placing on the market or use of such substances on their own, in mixtures or in

[13] 'Low voltage external power supply' is defined as "an external power supply with a nameplate output voltage of less than 6 volts and a nameplate output current greater than or equal to 550 milliamperes".

articles and to the placing on the market of mixtures". Hazardous substances that are relevant for commercial or industrial laundry appliances will be analysed in later tasks of this preparatory study (Substances of Concern as addressed in the ESPR).

Radio Equipment Directive (RED) 2014/53/EU

The former Radio and Telecommunications Terminal Equipment Directive 1999/5/EC was repealed by the Radio Equipment Directive (RED) 2014/53/EU (European Parliament and Council 2014c). The RED establishes a regulatory framework for the making available on the market and putting into service in the Union of radio equipment. 'Radio equipment' is defined as "an electrical or electronic product, which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radiodetermination, or an electrical or electronic product which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radiodetermination". A guidance document provided by the Commission (European Commission 2018b) makes statements on 'non-radio electrical products functioning with radio equipment': "Electrical or electronic products whose function is not to intentionally emit or receive radio waves for the purpose of radio communication and/or radiodetermination (in this section referred to as 'non-radio product') may function with radio equipment". According to the document, such products are within the scope of RED, if "the radio equipment is (a) incorporated into the non-radio product; and (b) permanently affixed to the non-radio product".

This can be the case with 'smart' washing machines and dryers if they have WLAN, Bluetooth or other NFC interfaces for control via a smartphone, for example. In this case, they must comply with the requirements of the Directive, for example, they must be manufactured in such a way that they fulfil the essential requirements in Article 3.6.

European labelling

There is no EU-wide mandatory measure regarding the efficiency of commercial or industrial washing machines and dryers: The EU Ecolabel covers detergents but not washing machines or clothes dryers (European Commission o. J.).

Best Environmental Management Practices for Tourism addressing laundry operators, part of the European EMAS Program

Since 2016, under the European Commission EMAS programme, optimised large-scale or outsourced laundry operations are addressed by Best Environmental Management Practices (BEMP) for Tourism (EU 2016). This requires EMAS-registered organisations in the tourism sector to take the relevant sectoral reference documents into account.

BEMPs addressing optimised large-scale or outsourced laundry operations: The BEMP requires the facility to select an efficient laundry service provider that is certified by an ISO Type I ecolabel (e.g., Nordic Swan or equivalent), to ensure that on-site large-scale laundry operations comply with the criteria specified therein (see **Table 3-6**). Furthermore, the BEMP details several performance indicators and their considered benchmark of excellence,

referring to indicators related to water and energy consumption as well as the use of eco-labelled detergents.

Table 3-6: Specific criteria for large-scale or outsourced laundry operations in tourism facilities.

Environmental performance indicators	Benchmark of excellence
Water consumption per kg of laundry (l/kg)	Total water consumption over the complete wash cycle of large-scale laundry operations of ≤ 5 L per kg textile for accommodation laundry and ≤ 9 L per kg textile for restaurant laundry.
Energy consumption per kg of laundry (kWh/kg)	Total process energy consumption for dried and finished large-scale laundry products of ≤ 0.90 kWh per kg of textiles for accommodation laundry and ≤ 1.45 kWh per kg of textiles for restaurant laundry.
Percentage of eco-labelled laundry detergents (%)	For large-scale laundry operations, exclusive use of laundry detergents for professional use compliant with an ISO Type I ecolabel (e.g. EU Ecolabel, Nordic Swan), applied in appropriate doses.

Source: Reproduced from EU (2016)

Though these requirements are relevant for laundromats using commercial laundry appliances, it is understood to refer to the total consumption of the facility and not to consumptions at machine level.

3.1.5.2. Legislation at Member State level

This section deals with the subjects as above, but for legislation that has been indicated as being relevant at the Member State level.

France

In France, planned obsolescence is prohibited under Article L441-2[14] of the "Code de la Consommation". Planned obsolescence is defined there as the use of techniques – including software – by which the person responsible for placing a product on the market deliberately seeks to shorten its lifespan. Articles L441-3 and L441-4[15] lay down prohibitions on the use of techniques that prevent the repair of devices or that restrict the access of specialised personnel (for repair, reuse or repurpose) to spare parts, instructions, technical information or other tools necessary for the repair of products. The Article does not specify if it is also applicable to appliances not intended for the use in households.

According to Article 79[16] of the "LOI n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire", new washing machines must be equipped with a filter for microplastics from January 1, 2025. Detailed requirements are to be set out in a decree

[14] https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000044330817/2021-11-17/
[15] https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000044330859/2021-11-17; https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000044330822/2021-11-17.
[16] https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000041553844

yet to be issued. The Article does not specify if it is also applicable to appliances not intended for the use in households. There are discussions about applying such a regulation at EU level (European Parliament 2020; Microplasticsolutions.org 2023).

Article 16[17] of the same law imposes an obligation on manufacturers, importers, distributors or other distributors of electrical equipment to provide a reparability index, including the parameters that made it possible to create this index. Sellers are obliged to use this index to inform customers about the repairability of products. This regulation already applies to washing machines (Ministère de l'économie des finances et de la souveraineté industrielle et numérique 2024). From 1 January 2024, a more general durability index will be defined for certain products. It will replace the reparability index for these products and also evaluate other indicators such as the reliability and robustness of the products[18]. Washing machines are one of two product groups for which the index was introduced first (Ministère de la Transition écologique et de la Cohésion des territoires 2024). As the aim of the indexes is to inform consumers, the regulation is considered relevant only for appliances intended for household use.

Nordic Swan (Scandinavia)

Nordic Swan (Scandinavia) has a few schemes related to laundry[19]:

- Nordic Ecolabelling for Textile services: specifies various criteria that laundries applying for the label need to comply with. Some of the criteria require a minimum level of performance, e.g., in relation to consumption of energy, water etc., however these are referenced to the complete laundromat as an establishment and not specified at the level of the single machine. In so far, the label is considered less relevant for this study.
- Nordic Ecolabelling for Laundry detergents for professional use[20]: The criteria refer to the constituents of the detergent itself in relation to hazardous properties. Criteria are also specified in relation to the packaging used for detergents and other requirements, however these cases are not considered to be in the realm of control of commercial or industrial laundry machine manufacturers. This label is thus also not considered to be relevant for this study.

Blue Angel (Germany) Ecolabel Schemes

The German Blue Angel addresses the same products (textile services[21] and laundry detergents[22]), but again fails to specify criteria directly related to laundry machines (neither domestic nor non-domestic).

17 https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000041553781
18 https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000041553781
19 For further details see: Nordic Ecolabelling 2024c.
20 For further details see: Nordic Ecolabelling 2024b.
21 For further details see: RAL gGmbH 2021.
22 For further details see: RAL gGmbH 2022.

Czech Environmentally Friendly Products label

The Czech Ecolabel does not currently cover washing machines or clothes dryers, either at household or industrial level (Czech Ministry of Environment).

SEAI Scheme for accelerated capital allowance

The Sustainable Energy Authority of Ireland (SEAI) has established incentives to encourage businesses to invest in energy saving technologies[23]. In the form of an accelerated capital allowance (ACA), businesses purchasing energy label A commercial laundry devices are eligible for a tax benefit, aside from the related energy savings associated with such equipment. The ACA scheme allows purchasing companies that pay corporation tax or income tax on trading or professional income in Ireland to deduct the full cost of the equipment from their profits in the year of purchase (as opposed to the standard deductions spread over a longer period). On this basis, the SEAI has published documents with criteria for 'Commercial Laundry Washers'[24] and for 'Commercial Laundry Dryers'[25].

Commercial laundry washers are defined as 'products that automatically use mechanical motion to clean laundry such as clothes, towels, sheets, etc, and use water as the primary washing solution'. To be eligible for the tax benefit, the purchased washer must:

- Have a load capacity ≥ 10 kg,
- Have a European Energy Label rating of A or equivalent (i.e., in kWh per kg dryer load) in relation to:
  - Energy consumption: ≤ 0.15 kWh per kg wash load, and
  - Have a washing efficiency Index of ≥ 1.03.
- The rating should be determined using the Standard 60 °C cotton cycle as set out by EN 60456 Clothes washing machines for household use - Methods for measuring the performance.

Commercial laundry dryers are defined 'as products that automatically use mechanical motion and a heat source to dry laundry such as clothes, towels, sheets, etc.'. To be eligible for the tax benefit, the purchased dryer must:

- Have a load capacity > 14 kg,
- Have a European Energy Label rating of A or equivalent (i.e., in kWh per kg dryer load):
  - Of ≤ 0.51 kWh/kg in the case of an air vented dryer, or
  - Of ≤ 0.55 kWh/kg in the case of a condensing dryer,
- The rating should be determined based on EN 61121: Tumble dryers for household use - Methods for measuring the Performance,

[23] For further details, see: Sustainable Energy Authority of Ireland n. d..
[24] See: Sustainable Energy Authority of Ireland o. J.b.
[25] See: Sustainable Energy Authority of Ireland o. J.a.

- have a moisture sensing element that will automatically turn off the machine once the load is dry.

Though this scheme is relevant only for commercial machines, it is of interest that the standards referred to address household machines and not (necessarily) commercial ones. Nonetheless, the definitions are of interest as a means of understanding what devices are regarded as non-domestic ones from a financial perspective.

European consumer association tests and consumer information portals

There are organisations in various countries that publish test reports for household appliances (e.g., *Stiftung Warentest* in Germany, *Que choisir* in France, *Altroconsumo* in Italy or *OCU* in Spain). It is assumed that these are only aimed at private users and are therefore not relevant in the context of this study.

3.1.5.3. Third country legislation

Again, this section deals with the subjects as above, but for legislation and measures in Third Countries (extra-EU) that have been indicated by stakeholders (NGOs, industry, consumers) as being relevant for the product group.

Appliance and Equipment Standards Program (USA)

(Formerly known as the Energy conservation standards)

The Building Technologies Office (BTO) implements minimum energy conservation standards for more than 60 categories of appliances and equipment. The programme provides a resource to help consumers make informed decisions in product selection aimed at saving them energy and money. A document exists for commercial clothes washers since 2007 (U.S. Department of Energy 2022) and manufacturers are required to comply with it for appliances in scope. The definition for commercial clothes washers is based on the Code of Federal Regulations (CFR) and defines the scope as follows:

"*'commercial clothes washer' means a soft-mounted front-loading or soft-mounted top-loading clothes washer that:*

(1) Has a clothes container compartment that

> *(i) For horizontal-axis clothes washers, is not more than 3.5 cubic feet, and*
>
> *(ii) For vertical-axis clothes washers, is not more than 4.0 cubic feet, and*

(2) Is designed for use in:

> *(i) Applications in which the occupants of more than one household will be using the clothes washer, such as multifamily housing common areas and coin laundries, or*
>
> *(ii) Other commercial applications*".

The standard contains energy and water consumption requirements which are specified differently depending on the year of manufacture of the specific model and its class. In each case a factor is referred to which is a result of the total consumption divided by the drum volume.

Table 3-7: Minimum energy and water factors that need to be complied with.

Commercial clothes washer class	Modified energy factor (MEF): cu. ft./kWh/cycle	Water factor (WF): gal./cu. ft./cycle
Manufactured on or after January 8, 2013, and before January 1, 2018: **Top-Loading**	1.60	8.5
Manufactured on or after January 1, 2018: **Top-Loading**	1.35	8.8
Manufactured on or after January 8, 2013, and before January 1, 2018: **Front-Loading**	2.00	5.5
Manufactured on or after January 1, 2018: **Front-Loading**	2.00	4.1

US ENERGY STAR Label

ENERGY STAR® is a US government-backed symbol for energy efficiency. The label provides information to help consumers and businesses make well-informed decisions. The US EPA Energy Star programme has a product specification for clothes washers which is currently in its 8th version (US EPA 2018). Certification to this label requires the manufacturer of a laundry appliance to comply with the eligibility criteria, which define the minimum performance requirements and test procedures for verifying a minimum level. The requirements apply to household washers and washer dryers, to commercial dryers (see following definition) as also to laundry centres.

A commercial washer is defined as "*a soft-mounted front-loading or soft-mounted top-loading clothes washer that is designed for use in applications in which the occupants of more than one household will be using the clothes washer, such as multi-family housing common areas and coin laundries*". This definition is understood to apply to situations where commercial washers are installed in public settings to serve private consumers, implying that they are operated by laypersons. The drum volume is limited for such commercial washers to in between 1.6 and 8.0 cubic feet, corresponding to an average load of 1.61-8.07 kg. Top loading design washers are excluded from applicability despite the above definition or in other words, only front-loaded washers could be certified with Energy Label. Energy and water factors are specified (the total consumption divided by the appliance capacity: 2.2 and 4.0 respectively) and provide a minimum level of performance that needs to be achieved, with allowances given for connected devices. Requirements are also specified for connected devices, such as the location of the related components, the protocols for use in communication to allow interoperability, remote management requirements,

There are also Energy Star requirements for clothes dryers (US EPA 2017). These define:

"*Commercial Clothes Dryer: An electric or gas clothes dryer that is designed for use in:*

1. Applications in which the occupants of more than one household will be using the clothes dryer, such as multi-family housing common areas and coin laundries; or

2. Other commercial applications".

However, commercial clothes dryers are excluded from eligibility and requirements are thus not further detailed here.

Australia Energy Rating

A wide range of products are regulated for energy efficiency in Australia. Also, new products are continually being considered for regulation or other types of programs in order to improve energy efficiency. Though standards exist for household clothes dryers (Australian Government 2015) and household clothes washers, at this time they do not cover commercial or industrial appliances.

China Standard Certification Center

Over the past several years, CSC[26] has introduced various product certification programmes to promote the use of energy-conserving, water-conserving, and environmentally friendly products and equipment. CSC's energy conservation certification programs now cover over 35 product categories, including home appliances, electronics, industrial products, office equipment, and building materials. To date, more than 2,000 individual products from approximately 250 manufacturers have participated in the certification programme. However, no information on commercial or industrial washing machines and dryers has been found.

Thai Green Label

The Green Label is an environmental certification logo awarded to specific products which have less detrimental impact on the environment in comparison with other products serving the same function. The Thai Green Label has developed criteria for laundry and dry-cleaning services focusing on limiting the use of water, waste water reduction (Thailand Environment Institute 2013). The criteria apply to laundry services and dry-cleaning services with registered trade, factory, service in hotels and hospitals. Based on the label definitions, laundry service refers to the service that offers to clean customers' clothes using water and laundry agents to remove stains or dirt. The requirements address the service provider and not the appliances (at least not for laundry services). For example, they require the client to load the machine to at least 80 % of its load capacity. Requirements of relevance for appliances addressed in this study are not included.

[26] The China Standard Certification Center (CSC) was officially founded in October 1998, by the former China State Economic and Trade Commission (SETC) with an approval from the former State Bureau of Quality and Technical Supervision. CSC has been administrated by China National Institute of Standardisation.

3.1.6. Conclusions as to the scope of the study

In the various sections of the above chapter, an effort was made to address the various uncertainties of the categorisation established in the 2011 preparatory study (Graulich et al. 2011).

Though numerous technical parameters were investigated in this respect, it was concluded that these usually do not provide a clear-cut **differentiation** between **household appliances** and **those intended for commercial or industrial use**. The only aspect that provided a differentiation between these two groups is considered the intended use prescribed by the manufacturer as part of the appliance approbation and which is embodied in related declarations of conformity. This is also understood to be reflected in the Machinery Directive (and the new Regulation to apply as of 2027) and the Low Voltage Directive and how they differentiate between household appliances and those intended for use in other segments. For this reason, a first differentiation of the sector is proposed through the reference to household and commercial/industrial appliances. These terms are not intended for the update of existing standards but rather for legislative purposes. They are meant to establish clarity that:

- appliances intended for household purposes will continue to be addressed by the existing Ecodesign and Energy Label Regulations, i.e., 2019/2023/EU and 2019/2014/EU respectively and their future versions, whereas
- appliances intended for commercial or industrial purposes are in the scope of the current study and could be regulated in the future by legislation that would result from its conclusions and recommendations.

Looking into the commercial and industrial segments of laundry appliances in the context of possible legislation raises a need for further differentiations.

As raised by stakeholders, the next distinction between appliances that use **batch operation** and those using **continuous operation** is quite straightforward and reflected well in the separation between commercial and industrial appliances. To the consultants understanding of the market, all appliances or rather machinery that operates continuously is intended by manufacturers as industrial equipment. Nonetheless, it is not the case that all batch appliances can be considered as commercial appliances. This is evident among others also in standardisation where separate documents exist for e.g., commercial washer extractors and industrial ones. The same is true for e.g., tumble dryers.

With the differentiation between industrial and commercial appliances in mind, a few industrial manufacturers have proposed a differentiation by load capacity, referring to the threshold of 40 kg above which they consider appliances to be in the industrial segment. Commercial manufacturers do not follow this differentiation, and it is also not reflected in their standards that in some cases explicitly refer to appliances with higher capacity loads. This also raises a need to ensure clarity for possible future ESPR legislation, as should performance requirements be developed for e.g., washer extractors, it would need to be clarified whether the use of separate standards is justified, for example due to differences in lifetime and durability, or not. Another stakeholder (2024) referred to this aspect, stating that:

"Manufacturers should be able to declare the machine as industrial or commercial due to intended use and report performance data according to the corresponding performance standard industrial or commercial.".

Looking further at the categorisations of laundry appliances, it seems that all stakeholders agree that functional differentiation is relevant. This would include:

- For washing machines:
  - Washer extractors
  - Washer-dryers
  - Barrier washers
  - Tunnel machines

From the different exchanges it has been concluded that all multi-drum washers in the commercial and industrial segments would either fall under the category of barrier washers or of tunnel machines. It is thus not intended to add a separate category for other washers with multiple drums unless new information is to be brought forward by stakeholders.

- For dryers:
  - Condenser dryers
  - Air vented dryers
  - Cabinet dryers
  - Tumble dryers
  - Pass through dryers

Multiple stakeholders stated that condenser dryers and air vented dryers are different types of tumble dryers and suggested to either omit the reference to tumble dryers or to the two types. A further option could be to refer to tumble dryers and include the two types as sub-groups, thus also applying to any other types of tumble dryers should these be relevant. It seems that when heat pumps are added to the above appliances, they should still be in the same categories. This preparatory study will investigate their energy use and performance in the next stages, but the study team does not see a need to create new categories.

Finally, the market volume of some of the functional categories is rather large. In addition, from previous experience, the consultants are aware that there is often advantage to scale in appliances in terms of accomplishing performance requirements. In this sense, it can be followed that the current performance standards apply evenly to the functional categories regardless of capacity load. However, it cannot yet be excluded that there would be differences in the ease of compliance depending on size. In parallel, professional customers have preferences for purchasing a large or small appliance that depend on their expected laundry through-put and the related efficiency of operating full-loaded cycles. It is in other words clear that there is a need for machines of different sizes, i.e., both larger and smaller appliances, to be made available on the market. The need for inclusion of sub-categories in the cases of

washer extractors and tumble dryers was thus also discussed with stakeholders in this preparatory study. Past categories addressed in the categorisation differentiated between:

- Appliances with a load capacity < 15 kg,
- Appliances with a load capacity equal or higher than 15 kg and equal or lower than 40 kg,
- Appliances with a load capacity > 40 kg,

These categories are viewed by some stakeholders as arbitrary, and they stated a need that this categorisation and the question if other values would be more suitable shall be discussed during this preparatory study or possibly when requirements are proposed. In this respect, APPLiA (2024) suggests that commercial washers are typically to be tested according to the EN 50640 standard. For very large washers APPLiA suggests that the manufacturer could either test the washer in a laboratory according to EN 50640 or in-situ according to EN 17116:4. This is explained to be due to the high level of customisation of larger machines, the smaller series of production and the problem of testing very large washers in laboratories due to space limitations. It is however clarified that in cases where measurement results are determined using different methods, they will not be comparable with results of measurements based on other standards.

Similarly, in the 2011 preparatory study categories ‘semi-professional’ washer extractors were in a category of their own. They have been explained to have a lower durability than that of other commercial or industrial appliances and here the question is to be discussed if this specification could be achieved through other means, e.g., through a reference to capacity load or other parameters.

In this respect, APPLiA (2024) states that light duty commercial appliances could be part of the commercial appliances when related specifications are required e.g. durability, reliability, (expected cycles). Another stakeholder (2024) stated that the only difference between light duty commercial and commercial machines is in relation to their durability. A small business such as a hair saloon does not need a washer that can run continuously for 10 years and therefore does not want to pay for that durability and robustness. In contrast, a household washing machine would not last long enough and be too expensive in the long run. Therefore, there is a need for a machine with a durability between these two categories.

3.1.7. Categorisation proposed following the stakeholder meeting of 30 September 2024

On 30 September 2024 a hybrid meeting was held in Brussels with stakeholders participating in person and online, to verify the initial results presented in this report. Among others, the aspects raised in the last section were discussed as well as further aspects related to the scope of laundry appliances and machines to be covered by this study and resulting legislation. The categorisation of laundry product groups has been revised and simplified following the meeting (The term ‘professional’ was still used at the stakeholder meeting; in the course of finalising this study, it has now been replaced by ‘commercial’ or ‘industrial’. Further, later stakeholder feedback suggested to replace the term ‘semi-‘ in categories WM1 and D1

by ‘light duty’. Finally, it was suggested to add the term ‘commercial’ to the category D3 Cabinet Dryer). Some explanations follow to clarify the intention of proposed changes for some categories.

- Commercial and industrial washing machines (WM) categories:
  - WM1: Light duty commercial washer extractor
  - WM2: Commercial washer extractor (designed for extra-long durability)
  - WM3: Commercial washer dryer
  - WM4: Commercial barrier washer
  - WM5: Industrial continuous tunnel washer

During the meeting, stakeholders expressed the need to differentiate between WM1 appliances and other more robustly built commercial washing machines. This was explained by the fact that the appliances included are intended for use by the general public, such as in laundries, campsites and public laundries in residential buildings. It was explained that such appliances are sometimes similar in construction to household appliances but have been approved as commercial appliances. In addition, such appliances were said to be less durable than other commercial washing machines.

The new category WM2 is a merge of the former categories WM2, WM3 and WM4.

The next categories have changed in numbering but not otherwise, i.e., former WM5 is now WM3, WM6 is now WM4 and WM7 is the new WM5.

- Commercial and industrial dryers (D) categories:
  - D1: Light duty commercial tumble dryer
  - D2: Commercial tumble dryer (designed for extra-long durability)
  - D3: Commercial cabinet dryer
  - D4: Industrial pass-through (transfer) tumble dryer

Similarly, to WM1, the new category D1 (Light duty commercial tumble dryer) represents dryers used by untrained users which were originally, i.e. in the previous preparatory study of 2011, under category D1 for semi-professional condenser dryers and D2 for semi-professional air vented dryers. During the stakeholder meeting it was explained that both categories are in fact certain types of tumble dryers. Thus, the category name now refers to tumble dryers.

Under category D2, the earlier categories D4, D5 and D6 have been merged, now representing all tumble dryers used by trained users.

D3 has remained unchanged. In the final stages of the study, stakeholder feedback suggested to add the term ‘commercial’ to the category to clearly distinguish to industrial appliances.

D4 covers industrial pass-through dryers or continuous operation dryers which were previously covered by category D7.

In December 2025 European Textile Care Technology (ETCT) requested to hold a meeting with the consultants to lay down their views on the scope of the study and the proposed categories. Information provided during and following the meeting is presented in **Annex III: Categorisation of 2011 study**. In short, various arguments were raised as to the differentiation between commercial and industrial washing machines, how this should be considered in the categorisation and in how machines of each segment are regarded in this study.

Though the consultants agree that there is a need to differentiate clearly between commercial and industrial laundry machines in particular for e.g., washer extractors and tumble dryers, the differentiation proposed, namely the 40 kg threshold could not be taken up as it is in discrepancy with standards of commercial laundry machines (e.g., EN 50460). In addition, from other exchanges with stakeholders, the consultant further concludes that though the industrial manufacturers are in favour of this threshold, the commercial ones would disagree to it. As the threshold is not directly related to environmental impacts, settling this dispute is considered beyond the mandate of the consultants and of ESPR.

ETCT further provided examples of industrial laundry set-ups to clarify why they argue for a process-based analysis of their appliances as well as process-based performance benchmarks and requirements. Though this argumentation can be followed, by the time the detail was provided in January 2025, the report for Tasks 1-4 had already been completed together with several feedback rounds from stakeholders. Revising the general approach was no longer feasible in the course of this study.

3.2. MEErP Task 2 – Markets

The aim of MEErP Task 2 is to provide insights on market and cost aspects of commercial and industrial laundry equipment, to provide insight in the latest market trends, to provide a practical data set of prices and rates to be used in a Life Cycle Costs (LCC) calculation and to make recommendations on the refined product scope in MEErP Task 1, as well as providing indications for the development on Base Cases (BCs) in MEErP Task 5, for example, by assessing the relevant product categories from the economical / commercial perspective.

MEErP Task 2 includes a description of the market trends including for example channels to market, general trends in product design and product features, major players and the market share, business models, geographical distribution of production, distribution channels (retail versus wholesale), the number of employees, role of installation services, role of repair and maintenance (service models), supplemented by information on market and logistical support of recyclability and availability of amounts of recycled materials related to the market size.

3.2.1. General economic data from official sources

3.2.1.1. Production

This section provides a brief description of the market situation of commercial and industrial washing machines and dryers in the EU. The PRODCOM[27] database is useful for an initial analysis as it is transparent and publicly available data on manufacturing and production within the EU, as provided by Member States. Of the PRODCOM categories presented in Task 1, only the following are included in the scope of the study and were analysed:

- **Code 28.94.22.30**: Household or laundry-type washing machines of a dry linen capacity > 10 kg (including machines that both wash and dry);
- **Code 28.94.22.70**: Drying machines, of a dry linen capacity > 10 kg.

In both cases, the inclusion criterion is based on the dry linen capacity, not on the use case (household vs. commercial/industrial). This means that also household appliances of the described dry linen capacity are included in these statistical categories. In the absence of a more granular classification in PRODCOM, e.g. per use case, these are the categories that were used in this section, with hence the caveat that the figures also include those for household appliances above 10 kg of dry linen capacity.

The following PRODCOM product categories were not analysed in this section (cf. Task 1):

- **Code 28.94.21.30**: Ironing machines and presses, because fusing presses and dryers using indirect methods of heat transfer were proposed to be excluded from the scope in Task 1;
- **Code 28.94.21.50**: Washing, bleaching or dyeing machines (excluding household or laundry-type washing machines), because not relevant;

[27] PRODucts of the European COMmunity.

- **Code 28.94.21.70**: Machines for reeling, unreeling, folding, cutting or pinking textile fabrics, because not relevant;
- **Code 28.94.21.80**: Machines used in the manufacture of linoleum or other floor coverings for applying the paste to the base fabric or other support and machines for dressing, finishing, wringing, drying, coating or impregnating textile yarns, fabrics or made up textile articles, because not relevant.
- **Code 28.94.23.00**: Centrifugal clothes-dryers, because separate hydro-extractor or pressing appliances were excluded from the scope in Task 1.

Unit volume

In 2023, the PRODCOM database reports that 210,000 washing machines and 32,148 dryers were produced in EU27 for the Codes 28.94.22.30 and 28.94.22.70 respectively.[28] **Table 3-8** and

[28] These categories might also include large household washing machines or dryers > 10 kg.

Table 3-9 show the number of units for 2019-2023, giving an indication of where large manufacturing centres of commercial and industrial washing machines and dryers are located.

Table 3-8: Number of household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers)[29] produced, 2019-2023.

Member State	2019	2020	2021	2022	2023
Austria	0	0	0	0	0
Belgium	:	:	:	:	:
Bulgaria	0	0	0	0	0
Croatia	0	0	0	0	0
Cyprus	0	0	0	0	0
Czechia	0	0	0	0	0
Denmark	0	0	0	0	0
Estonia	0	:	0	0	0
Finland	0	0	0	0	0
France	657	799	881	952	895
Germany	18,216	:	:	:	:
Greece	0	0	0	0	0
Hungary	0	0	0	:	:
Ireland	0	0	0	0	0
Italy	:	:	:	2,320	:
Latvia	0	0	0	0	0
Lithuania	0	0	0	0	0
Luxembourg	0	0	0	0	0
Malta	0	0	0	0	0
Netherlands	0	0	0	0	0
Poland	36	:	:	:	:
Portugal	0	0	0	0	0
Romania	0	0	0	0	0
Slovakia	0	0	0	0	0
Slovenia	:	:	:	:	:
Spain	26,519	17,830	20,497	23,254	21,579
Sweden	:	14,707	15,335	16,837	17,436
EU27-2020	70,000	100,000	120,000	160,000	210,000

[29] PRODCOM Code 28.94.22.30

Legend: ":" stands for "Not available"
Source: Eurostat (PRODCOM)

The limited PRODCOM data suggests that Spain, Sweden, Germany (figures available only for 2019), Italy (figures available only for 2022) and France are the largest centres of manufacturing of commercial and industrial washing machines.

The total number of manufactured units being reported displays a considerable and unexplained rise over the years 2019 to 2023 (a three-fold increase in 5 years). This data is most surprising and invites to consider PRODCOM data with considerable caution.

PRODCOM data includes a large and strongly rising number of units unaccounted for (= the units in the total for the EU that are absent from the values reported by Member States):

- 35 % of total in 2019
- 67 % of total in 2020
- 69 % of total in 2021
- 73 % of total in 2022
- 81 % of total in 2023

These figures in unreported units tend to increase the caution to be kept regarding the reliability of total figures provided by PRODCOM for the EU27 regarding the number of units sold.

Table 3-9: Number of drying machines of a dry linen capacity superior to 10 kg[30] produced, 2019-2023.

Member State	2019	2020	2021	2022	2023
Austria	:	:	:	:	:
Belgium	:	:	:	:	:
Bulgaria	0	0	0	0	0
Croatia	0	0	0	0	0
Cyprus	0	0	0	0	0
Czechia	:	:	:	:	:
Denmark	0	0	0	0	0
Estonia	0	:	0	0	0
Finland	0	0	0	0	0
France	:	0	0	0	0
Germany	3,356	:	:	4,206	:
Greece	0	0	0	0	0
Hungary	0	0	0	0	0
Ireland	0	0	0	0	0
Italy	:	:	:	:	:
Latvia	0	0	0	0	0
Lithuania	0	0	0	0	0
Luxembourg	0	0	0	0	0
Malta	0	0	0	0	0
Netherlands	0	0	0	0	0
Poland	17	19	15	14	:
Portugal	:	44	44	:	:
Romania	0	0	0	0	0
Slovakia	0	0	0	0	0
Slovenia	:	:	:	:	:
Spain	:	:	5,947	8,457	8,217
Sweden	:	9,258	15,517	:	:
EU27-2020	33,442	26,810	34,341	33,426	32,148

Legend: ":" stands for "Not available"
Source: Eurostat (PRODCOM)

Concerning **dryers**, the PRODCOM data available is even scarcer. The total number of dryers produced is 32,148 units in 2023. Based on the information in

[30] PRODCOM Code 28.94.22.70

Table 3-9, the only year where the reported data constitutes a meaningful share of the total EU27 data is 2021, where Spain and Sweden respectively reported to manufacture 17.3 % and 45.2 % of the total EU production, respectively, leaving only 37 % of the volumes unaccounted for.

However, compared to the data on washing machines, the data for the whole EU27 is consistent and realistic: the numbers are reasonably steady over the period considered, which would lead to a good level of confidence in the figures provided by this source.

Sales value

Figure 3-3 shows the value of commercial and industrial washing machines and dryers produced according to PRODCOM. The production value of commercial and industrial washing machines and dryers produced in the EU amounted to **565 million Euros** in 2023 (compared to 404 million Euros in 2014), split into 360 million Euros for washing machines and 204 million Euros for dryers. The average annual increase in sales over the period is 3.8 %/year, with a stronger growth of 13.9 %/year over the post-Covid recovery period 2020-2023. This will be elaborated further in **Section 3.2.3** on the market trends.

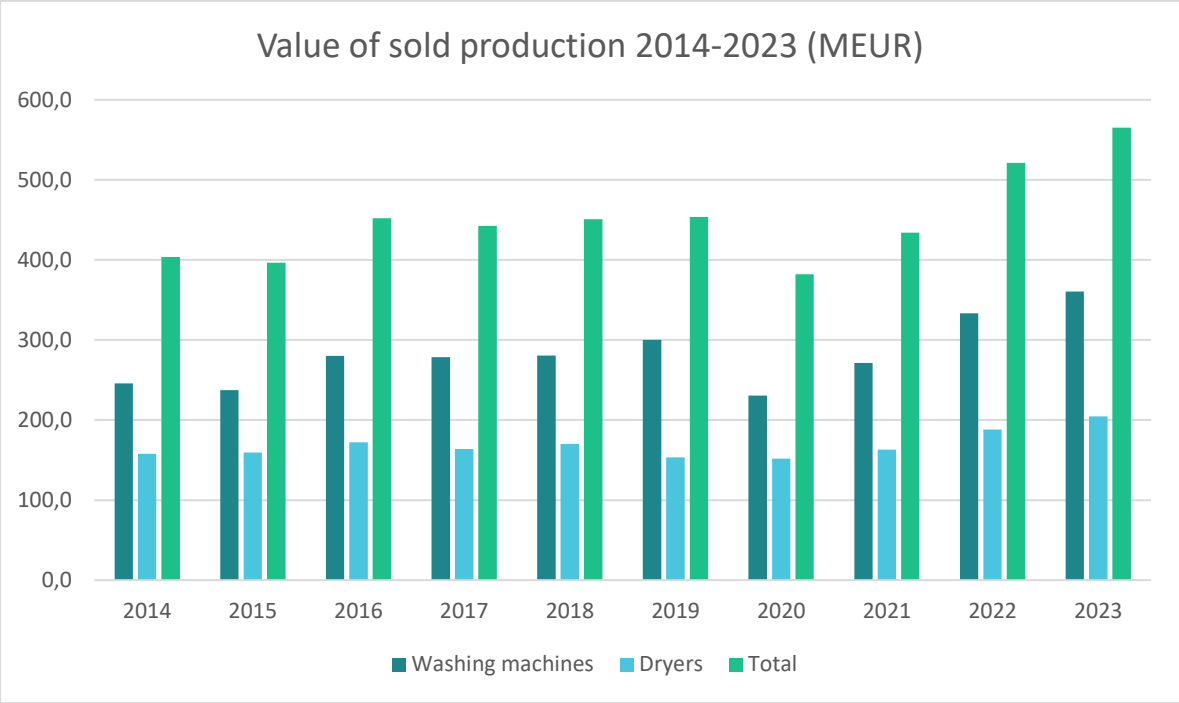

Figure 3-3: Value of household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers) and of Drying machines, of a dry linen capacity > 10 kg produced in EU27 (million Euros), 2014-2023.

Source: Eurostat (PRODCOM) [31]

[31] PRODCOM statistics based on NACE 2 Rev. accessed at: http://epp.eurostat.ec.europa.eu/portal/page/portal/prodcom/data/database, 12 September 2024.

The value of commercial and industrial laundry appliances produced per reporting Member State (see **Table 3-10** and **Table 3-11**) shows the market share (in value) of the manufacturers located in each of them.

In 2022, where the reported values are the most complete, the respective market shares of the largest producing countries of **washing machines** were the following:

- Germany: 40.7 %
- Spain: 29.1 %
- Sweden: 19 %
- France: 4.5 %
- Italy: 4.1 %
- All other EU Member States: 2.6 %

These figures, illustrated in **Figure 3-4** below, show that the three dominant EU producing countries in this market of commercial and industrial washing machines are Germany, Spain and Sweden, with France and Italy playing minor roles.

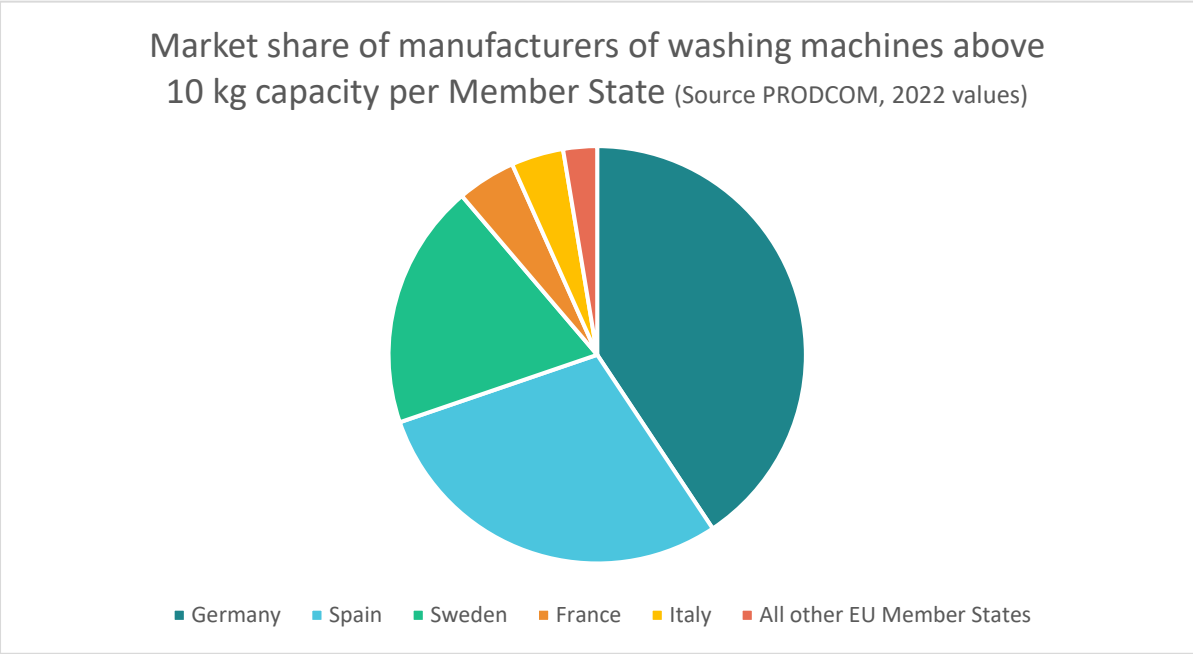

Figure 3-4: Market share of EU Member States manufacturing household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers).

Source: Eurostat (PRODCOM), 2022 data

Table 3-10: Value of household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers)[32] produced in EU27 by Member State (in million Euros).

Member State	2019	2020	2021	2022	2023
Austria	0	0	0	0	0
Belgium	:	:	:	:	:
Bulgaria	0	0	0	0	0
Croatia	0	0	0	0	0
Cyprus	0	0	0	0	0
Czechia	0	0	0	0	0
Denmark	0	0	0	0	0
Estonia	0	:	0	0	0
Finland	0	0	0	0	0
France	8.91	11.8	14.0	15.1	13.8
Germany	118.4	107.9	120.4	135.4	169.8
Greece	0	0	0	0	0
Hungary	0	0	0	:	:
Ireland	0	0	0	0	0
Italy	:	:	:	13.5	:
Latvia	0	0	0	0	0
Lithuania	0	0	0	0	0
Luxembourg	0	0	0	0	0
Malta	0	0	0	0	0
Netherlands	0	0	0	0	0
Poland	0.2	:	:	:	:
Portugal	0	0	0	0	0
Romania	0	0	0	0	0
Slovakia	0	0	0	0	0
Slovenia	:	:	:	:	:
Spain	85.2	55.3	70.4	96.9	100.8
Sweden	:	47.2	50.9	63.3	61.1
EU27 - Total	300	230.4	271.2	333.1	360.5

Legend: ":" stands for "Not available"

Source: Eurostat (PRODCOM)

[32] PRODCOM Code 28.94.22.30

The manufacturers based in Germany also dominate the market for **dryers**. Based on the data from the years 2021 and 2022 from **Table 3-11** below, the following market shares can be estimated for the manufacturers based in the EU27:

- Germany: 51.5 % (2022 value)
- Spain: 14.0 % (2022 value)
- Sweden: 5.8 % (2021 value)
- All other EU Member States: 28.8 % (estimate based on values from 2021 and 2022)

These market shares are illustrated in **Figure 3-5** below.

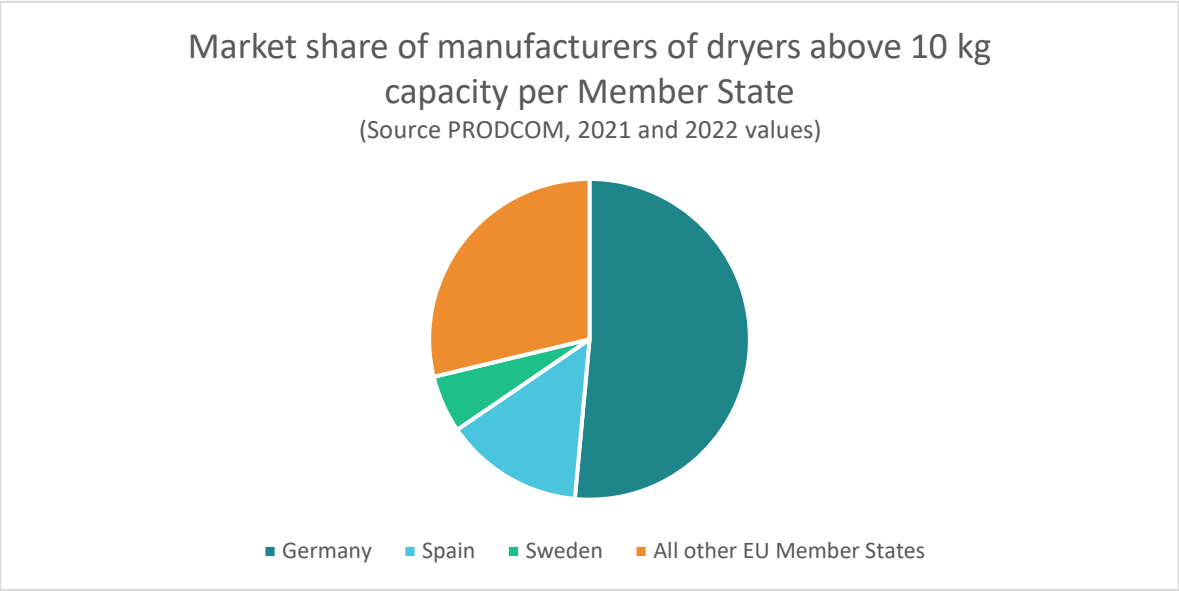

Figure 3-5: Market share of manufacturers of dryers above 10 kg capacity per Member State.

Source: Eurostat (PRODCOM), 2021 and 2022 data

Table 3-11: Value of drying machines of a dry linen capacity superior to 10 kg[33] produced in EU27 by Member State (in million Euros).[34]

Member State	2019	2020	2021	2022	2023
Austria	:	:	:	:	:
Belgium	:	:	:	:	:
Bulgaria	0	0	0	0	0
Croatia	0	0	0	0	0
Cyprus	0	0	0	0	0
Czechia	:	:	:	:	:

[33] PRODCOM Code 28.94.22.70
[34] PRODCOM statistics based on NACE 2 Rev. accessed at: http://epp.eurostat.ec.europa.eu/portal/page/portal/prodcom/data/database, 28 September 2010.

Member State	2019	2020	2021	2022	2023
Denmark	0	0	0	0	0
Estonia	0	:	0	0	0
Finland	0	0	0	0	0
France	:	0	0	0	0
Germany	87.1	:	:	96.8	:
Greece	0	0	0	0	0
Hungary	0	0	0	0	0
Ireland	0	0	0	0	0
Italy	:	:	:	:	:
Latvia	0	0	0	0	0
Lithuania	0	0	0	0	0
Luxembourg	0	0	0	0	0
Malta	0	0	0	0	0
Netherlands	0	0	0	0	0
Poland	0.05	0.07	0.05	0.05	:
Portugal	:	0.68	0.93	:	:
Romania	0	0	0	0	0
Slovakia	0	0	0	0	0
Slovenia	:	:	:	:	:
Spain	:	:	16.5	26.4	27.7
Sweden	:	16.7	9.4	:	:
EU27 - Total	153.6	151.7	163.0	188.2	204.6

Source: Eurostat (PRODCOM)

Unit value

Commercial and industrial washing machines and dryers have a unit value which is highly dependent on the specific MS market. **Table 3-12** shows the range of unit values for commercial and industrial washing machines and dryers as reported by PRODCOM for Member States where information is available.

Table 3-12: Average unit value of household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers) and of drying

machines, of a dry linen capacity > 10 kg by Member States reporting, latest available data in years 2018-2023.

Member State	Unit value of washing machines[35] (Euros)	Date for which the available data enables the computation	Unit value of dryers[36] (Euros)	Date for which the available data enables the computation
France	15,429	2023	-	-
Germany	28,245	2018	23,026	2022
Italy	5,825	2022	22,516	2018
Poland	6,501*	2019	3,810*	2022
Portugal	-	-	21,227*	2021
Spain	4,672	2023	3,368	2023
Sweden	3,506	2023	607	2021
Average EU	5,398	2018**	6,363	2023

(*) = Number of units sold below 100, hence low significance

(**) = Value for 2019 is provided, as it is the latest for which the figures for the total number of units manufactured in the EU27 reported in PRODCOM appear as reliable

The average unit value of commercial and industrial washing machines in the EU27 is **5,398 Euros** (2018 value) while that of dryers is **6,363 Euros** (2023 value). Given the low number of Member States with data available, and the lack of reliability regarding the total number of units manufactured in the EU27, these numbers should be considered with caution.

Overall, it appears a clear market segmentation between manufacturers:

- A large capacity market, with average unit prices above 15,000 EUR, with manufacturers located in Germany (washing machines and dryers), France (washing machines only), Italy (dryers only) and Portugal (minor player, dryers only);
- A small capacity market, with average unit prices around 5,000 EUR and below, with manufacturers in Spain and Sweden, with a minor player in Poland (in all three cases, for washing machines and dryers).

3.2.1.2. Trade

The COMEXT database provide extra-EU trade data for the following product categories, which are similar to, but still distinct from those of PRODCOM:

- 845020 - Laundry-type washing machines, of a dry linen capacity > 10 kg
- 845129 - Drying machines for textile yarns, fabrics or made-up textile articles (excl. machines of a dry linen capacity <= 10 kg and centrifugal driers)

[35] PRODCOM Code 28.94.22.30
[36] PRODCOM Code 28.94.22.70

Whereas COMEXT category 845020 is very close to the scope of this study (commercial and industrial washing machines), the category 845129 can include household appliances. We have used it in this study for lack of more granular data in the COMEXT database.

Table 3-13 below provides the extra-EU import and export values, in million euros (MEUR), for these two product categories.

Table 3-13: Value of import and export of laundry-type washing machines, of a dry linen capacity > 10 kg and of drying machines for textile yarns, fabrics or made-up textile articles (excl. machines of a dry linen capacity <= 10 kg and centrifugal driers), from 2014 to 2023 (MEUR).

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Washing machines - Imports	38.8	43.4	53.6	56.2	56.6	60.1	82.7	94.1	126.3	142.7
Washing machines - Exports	172.1	187.3	193.1	216.7	228.9	228.5	170.4	183.4	244.0	288.2
Washing machines - Trade balance	133.2	143.9	139.5	160.5	172.4	168.3	87.7	89.2	117.7	145.6
Dryers - Imports	20.9	26.5	27.3	34.0	28.7	29.3	22.5	20.3	26.6	28.7
Dryers - Exports	132.6	149.7	157.4	175.1	166.0	137.0	125.1	134.6	168.7	166.1
Dryers - Trade balance	111.6	123.2	130.1	141.1	137.3	107.8	102.6	114.3	142.1	137.4

Source: Comext

Figure 3-6 below displays these quantitative data in a visual graph for washing machines.

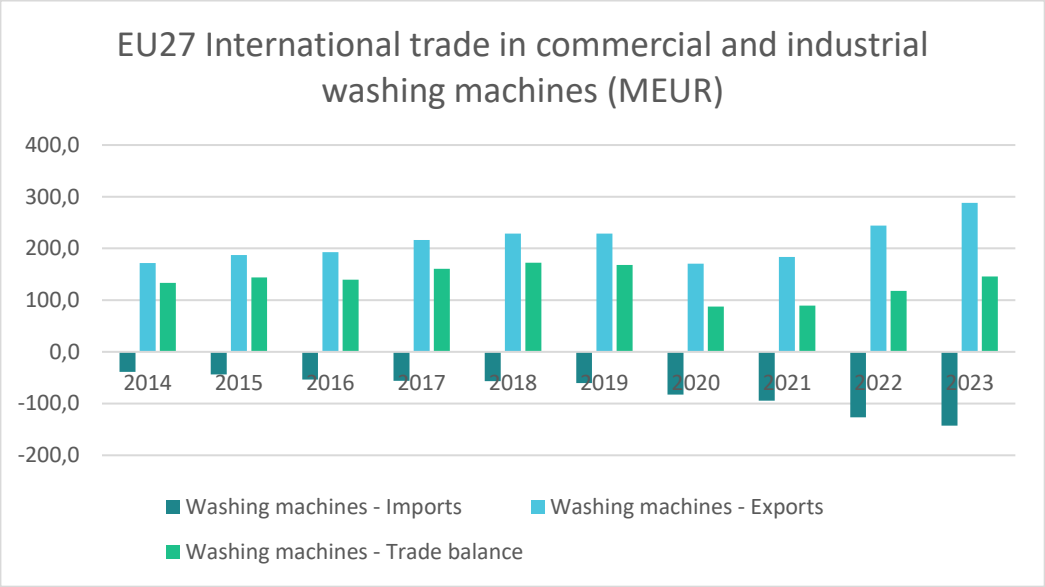

Figure 3-6: International trade of the EU27 of laundry-type washing machines, of a dry linen capacity > 10 kg, 2014-2023 (in MEUR) - COMEXT data.

From these figures, it appears that the international competitive position of EU manufacturers of commercial and industrial washing machines is **deteriorating** since the Covid pandemic of 2020. Extra-EU imports have more than doubled between 2019 and 2023, whereas extra-EU exports have grown by 26 % only. Thereby, the trade balance has deteriorated, from a very favourable position of a trade surplus of +168 MEUR in 2019 to +145 MEUR in 2023.

Figure 3-7 below displays these quantitative data in a visual graph for dryers.

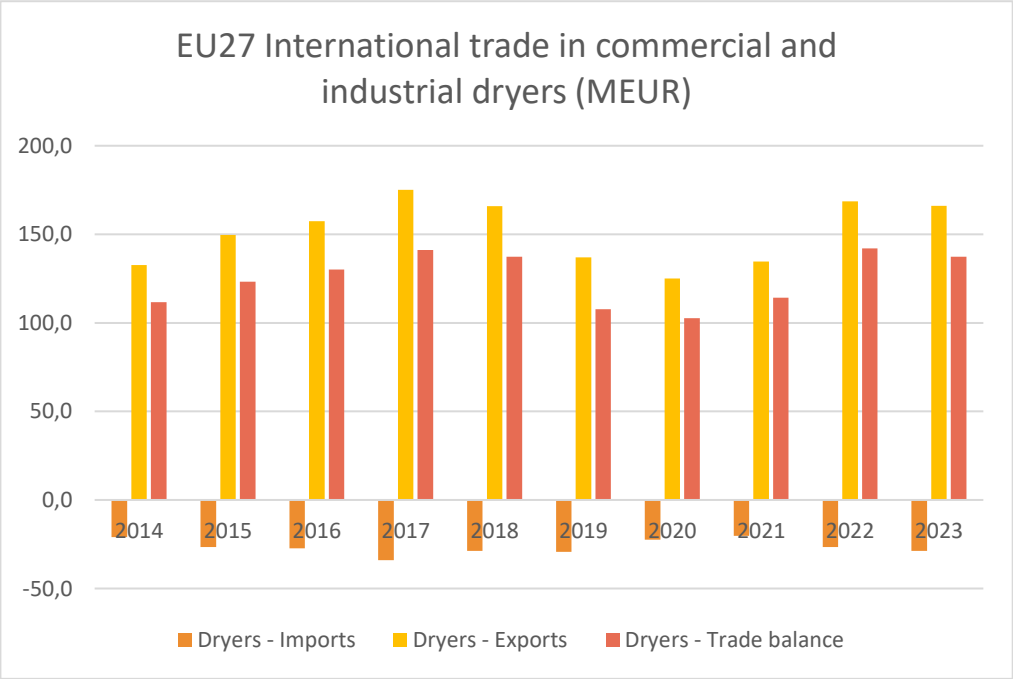

Figure 3-7: International trade of the EU27 of drying machines, of a dry linen capacity > 10 kg, 2014-2023 (in MEUR) - COMEXT data.

The international competitive position of EU manufacturers of large capacity dryers appears to be much more solid, with almost no change in extra-EU imports over these 10 years, and a recovery of extra-EU exports (and of the highly positive trade balance) between 2020 and 2023.

3.2.1.3. Conclusion on official sources of data

The Eurostat PRODCOM and COMEXT databases have the advantage of being a publicly available, official EU source that is used and referenced in other EU policy documents regarding trade and economic policy. However, it is not complete or of high enough quality to serve as a useful market data source for this study and it was necessary to investigate other sources of sales and stock data. Additional information that was gathered through questionnaires sent to stakeholders (cf. Annex II, **Section 5**), mainly manufacturers, is therefore presented in the next section.

3.2.2. Market and stock data

Based on the initial product definition of the former preparatory study of 2011, seven categories have been defined for commercial and industrial washing machines and seven categories for commercial and industrial dryers, which were used here for market and stock data definition. Based on the market data collected, further refinement will allow the key representative products (or product features) to be identified and analysed in the later stages of the study, while others may be put aside.

Questionnaires were sent to the complete mailing list of stakeholders registered on the preparatory study website, and were followed up by contacting nine key manufacturers and associations directly. Responses were received from four manufacturers[37] and two associations of manufacturers[38].

3.2.2.1. Market structure

The commercial and industrial laundry market is above all a business to business (B2B) market and therefore can be characterised by some key points.

- The majority of smaller manufacturers typically sell and distribute their products to laundry equipment dealers who can stock and sell one or several brands of washing machine, dryer and usually other types of laundry equipment (pressing and ironing appliances, etc.). This is particularly applicable for the smallest capacity commercial washer extractors. Manufacturers of small capacity appliances sold through intermediate dealers/retailers generally do not track where many of their products end up.
- Many commercial and all industrial laundry appliances are also directly sold by the manufacturer to the customer, especially larger capacity machines (heavy duty

[37] Electrolux, Miele, Kannegiesser, Jensen.
[38] ETCT (European Textile Care Technology), APPLiA

appliances) which are usually tuned to customer-specific specifications or requirements upon purchase. In particular, manufacturers can assist the customers in the definition of suitable washing or drying programmes for light duty commercial (partly programmable) and commercial (fully programmable) equipment, depending on the use patterns (see Task 3 for more details).

- Equipment dealers often service and maintain products and can also be dedicated (affiliate) to one or a few brands.
- The proportion of appliances sold directly or through dealers varies depending on the manufacturer, the type of appliance and the Member State considered. Manufacturers estimate that around 20 % of the sales are made directly between the manufacturer and the customer and the remaining share occurs through intermediate dealers.
- Because commercial laundry appliances are designed for a long and intense use, they tend to be designed for ease of maintenance, repair and refurbishing (more on this below). This leads to the existence of a market for second-hand, refurbished products ("after market"), estimated by stakeholders at 10-20 % of the total market. For example, one manufacturer reported in an interview that they have not implemented an own refurbishment practice (besides providing spare parts), but that it is being carried out by specialist retailers (third-party providers)[39] who are giving appliances a second life.

3.2.2.2. Manufacturers

The B2B nature of the commercial and industrial washing machine and dryer market makes it much less visible than the domestic market. This poses difficulties when attempting to characterise the market in terms of sales, stock and prices. Besides, there are few manufacturing companies so that the market data is highly sensitive for competitiveness reasons. It is considered relevant to list the manufacturers for the sake of characterising the market. The following manufacturers have been identified in the commercial and industrial washing machine and dryer market in the EU (see **Table 3-14**).

Table 3-14: Non-exhaustive list of commercial and industrial washing machine and dryer manufacturers relevant to EU market.

Manufacturer	Country (alphabetic order)	Manufacturer	Country (alphabetic order)
IPSO (part of Alliance Laundry Systems – USA)	Belgium	PODAB	Sweden
Primus (part of Alliance Laundry Systems – USA)	Belgium (Czech Republic)	Schulthess	Switzerland
Jensen	Denmark (Sweden, Germany, Italy, Switzerland)	Alliance Laundry Systems	United States

[39] See for example https://www.laundrysystems.nl/en/refurbished-machines or https://www.greenlaundry.com/used-washers

Manufacturer	Country (alphabetic order)	Manufacturer	Country (alphabetic order)
Danube	France	ASKO	United States
Kannegiesser	Germany	American Dryer Corporation	United States
Miele Professional	Germany (Austria)	Whirlpool Commercial	United States
Stahl	Germany	Staber	United States
IMESA	Italy	Milnor	United States
Girbau	Spain (France)		
Fagor Industrial	Spain		
Electrolux Professional	Sweden (France, Thailand)		

(Brackets for country signify presence of production sites)

The above list is not intended to be exhaustive but should include a majority of the manufacturers relevant to the European market with a vast majority of the market share covered. It can be seen by the number of manufacturers operating in each Member State that, in addition to Germany, Sweden, Spain, France and Italy that have been identified via PRODCOM data, Belgium, Denmark and the Czech Republic seem to belong to the manufacturing sites for commercial and industrial laundry machines.

There are no EU-wide manufacturer associations in the market segment of commercial and industrial washing machines and dryers, which partly explains the limited market data available on commercial and industrial laundry appliances. There are, however, textile services associations at Member State level and at EU level (e.g. European Textile Services Association (ETSA)).

3.2.2.3. Sales

The aim of this section is to assess the sales volume (number of units sold) for different types of light duty commercial and commercial laundry equipment.

In addition to the PRODCOM data, APPLiA provided data on the **number of batch-loaded units**, i.e. of all product types other than 'Washing tunnel machines' and 'Pass-through (transfer) tumble dryer', being manufactured in the EU, based on information gathered from 4 major manufacturers[40]. These 4 manufacturers represent ca. 80 % of the EU manufacturing capacity, and manufactured in 2023 a total of:

- Batch-loaded washers 65,000 units
- Batch-loaded tumble dryers 55,000 units

[40] Alliance Laundry, Electrolux Professional, Girbau, Miele Professional. These manufacturers represent 80 % of the EU production. The EU production is sold on the EU Internal Market on the one hand and exported outside EU. On the EU Internal Market, the EU production competes with extra-EU imports.

- Batch-loaded drying cabinets 8,000 units

These figures have been rounded to the closest thousand.This leads to an estimate of the number of batch-loaded units manufactured in the EU for 2023 as displayed in **Table 3-15** below.

Table 3-15: Commercial laundry appliances - Number of batch-loaded units manufactured in the EU.

Category of commercial laundry appliance	Number of batch-loaded units manufactured in the EU27 in 2023 (estimate)
Batch-loaded washers (product types WM1 to WM4 inclusive)	81,000
Batch-loaded tumble dryers (product types D1 to D2 inclusive)	69,000
Batch-loaded drying cabinets (product type D3)	10,000

Source: estimate based on data gathered by APPLiA

These figures are to be compared to the PRODCOM data provided above in **Table 3-8** for washing machines and in

Table 3-9 for dryers.

The figure provided by APPLiA for **washing machines** appears to be much more in line with the historical values (before 2019) of the PRODCOM database than those provided since by PRODCOM. The consultant team recommends retaining the APPLiA data as a reasonable estimate. On the other hand, the figure provided by APPLiA for **dryers** is much larger than the one from PRODCOM, which displays a good consistency over the time period 2014-2023. The consultant team attributes this difference in quantitative data to misalignment in scope between the PRODCOM nomenclature and the one used by APPLiA and recommends using the PRODCOM data for dryers.

APPLiA also provided a breakdown of the number of units manufactured per product type, which can be compared with the figures from the 2011 Preparatory Study bearing on 2009 figures. This leads to **Table 3-16** below.

Table 3-16: Number of batch-loaded washing machines manufactured in the EU27.

Product type*	Estimated number of units (2009 figures)[41]	Share of total number of batch-loaded units (computed from 2009 figures)	Estimates of share of number of batch-loaded units (APPLiA data, 2024)[42]	Estimated number of batch-loaded units (computed from APPLiA data, 2024)
Washing machines				
WM1: Light duty commercial washer extractor	25,000	31.9 %	25-35 %	20,250 – 28,350
WM2: Commercial washer extractor, <15 kg	45,500	58.0 %	50-60 %	40,050 – 48,600
WM3: Commercial washer extractor, 15-40 kg	6,200	7.9 %	5-10 %	4,050 – 8,100
WM4: Industrial washer extractor, >40 kg	210	0.3 %	0-1 %	0 – 810
WM5: Commercial washer dryer	200	0.3 %	0-1 %	0 – 810
WM6: Commercial barrier washer	850	1.1 %	1-2 %	810 – 1,620
WM7: Washing tunnel machine	250			

41 From Preparatory Study of 2011. Öko-Institut, Bio Intelligence Service (2011) Preparatory Studies for Eco-design Requirements of Energy-using Products Lot 24: Professional Washing Machines, Dryers and Dishwashers. Final Report, Part: Washing Machines and Dryers, Task 2: Economic and Market Analysis

42 Figures provided by APPLiA during the stakeholder consultation, 2024, based on aggregated data from more than 4 manufacturers representing collectively more than 80 % of sales volume.

Product type*	Estimated number of units (2009 figures)[41]	Share of total number of batch-loaded units (computed from 2009 figures)	Estimates of share of number of batch-loaded units (APPLiA data, 2024)[42]	Estimated number of batch-loaded units (computed from APPLiA data, 2024)
Total washing machines	**78,710**			**81,100[43]**

* To facilitate comparability, the categories, mentioned in this table, represent ones used in the LOT 24 study from 2011, however, with the term 'professional' replaced by 'commercial' or 'industrial', and the term 'semi-' by 'light duty'.

Source: estimate based on APPLiA and on PRODCOM data and reminder of outcomes of 2011 study

Table 3-17: Number of batch-loaded dryers manufactured in the EU27.

Product type*	Estimated number of units (2009 figures)[44]	Share of total number of batch-loaded units (computed from 2009 figures)	Estimates of share of number of batch-loaded units (APPLiA data, 2024)[45]	Estimated number of batch-loaded units (computed from PRODCOM and APPLiA data, 2024)
Dryers				
D1: Light duty commercial dryer, condenser	3,200	8.4 %	20-25 %	7,000 – 9,000
D2: Light duty commercial dryer, air vented	4,300	11.3 %	0	0
D3: Commercial cabinet dryer	10,700	28.2 %	separate estimation	10,000[46]
D4: Commercial tumble dryer, <15 kg	16,000	42,1 %	50-60 %	16,000 – 19,000
D5: Commercial tumble dryer, 15-40 kg	3,500	9.2 %	10-20 %	3,200 –6,400
D6: Tumble dryer, >40 kg	300	0.8 %	0-5 %	0 – 1,600
D7: Pass-through (transfer) tumble dryer	1,200			

43 Figure provided by APPLiA during the stakeholder consultation, 2024, based on aggregated data from more than 4 manufacturers representing collectively more than 80 % of sales volume.

44 From Preparatory Study of 2011. Öko-Institut, Bio Intelligence Service (2011) Preparatory Studies for Eco-design Requirements of Energy-using Products Lot 24: Professional Washing Machines, Dryers and Dishwashers. Final Report, Part: Washing Machines and Dryers, Task 2: Economic and Market Analysis

45 Figures provided by APPLiA during the stakeholder consultation, 2024, based on aggregated data from more than 4 manufacturers representing collectively more than 80 % of sales volume.

46 Separate estimate provided by APPLiA in the stakeholder consultation of 2024.

Product type*	Estimated number of units (2009 figures)[44]	Share of total number of batch-loaded units (computed from 2009 figures)	Estimates of share of number of batch-loaded units (APPLiA data, 2024)[45]	Estimated number of batch-loaded units (computed from PRODCOM and APPLiA data, 2024)
Total dryers	**39,200**			**32,000 tumble dryers[47] + 10,000 cabinet dryers**

* To facilitate comparability, the categories, mentioned in this table, represent ones used in the LOT 24 study from 2011, however, with the term 'professional' replaced by 'commercial' or 'industrial', and the term 'semi-' by 'light duty'.
Note: the stability between 2009 figures and updated 2024 figures.

Source: estimate based on APPLiA and on PRODCOM data and reminder of outcomes of 2011 study

It has to be noted that the data that the only reliable data accessible are the figures for the number of units manufactured by EU-based manufacturers (from APPLiA), however, with no details on the split of these products manufactured in the EU that are sold on the EU Internal Market or exported to third countries. Also, there are no reliable data on the number of units sold on the EU27 market that are manufactured by EU-based manufacturers or imported from third countries, because PRODCOM data on the production is highly unrealistic (see Section 3.2.1.1), leading to major uncertainties on apparent consumption, and COMEXT data providing no figure expressed in number of units (only economic values). This is an issue because the number of units sold on the EU Internal Market is the figure relevant for an ESPR study, which regulates the products sold on the EU Internal Market, not those manufactured in the EU.

Against this background, the study team had to make the approximation that the production made in the EU27 is representative of the consumption made on the EU27 market, even if the market share of imports for washing machines seems to be growing fast.

From the above figures, it appears that the **dominant** market segments in terms of numbers of units sold are:

- Among washing machines: Light duty commercial and commercial washer-extractors below 15 kg capacity (WM1 and WM2);
- Among dryers: Light duty commercial and commercial tumble-dryers below 15 kg capacity, commercial cabinet dryers (D1, D3 and D4).

The machines with intermediate capacity (between 15 and 40 kg) represent a small, but still significant share of the market.

[47] Source: Eurostat – PRODCOM data (2024), Product Code 28.94.22.70: Drying machines, of a dry linen capacity > 10 kg

The higher-capacity machines (WM5) and the machines with specific functionalities (washer-dryers and barrier washers) represent niche markets. The market figures seem to have remained remarkable **stable** between 2011 and 2024.

3.2.2.4. Sales by customer

In the US in the late 1990s, the professional customers of laundry equipment with the largest market share were hotels, hospitals and contract laundry services that serve commercial and institutional customers.[48] Government institutions, including the armed services, prisons, schools, and hospitals, bought about 11 % of the production. It seems reasonable to assume that these shares have not substantially changed since, and EU estimations should therefore be close to these. Commercial and industrial laundry equipment is produced for the following main customer segments (cf. Task 1 report):

- **Coin & Card Laundry (CCL)**: laundrette, camping, student dormitories, real estate etc. and **Apartment Household Laundry (AHL):** household, real estate, old people's homes etc; the users are not the owners and therefore safety and easy handling are the most important issues.
- **Hospitality Laundry (HPL):** hotels, restaurants, quick service restaurants etc.
- Healthcare Laundry (HCL):
- **Healthcare Hospital (HH)** with very demanding hygiene requirements
- **Healthcare Nursing Home (HN)** with moderate hygiene requirements
- **Commercial Industrial Laundry (CIL):** service providers, textile rent cleaning, small or heavy-duty laundries etc.
- **Speciality Laundry (SP)** including high-tech industries (mops, functional garments like fire and rescue service or offshore, pharmaceutical and electronic factories).

It will be quite difficult and not well targeted to estimate the different market shares and all the associated parameters (lifetimes, user behaviours, etc.) for each product group in each market segment. To focus the analysis, the most dominant customer segment for each category has been evaluated (see **Table 3-18** and **Table 3-19**). The presentation of the market shares for each type of appliance is based on global market research and stakeholders' feedback.

[48] Source: http://business.highbeam.com/industry-reports/equipment/commercial-laundry-drycleaning-pressing-machines

Table 3-18: Target customer segments of commercial and industrial washing machines by product category.

Product type*	Market share of customer segments	Dominant customer segment
WM1: Light duty commercial washer extractor	**CCL+AHL: 60 %** HPL: 25 % HH: 10 % HN: 5 % CIL: ~0 % SP: ~0 %	Coin & Card Laundry + Apartment Household Laundry
WM2: Commercial washer extractor, <15 kg	**CCL+AHL: 50 %** HPL: 25 % HH: 10 % HN: 5 % CIL: 5 % SP: 5 %	Coin & Card Laundry + Apartment Household Laundry
WM3: Commercial washer extractor, 15-40 kg	CCL+AHL: 0 % **HPL: 65 %** HH: 10 % HN: 15 % CIL: 5 % SP: 5 %	Hospitality Laundry
WM4: Washer extractor, >40 kg	CCL+AHL: 0 % HPL: 35 % HH: 5 % HN: 5 % **CIL: 50 %** SP: 5 %	Commercial Industrial Laundry
WM5: Commercial washer dryer	CCL+AHL: 35 % **HPL: 65 %** HH: 0 % HN: 0 % CIL: 0 % SP: 0 %	Hospitality Laundry
WM6: Commercial barrier washer	CCL+AHL: 0 % HPL: 0 % **HH: 50 %** HN: 40 % CIL: 0 % SP: 10 %	Healthcare Hospital Laundry
WM7: Washing tunnel machine	CCL+AHL: 0 % HPL: 0 % HH: 5 % HN: 0 % **CIL: 90 %** SP: 5 %	Commercial Industrial Laundry

* To facilitate comparability, the categories, mentioned in this table, represent ones used in the LOT 24 study from 2011, however, with the term 'professional' replaced by 'commercial' or 'industrial', and the term 'semi-' by 'light duty'.

Table 3-19: Target customer segments of commercial and industrial dryers by product category.

Product type*	Market share of customer segments	Dominant customer segment
D1: Light duty commercial dryer, condenser	**CCL+AHL: 60 %** HPL: 25 % HH: 10 % HN: 5 % CIL: 0 % SP: 0 %	Coin & Card Laundry + Apartment Household Laundry
D2: Light duty commercial dryer, air vented	**CCL+AHL: 60 %** HPL: 25 % HH: 10 % HN: 5 % CIL: 0 % SP: 0 %	Coin & Card Laundry + Apartment Household Laundry
D3: Commercial cabinet dryer	**CCL+AHL: 70 %** HPL: 10 % HH: 10 % HN: 10 % CIL: 0 % SP: 0 %	Coin & Card Laundry + Apartment Household Laundry
D4: Commercial tumble dryer, <15 kg	**CCL+AHL: 50 %** HPL: 25 % HH: 10 % HN: 5 % CIL: 5 % SP: 5 %	Coin & Card Laundry + Apartment Household Laundry
D5: Commercial tumble dryer, 15-40 kg	CCL+AHL: 0 % **HPL: 65 %** HH: 10 % HN: 15 % CIL: 5 % SP: 5 %	Hospitality Laundry
D6: Tumble dryer, >40 kg	CCL+AHL: 0 % HPL: 35 % HH: 5 % HN: 5 % **CIL: 50 %** SP: 5 %	Commercial Industrial Laundry
D7: Pass-through (transfer) tumble dryer	CCL+AHL: 0 % HPL: 0 % HH: 5 % HN: 0 % **CIL: 90 %** SP: 5 %	Commercial Industrial Laundry

* To facilitate comparability, the categories, mentioned in this table, represent ones used in the LOT 24 study from 2011, however, with the term 'professional' replaced by 'commercial' or 'industrial', and the term 'semi-' by 'light

duty'.

The tables show that industrial users (CIL) are purchasers of heavy-duty appliances (washer extractors >40 kg, washing tunnel machines, tumble dryers >40 kg, pass-through tumble dryers) while users in hospitality and coin & card/apartment household laundry are purchasers of smaller washer extractors and dryers. The health care sector purchases both small and large appliances and is the main market segment for barrier washers.

It is expected that the variation between MS on the type of commercial or industrial laundry equipment purchased varies very little, but the type of purchasers can be slightly different for cultural reasons. As already stated before, in Nordic countries, Switzerland and Austria light duty commercial or commercial laundry equipment is provided in every building to be used by the inhabitants while launderettes are more common in other MS. The type of equipment and the use patterns in these two end markets are similar even if these machines are not used in the same environment. Thus, the average laundry needs and purchases are estimated to be similar in the different MS, despite possible structural differences of the market segments.

3.2.2.5. Lifetime

The technical lifetime of products is measured in number of cycles. Based on stakeholder feedback, the typical lifetime duration for commercial and industrial machines is provided in the **Table 3-37** and **Table 3-38** in **Section 3.2.6** below.

In general, the number of cycles for which an appliance is designed is in line with the intensity of its usage, so that the overall duration of usage remains constant.

Based on stakeholder input, it appears that the duration of usage is in the range of **10 years**.

3.2.2.6. Stock

The number of commercial and industrial laundry appliances in the stock should be determined by the accumulation of the number of units entering and leaving the stock each year. This figure is unknown, as the number of units being exported and imported at the scale of the EU27 is not provided, neither by PRODCOM (which provides trade figures per Member State, but including intra-EU trade of no relevance for this study) nor by COMEXT (which provides data in value, but not in units).

Considering that extra-EU trade has become very significant over the last 10 years, with imports strongly increasing since 2020 in particular (see **Section 3.2.1**), it is no longer accurate to approximate domestic consumption with domestic production. However, this is the only method for which some quantitative data is available. We will hence use it, and **approximate** the **stock** by the **accumulation of the domestic production in the EU27 over the last 10 years**, based on:

- For washing machines: PRODCOM data until 2018, and a linear extrapolation from that latest data point to the figure provided by APPLiA for 2023 (considering that the total figures for the EU27 in PRODCOM from 2019 onwards appear as being highly unreliable);

- For dryers: PRODCOM data.

Table 3-20: Approximation of the stock of commercial and industrial laundry appliances in the EU27.

Year	Number of washing machines manufactured in the EU27	Number of dryers manufactured in the EU27
2014	36,253	27,886
2015	37,699	20,928
2016	45,000	23,676
2017	45,003	25,157
2018	51,997	32,697
2019	57,798*	33,442
2020	63,598*	26,810
2021	69,399*	34,341
2022	75,199*	33,426
2023	81,000	32,148
Total stock (estimate)	562,946	290,511

(*) = estimate, based on interpolation between reliable PRODCOM data of 2018 and figure by APPLiA for 2023

(°) = Data provided by APPLiA

It should be noted that this is only a very rough quantitative approximation, to be considered only as a reasonable estimate of orders of magnitude only.

3.2.3. Market trends

3.2.3.1. General market trends

As described in the **Section 3.2.2**, the market for commercial and industrial laundry appliances has experienced a **moderately high growth rate** over the last decade of **+3.8 % per year CAGR**, with a strong post-Covid recovery at +13.9 % per year CAGR over the years 2020 – 2023.

This is above the evolution of the underlying needs, namely those of its main market segments:

- Coin & Card Laundry (CCL) and Apartment Household Laundry (AHL): linked to the evolution of the overall population, which is stagnating in the EU27, but subject to the competition of privately-detained household appliances, which leads to a probable decline in the market;

- Hospitality Laundry (HPL): linked to the activity of the sector NACE I "Accommodation and food services activities", which grew at an average of 1.7 %/year[49] over the years 2011-2021;
- Healthcare Laundry (HCL), linked to the evolution of the elderly population, in hospitals and in nursing homes. The population aged 80 years and more has increased its share in the total population of the EU27 from 5.2 % to 6.0 % between 2014 and 2023[50], at an annual growth rate of 1.44 %/year;
- Commercial Industrial Laundry (CIL), linked to the evolution of the activity of textile services providers, which grew by 1.1 %/year in the years preceding 2014[51];
- Speciality Laundry (SP), linked to the evolution of the activity of the dedicated sub-segment of the textile services providers which grew by 3.8 %/year in the years preceding 2014[52].

3.2.3.2. Volume of laundry being processed by commercial and industrial laundry appliances

A study of 2014[53] states that 24,000 industrial laundries in the world (processing more than 15 tonnes per week) wash 34 million tonnes of clothing on an annual basis, whereas 65,000 commercial laundries (units producing less than 15 tonnes weekly) wash approximately 21 million tonnes of textiles annually.

According to the same source, of the 24,000 industrial laundries existing globally, a total of ca. 3,200 are located in the EU27, i.e. 13.3 % of the global total.

It can hence be approximated that, under a hypothesis that the unit capacities of European laundries are no different from those in other parts of the world, and that the share of EU27 *commercial* laundries in the global total is equivalent to the EU27's share in the global total of *industrial* laundries:

- The **industrial** laundries (processing more than 15 tonnes of laundry per week) located in the EU27 process a total of ca. **4.5 M tonnes of laundry per year** (i.e. 34 M tonnes x 13.3 %);
- The **commercial** laundries (processing less than 15 tonnes of laundry per week) located in the EU27 process a total of ca. **2.8 M tonnes of laundry per year** (i.e. 21 M tonnes x 13.3 %).

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[49] Eurostat, Annual detailed enterprise statistics for services (NACE Rev. 2 H-N and S95) (2005-2020) Online data code sbs_na_1a_se_r2, https://doi.org/10.2908/SBS_NA_1A_SE_R2 and Enterprises by detailed NACE Rev.2 activity and special aggregates, Online data code sbs_ovw_act, https://doi.org/10.2908/SBS_OVW_ACT

[50] Eurostat: Population structure indicators at national level. Online data code: demo_pjanind https://doi.org/10.2908/DEMO_PJANIND

[51] Deloitte study for ETSA, 2014: https://www.textile-services.eu/market_figures/

[52] Deloitte study for ETSA, 2014: https://www.textile-services.eu/market_figures/

[53] Steen Søgaard, Laundry Logics (2014) Laundry Operations, downloadable at: https://www.pdfdrive.com/laundry-operations-laundry-operations-d50620017.html , §1.4.2

These figures are an approximation, based on a top-down approach, of the total amount of textiles being processed per year by the total stock of commercial and industrial laundry appliances present in the EU27. They differ from the figures provided in **Sections 3.2.7.1** and **3.2.7.2** below that describe the amount of textile processed per year per machine.

3.2.3.3. Employment figures

In the stakeholder consultation of this preparatory study in 2024, only one company provided information on the number of employees of its business unit manufacturing commercial and industrial laundry appliances. This is not sufficient to draw conclusions at the sector scale. The 2011 study provided a total figure of ca. **6,000 employees** in the sector of commercial and industrial laundry appliances.

One company in the 2024 stakeholder consultation provided a breakdown of its employees between the different functions in the business unit, provided in **Table 3-21** below.

Table 3-21: Share of employees per function in the business unit manufacturing of laundry appliances in the professional context (case study).

Function in the business unit	Share of employment
Manufacturing	68.6 %
Sales	4.9 %
Installation and commissioning	4.9 %
Maintenance and repair	17.2 %
Refurbishing / upgrade	1 %
De-commissioning / dis-assembly	1 %
Preparation of parts for re-use or for recycling	2.5 %
Total	**100 %**

3.2.3.4. Redesign cycle

According to information provided by stakeholders, the redesign cycle varies with the category of equipment and the objective of the process. Designing equipment 'from scratch' with completely new characteristics can take between 10 to 12 years for heavy duty appliances and from 6 to 10 years for smaller washing machines and dryers.

Redesigning a single part of the appliance can take between 6 and 36 months depending on its complexity: the required time is very specific to the design changes so that it is not realistic to indicate an average or typical timing.

3.2.3.5. Product specific trends – development of commercial and industrial laundry appliances, 2010-2030

Customer requirements

In general, the owners of commercial and industrial laundry appliances are very focused on economy and maximising profit out of the laundry. This leads to requirements on the following items:

- Robustness and long lifetime,
- Programmability,
- Short cycle times while retaining good quality of the processed linen,
- Keeping a high availability of the appliance, which implies,
  - High reliability,
  - High level of aftermarket service with fast and good-quality support,
  - Fast delivery of spare parts.
- Good overview of the usage of machines, IT supervision and monitoring tools. Connectivity and Internet of Things (IoT) is a growing request,
- Good ergonomics and ease of use to secure the long-term occupational health & safety of operators,
- Environmental friendliness and sustainable solutions are also more and more requested from the customers.

Users and operators of the appliances are even more focused on ease to use and require:

- User friendly interfaces,
- Ergonomics,
- Speed.

Past technical improvements

The most notable technical improvements made to commercial and industrial laundry appliances in the recent decades have been in the following areas:

- **Heat pump technology** within commercial and industrial dryers have been implemented already in the 80s and the technology have improved a lot with faster cycles and reduced energy consumption. The consequence of this is a dramatic increase in the market share of heat pump dryers, with a concurrent decline in the market presence of condenser dryers.
- **Water usage/kg laundry** has been reduced dramatically over the last decades since it means lower energy consumption and faster wash cycles.

- Extraction of water within this market segment measured in **residual moisture content** has improved a lot, leading to very low remaining humidity in garment after extraction and thereby much shorter drying time and less energy consumption.
- **Serviceability** and **repairability** is very much considered to improve continuously, since the B2B laundry market cannot afford that the appliances are standing still.
- **Long lifetime** is taken for granted in this market. This goes hand in hand with sustainability requirements.

Anticipation of future technical developments

The industry expects the areas of main technical developments to lie in the following areas:

- Continuous heat pump technology development;
- Automatic dosing systems for optimised detergent usage;
- Improved connectivity to the IoT, for better control of the appliances and optimised performance, reduced energy and planning according to circular economy;
- Improved user interfaces and more user-friendly programming, in order to secure error-free and optimal usage of the appliances.

Detailed assessment of the presence of sustainable technical features in commercial and industrial laundry appliances

Table 3-22 below provides an overview of the current presence of specific technical features linked to sustainability in professional laundry appliances, and on the trends regarding their future deployment.

Table 3-22: Presence of technical features related to sustainability in current (2024) commercial and industrial laundry appliances and trends for the future.

Sustainability indicator	Technical feature related to sustainability	Current (2024) presence in commercial and industrial laundry appliances and future trends
Heat saving	Heat exchanger	Not so common
	Waste water heat recovery	In large commercial and in industrial installations. Probably more heat recovery will be part of the building in future but is very unlikely to be included in the appliance itself, for cost reasons.
	Heat pump	Increasingly used, typically for smaller dryers, accepting longer drying time
	Additional warm/hot water connection	Very common
	Gas-operated heating	Common for dryers in south EU

Sustainability indicator	Technical feature related to sustainability	Current (2024) presence in commercial and industrial laundry appliances and future trends
	Steam-operated heating	Common only for big size washers and dryers
	Improved thermal insulation	Part of continuous development
Water saving	Recovery of wash water	In large commercial and in industrial installations
	Improved rinsing systems	Part of continuous development. The recently developed performance standard for household equipment EN 60456 includes requirements on rinsing that can lead to increased water usage. The standard applicable to commercial washers EN 50640 includes no such requirement, but the situation can change, with the same potential effects.
Electric energy saving	Electronic stop controls (disconnects the machine when the programme ends or after the last user action)	Not so common and neither really needed, since many machines operate 24/7 or almost
Chemical use saving	Automatic dosing of detergent	Common and increasingly used, due to sustainability requirements and to cost savings
Resource saving upon use (general)	Automatic weighing system / automatic load control	Already common and well controlled with professional users. Increasingly used in Coin & Card Laundry (CCL) and Apartment Household Laundry (AHL) segments
	Automatic adaptation of programme to load and to soiling level of textile articles	Already well controlled by professional users, who develop their own specific programmes to deal with homogeneous batches of laundry
Circular Economy	Improved maintainability / repairability / capacity to be upgraded or refurbished. Ease of dis-assembly	Already present in the commercial and industrial laundry market because of customer requirements and of 24/7 usage of many appliances
	Improved recyclability (avoidance or clear marking of substances of concern, separability of parts made of different materials)	Increasing presence, as a consequence of regulation
	Use of recycled materials	Increasing, due to sustainability requirements
	Reduced wear & stress imposed on textiles	Integrated into the washing programmes

Sustainability indicator	Technical feature related to sustainability	Current (2024) presence in commercial and industrial laundry appliances and future trends
Social aspects	Improved ergonomics of operation (load carrying, temperature, humidity, noise)	Part of continuous development

Source: stakeholder feedback

The sustainability features that already are implemented to a large extent in the existing commercial and industrial laundry appliances are those related to the business requirements of users:

- Savings of heat and of water (with the exception of heat exchangers / recovery of wastewater heat and of waste water);
- Automated controls and programmes to adapt the energy and resource use to the needs;
- All features contributing to longevity and reliability.

These areas could be the purpose of Ecodesign requirements at low cost for the industry, with the main effect of bringing all players (including importers) at the benchmark level of the market.

The areas in which ecodesign requirements would be likely to accelerate the uptake of sustainability features beyond the spontaneous market evolution would be:

- Recyclability and incorporation of recycled materials;
- Recovery of waste water and of wastewater heat (maybe at the scale of the installation, not of the individual appliance, for the sake of pooling the needed infrastructure and volume).

3.2.4. Customer expenditure database

Based on the defined product categories for commercial and industrial washing machines and dryers, average consumer prices, including VAT (in Euro), as well as applicable rates for running costs (e.g. electricity, repair and maintenance, disposal) and other financial parameters (e.g. inflation rates) will be determined.

The total lifetime cost of a laundry machine can be divided into five relevant categories:

- Purchase price: the cost incurred to purchase the machine (including labour costs, costs due to raw material, etc.);
- Installation cost: the cost required to install a commercial or industrial laundry machine;
- Running costs: the costs incurred to operate the machine throughout a typical lifetime. They may include electricity costs and costs of consumables (detergents, water, filters, etc.);

- Maintenance and repair costs: the costs incurred by the owner of the commercial or industrial laundry machine throughout the lifetime of the machine to ensure its proper and effective operation;
- Disposal costs: the quantifiable costs (or benefits) borne by the owner of the machine at the end of life of a commercial or industrial laundry machine.

3.2.4.1. Purchase price

In the context of this study, average appliance consumer prices are of interest as they are required as an input for the LCC calculations of the base cases that will be performed in MEErP Task 5.

Prices within an appliance category can vary widely on the different markets of the EU. Parameters that are the most critical for fixing the price are the capacity, followed by the technical features and functional options available and chosen by the client. Because commercial and industrial laundry equipment is a B2B sector, prices of appliances are not easily available (at least, prices from EU manufacturers). Therefore, the assessment of average product prices relies entirely on aggregated stakeholders' data. They were estimated as an average of the responses received to the questionnaires sent to manufacturers (5 replies received).

Commercial and industrial washing machines – Prices in the 2011 study

In the 2011 study, the "semi-professional washer extractors", in the current study named "light duty commercial washer extractors" (WM 1) tended to start at 1,000 Euros and could cost up to 5,500 Euros. The price range of commercial washer extractors up to 40 kg (WM 2-3) was comprised between 5,000 and 35,000 Euros. These appliances tend to occupy the lower cost portion of the market, while appliances designed for heavier garment load (WM 4-7) tend to occupy the more expensive portion of the market, with purchase prices at the time of up to 500,000 Euros. Their price range is much larger than other types and therefore they are more difficult to characterise on a broad European level. Washing capacity and digital programmes tend to be the differentiating factors between purchasing prices of products in this study. Barrier washers (WM6) tend to be more expensive than washer extractors as they have specific features and accessories, ensuring their specific objectives related to hygiene are met. These products typically had in the 2011 study been found to start at 15,000 Euros and could cost up to 120,000 Euros.

Commercial and industrial dryers – Prices in the 2011 study

Similarly, the same structure of the market applied to commercial and industrial dryers. In the 2011 study, smaller tumble dryers and cabinet dryers (D1 to D3) costed between 800 and 35,000 Euros, while heavy duty appliances (D7) belonged to the range of 40,000 to 110,000 Euros. The costs for pass-through (transfer) tumble dryers are influenced not only by the capacity, but by the different features (e.g. heat recovery), components and stages presented by the appliance. The most expensive models include for example one pre-treatment module, four steam modules, four air circulation modules, one exit module.

Extrapolation of prices per unit to 2023

In order to extrapolate the prices in 2023 from the data of the 2011 study, the average price of commercial and industrial laundry appliances, as it appears from PRODCOM data time series, was used.

Table 3-23 below provides the average price of commercial and industrial laundry appliances, as they can be calculated from PRODCOM data[54], for the Member States and the years, between 2009 and 2023, where the available data enables a calculation. Empty cells correspond to missing data.

[54] By dividing the total value of production (PRODVAL) by the number of units produced (PRODQNT).

Table 3-23: Average prices of commercial and industrial washing machines manufactured in the EU27, years 2009-2023 (PRODCOM data).

Average price (EUR / unit)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
France	8,053			9,212	8,743		7,973	14,883	14,423	15,109	13,573	14,818	15,875	15,913	15,429
Germany	24,419	24,103	24,505	25,637	30,421	29,527	28,728	29,911	25,109	28,246					
Italy	4,933		5,158		4,693	4,760	5,002	5,089	5,464					5,825	
Poland	9,550	9,867	4,977	6,113				12,223	4,666	5,576	6,502				
Spain	5,754	5,763	4,069	5,285	4,123	5,910	4,151	3,481	4,074	3,178	3,215	3,102	3,435	4,168	4,673
Index (base 100 =2009)	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
France	100			114.4	108.6		99.0	184.8	179.1	187.6	168.5	184.0	197.1	197.6	191.6
Germany	100	98.7	100.4	105.0	124.6	120.9	117.6	122.5	102.8	115.7					
Italy	100		104.6		95.1	96.5	101.4	103.2	110.8						
Poland	100	103.3	52.1	64.0				128.0	48.9	58.4	68.1				
Spain	100	100.2	70.7	91.9	71.7	102.7	72.1	60.5	70.8	55.2	55.9	53.9	59.7	72.4	81.2

Table 3-24: Average prices of commercial and industrial dryers manufactured in the EU27, years 2009-2023 (PRODCOM data).

Average price (EUR / unit)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Germany		31,552	29,727	35,659		28,929	28,925	29,310	29,637		25,953			23,027	
Italy	3,603		3,802						18,820	22,516					
Poland	1,954	2,479	2,988	2,469				2,382	2,529	2,601	2,770	3,877	3,578	3,811	
Spain	5,962	3,490	3,951	2,891	4,521	3,270	2,804	3,312	3,066				2,777	3,114	3,369
EU 27	4,161				4,093	5,660	7,608	7,274	6,511	5,205	4,592	5,658	4,747	5,630	6,363
Index (base 100 =2009)	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	2019	2020	2021	2022	2023
Germany*		100.0	94.2	113.0		91.7	91.7	92.9	93.9		82.3			73.0	
Italy	100		105.5						522.3	624.9					
Poland	100	126.9	152.9	126.4				121.9	129.4	133.1	141.8	198.4	183.1	195.0	
Spain	100	58.5	66.3	48.5	75.8	54.8	47.0	55.6	51.4				46.6	52.2	56.5
EU 27	100				98.4	136.0	182.9	174.8	156.5	125.1	110.4	136.0	114.1	135.3	152.9

(*) = Index base 100 - 2010

The data computed from PRODCOM and displayed above provides an indication of:

- Diverging evolutions between the market segments for **washing machines**:
  - Prices in the large capacity market segment (manufactured in France and in Germany) have strongly risen over the period; whereas
  - Prices in the smaller capacity market segment (manufactured in Spain) have strongly declined.
- For **dryers**: a contradiction between the data at EU level (indicating a strong rise in unit prices) and that at the scale of the Member States where data is available (indicating a decline in unit prices).

Based on the above, we will make the following assumptions and approximations regarding the prices in 2023:

- For washing machines:
  - A unit price index set at 150 (base 100 = 2009), corresponding to a middle ground between the price evolutions of France and of Germany, for high-end machines (WM3 to WM5).
  - A unit price index set at 80 (base 100 = 2009), corresponding to the price evolutions of Spain, for low-end machines (WM1 to WM2).
- For dryers: a unit price index set at 80 (base 100 = 2009), corresponding to a preference given to the data at Member State level.

This leads to **Table 3-25** below providing price estimates of commercial and industrial laundry appliances per segment in 2023.

Table 3-25: Estimate of the unit prices of commercial and industrial laundry appliances in 2023 (based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices).

Type of appliance*	Typical price range (Euros)	Average price (Euros)
Laundry machines		
WM1: Light duty commercial washer extractor	800 - 4,400	2,136
WM2: Commercial washer extractor, <15 kg	4,000 - 28,000	4,000
WM3: Commercial washer extractor, 15-40 kg	4,000 - 28,000	12,200
WM4: Washer extractor, >40 kg	75,000 – 255,000	88,125
WM5: Commercial washer dryer	N/A	12,000
WM6: Commercial barrier washer	22,500 – 180,000	57,375
WM7: Washing tunnel machine	420,000 - 750,000	585,000
Dryers		
D1: Semi-commercial dryer, condenser	640 – 2,800	1,576
D2: Semi-commercial dryer, air vented	640 – 2,800	1,344
D3: Commercial cabinet dryer	2,800 – 16,000	2,800
D4: Commercial tumble dryer, <15 kg	2,800 – 16,000	3,200
D5: Commercial tumble dryer, 15-40 kg	2,800 – 16,000	5,700
D6: Tumble dryer, >40 kg	14,400 – 28,000	17,200
D7: Pass-through (transfer) tumble dryer	32,000 – 88,000	50,000

* To facilitate comparability, the categories, mentioned in this table, represent ones used in the LOT 24 study from 2011, however, replacing the term ‘professional’ by ‘commercial’ or ‘industrial’, and the term ‘semi-‘ by ‘light duty’.

3.2.4.2. Installation costs

Delivery and installation costs can be included in the product price as the manufacturers deal with this task requiring skilled personnel, but it is not always the case (e.g. if the appliance is sold through an intermediate dealer). Depending on the product considered there is a high variation of these costs. They are not negligible compared to other expenses due to laundry appliances (purchase price or operating expenses). Stakeholders have estimated that delivery and installation costs represent around 4 % of the purchase price of the smallest appliances and around 9 % for the heavy-duty machines (WM7 and D7).

However, no information was available by product category so that this rate will be used for all appliances.

3.2.4.3. Running costs

Running costs, understood as costs generated by the use of the appliance, can be split into energy (electricity, gas), water and consumable costs (detergent, etc.).

Energy costs are a significant running cost of commercial and industrial laundry equipment. They are mainly due to the mechanical action required (e.g. tumblers) as well as to the heating of the water in laundry machines and of the air in dryers. According to stakeholders, the equivalent of 1 kWh of heat per kg is used to heat water.

In industrial applications, the consumption is variable: manufacturers usually only deliver the appliances or systems and the specifications of the washing process (i.e. the 'recipe' of the process, including programme time, temperature, dosage of chemicals, water/laundry ratio) are defined individually by the customer himself or the detergent provider. The energy, water and detergent (and other chemicals) consumption depend on the definition of the recipe (see Task 3).

The latest electricity and gas rates for industrial customers in Member States are presented below, according to the different consumption classes. The EU average will be used in LCC calculations at a later stage of the study (MEErP Task 5 and Task 6).

Energy costs

Electricity rate

The electricity rate in EU depends on the consumption and therefore will vary depending on the customer types (which can be attributed to certain product types too). Three consumption bands for the electricity rate at industrial rates (IA – < 20 MWh, IB – 20-499 MWh, and IC – 500-1,999 MWh) are presented below. These are the relevant consumption bands for the commercial and industrial washing machines and dryers, as results from the computations made in MEErP Task 4 – Technologies, and more specifically in the **Section 3.3.1.3** and **0**.

The cost of electric energy for industrial users has experienced very strong variations, starting with the aggression war of Russia against Ukraine in February 2022. Following the restrictions to the import of natural gas from Russia in the EU, the prices of this commodity have risen sharply, and then decreased, following the successful implementation of measures reducing the EU's dependency on Russian fossil fuels (the RePowerEU programme). Dependent on the share of natural gas in the mix of the suppliers of electric energy in the EU, this evolution in the price of natural gas has resulted more or less parallel evolutions in the price of electricity to industrial consumers – the higher the dependency, the stronger the correlation between the prices of natural gas and of electricity. Governments have intervened to mitigate this impact to companies, essentially by introducing reductions to the taxes applicable to electricity, but this has not been sufficient to fully dampen the impact of the rising cost of electric energy[55].

Consequently, it is not relevant to define a representative price for electric energy, based on an average of latest available data, and which would be valid for the Life Cycle Costing of the implementation of Ecodesign requirements to be implemented in the future.

[55] Trinomics, Enerdata, E3Modelling, Öko Institut, LBST, Atico Estudio (2024) Study on energy prices and costs– 2024 edition

The tables below (**Table 3-26** to **Table 3-28**) hence present the price of electricity at two dates:

- In the first semester of 2021, before the international tensions on the gas market led to an increase in its price.
- At the latest available date, namely the first semester of 2024, which witnesses a slow decrease of the electric energy price compared to the peaks observed in the first semester of 2023.

The LCC exercise will hence need to make assumptions about the future evolution in the price of electric energy.

Table 3-26: Price of electric energy for non-household uses; Consumption band IA.

Member State	Electricity price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band IA (annual consumption below 20 MWh)	
	Semester 1 - 2021	Semester 1 - 2024
Austria	0.1768	0.2668
Belgium	0.2294	0.2762
Bulgaria	0.1131	0.1359
Croatia	0.1411	0.2787
Cyprus	0.1726	0.2783
Czechia	0.1970	0.3091
Denmark	0.1554	0.1662
Estonia	0.1279	0.2218
Finland	0.0947	0.1292
France	0.1764	0.2526
Germany	0.2492	0.3293
Greece	0.1834	0.2605
Hungary	0.1300	0.2254
Ireland	0.2513	0.3242
Italy	0.2777	0.3483
Latvia	0.1996	0.2481
Lithuania	0.1530	0.2923
Luxembourg	0.1663	0.1647
Malta	0.2398	0.1882
Netherlands	0.1923	0.3104
Poland	0.1732	0.3309
Portugal	0.1947	0.2242
Romania	0.1219	0.1751
Slovakia	0.2171	0.2844

Member State	Electricity price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band IA (annual consumption below 20 MWh)	
Slovenia	0.1551	0.2340
Spain	0.2322	0.2433
Sweden	0.1260	0.1777
European Union - 27 countries (from 2020)	0.2093	0.2843

Source: Eurostat (2024). Electricity prices for non-household consumers - bi-annual data (from 2007 onwards). Online data code: nrg_pc_205. https://doi.org/10.2908/NRG_PC_205.

Custom dataset:
https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_205__custom_13397870/default/table?lang=en

Table 3-27: Price of electric energy for non-household uses; Consumption band IB.

Member State	Electricity price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band IB (annual consumption from 20 MWh to 499 MWh)	
	Semester 1 - 2021	**Semester 1 - 2024**
Austria	0.1403	0.2326
Belgium	0.1569	0.2075
Bulgaria	0.1018	0.1248
Croatia	0.1205	0.2455
Cyprus	0.1610	0.2603
Czechia	0.1363	0.2298
Denmark	0.0985	0.1113
Estonia	0.1017	0.1546
Finland	0.0842	0.1146
France	0.1450	0.2451
Germany	0.2043	0.2723
Greece	0.1588	0.2020
Hungary	0.1098	0.2522
Ireland	0.1816	0.3032
Italy	0.1790	0.2444
Latvia	0.1255	0.1730
Lithuania	0.1174	0.1999
Luxembourg	0.1188	0.2182
Malta	0.1518	0.1557
Netherlands	0.1532	0.2677
Poland	0.1341	0.2534
Portugal	0.1400	0.1569

Member State	Electricity price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band IB (annual consumption from 20 MWh to 499 MWh)	
Romania	0.1143	0.1726
Slovakia	0.1510	0.2264
Slovenia	0.1121	0.1946
Spain	0.1404	0.1784
Sweden	0.0856	0.1106
European Union - 27 countries (from 2020)	0.1562	0.2299

Source: Eurostat (2024), Electricity prices for non-household consumers - bi-annual data (from 2007 onwards). Online data code: nrg_pc_205. https://doi.org/10.2908/NRG_PC_205.

Custom dataset: https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_205__custom_13397870/default/table?lang=en

Table 3-28: Price of electric energy for non-household uses; Consumption band IC.

Member State	Electricity price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band IC (annual consumption from 500 MWh to 1,999 MWh)	
	Semester 1 - 2021	**Semester 1 - 2024**
Austria	0.1228	0.1987
Belgium	0.1218	0.1780
Bulgaria	0.0962	0.1129
Croatia	0.1025	0.2314
Cyprus	0.1515	0.2453
Czechia	0.0883	0.1850
Denmark	0.0797	0.0981
Estonia	0.0957	0.1429
Finland	0.0676	0.0928
France	0.1057	0.1711
Germany	0.1813	0.2328
Greece	0.1174	0.1557
Hungary	0.0921	0.2281
Ireland	0.1512	0.2560
Italy	0.1584	0.2090
Latvia	0.1012	0.1469
Lithuania	0.1046	0.1688
Luxembourg	0.0954	0.2048
Malta	0.1345	0.1408
Netherlands	0.1128	0.1986
Poland	0.1092	0.2083

Member State	Electricity price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band IC (annual consumption from 500 MWh to 1,999 MWh)	
Portugal	0.1066	0.1149
Romania	0.0992	0.1599
Slovakia	0.1275	0.1883
Slovenia	0.0920	0.1725
Spain	0.1074	0.1371
Sweden	0.0711	0.0942
European Union - 27 countries (from 2020)	0.1285	0.1867

Source: Eurostat (2024), Electricity prices for non-household consumers - bi-annual data (from 2007 onwards). Online data code: nrg_pc_205. https://doi.org/10.2908/NRG_PC_205.

Custom dataset:
https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_205__custom_13397870/default/table?lang=en

Gas rate

Natural gas rates have to be taken into account for dryers which use natural gas fuel for heating. There are also few laundry machines using gas as a direct energy source (but indirectly, steam used to heat up the water may come from gas heating) but this option is more common for dryers.

The consumption bands that are relevant for dryers, based on the computations made in MEErP Task 4 – Technologies, and more specifically in the **Section 0**, are the bands I1 (annual consumption less than 1,000 GJ) and I2 (annual consumption from 1,000 GJ to 9,999 GJ).

For the same reasons as above, the prices presented in the tables below (**Table 3-29** and **Table 3-30**) are provided for the first semester of 2021 and the first semester of 2024.

Table 3-29: Price of natural gas for non-household uses; Consumption band I1.

Member State	Natural gas price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band I1 (annual consumption less than 1,000 GJ)	
	Semester 1 - 2021	**Semester 1 - 2024**
Austria	0.0486	0.1079
Belgium	0.0377	0.0658
Bulgaria	0.0303	0.0510
Croatia	0.0357	0.0643
Czechia	0.0302	0.0720
Denmark	0.0607	0.0852
Estonia	0.0333	0.0563

Member State	Natural gas price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band I1 (annual consumption less than 1,000 GJ)	
Finland	0.0752	0.0862
France	0.0492	0.1033
Germany	0.0470	0.0954
Greece	0.0461	0.0710
Hungary	0.0272	0.0842
Ireland	0.0433	0.1102
Italy	0.0537	0.0929
Latvia	0.0337	0.0643
Lithuania	0.0283	0.0467
Luxembourg	0.0411	0.0893
Netherlands	0.0774	0.1348
Poland	0.0383	0.0749
Portugal	0.0555	0.0993
Romania	0.0317	0.0540
Slovakia	0.0428	0.0926
Slovenia	0.0426	0.0760
Spain	0.0374	0.0444
Sweden	0.0983	0.1679
European Union - 27 countries (from 2020)	0.0476	0.0900

Source: Eurostat (2024), Gas prices for non-household consumers - bi-annual data (from 2007 onwards). Online data code: nrg_pc_203. https://doi.org/10.2908/NRG_PC_203

Custom dataset:
https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_203__custom_13399174/default/table?lang=en

Table 3-30: Price of natural gas for non-household uses; Consumption band I2.

Member State	Natural gas price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band I2 (annual consumption from 1,000 GJ to 9,999 GJ)	
	Semester 1 - 2021	**Semester 1 - 2024**
Austria	0.0375	0.0739
Belgium	0.0280	0.0567
Bulgaria	0.0294	0.0468
Croatia	0.0289	0.0582
Czechia	0.0261	0.0718
Denmark	0.0519	0.0752
Estonia	0.0342	0.0551

Member State	Natural gas price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band I2 (annual consumption from 1,000 GJ to 9,999 GJ)	
Finland	0.0602	0.0808
France	0.0422	0.0912
Germany	0.0405	0.0816
Greece	0.0359	0.0522
Hungary	0.0249	0.0808
Ireland	0.0390	0.0785
Italy	0.0406	0.0730
Latvia	0.0284	0.0564
Lithuania	0.0311	0.0438
Luxembourg	0.0391	0.0905
Netherlands	0.0693	0.1241
Poland	0.0320	0.0749*
Portugal	0.0375	0.0733
Romania	0.0272	0.0528
Slovakia	0.0368	0.0800
Slovenia	0.0385	0.0692
Spain	0.0328	0.0543
Sweden	0.0756	0.1119
European Union - 27 countries (from 2020)	0.0400	0.0789

(*) Data for Semester 2 - 2023

Source: Eurostat (2024), Gas prices for non-household consumers - bi-annual data (from 2007 onwards). Online data code: nrg_pc_203. https://doi.org/10.2908/NRG_PC_203

Custom dataset:
https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_203__custom_13399174/default/table?lang=en

Water costs

The New International Benchmarking Network for Water and Sanitation Services (New IBNet)[56], set up by the World Bank, provides an international benchmark for the price of water, by obtaining data from utilities. **Table 3-31** below provides the average (based on population served) and extreme prices per m^3 of water, based on a consumption of 15 m^3 per month, for all EU27 Member States (except Ireland).

[56] https://newibnet.org/about-us-0

Table 3-31: Prices of water from utilities in EU Member States.

EU Member State	Price per m^3 in EUR for a consumption of 15 m^3 / month		
	Average, based on population served	Minimum	Maximum
Austria	2.07	1.67	2.84
Belgium	2.82	2.06	3.43
Bulgaria	1.36	0.56	2.38
Croatia	1.73	0.80	3.18
Cyprus	1.60	1.56	1.66
Czech Republic	2.57	1.98	3.19
Denmark	3.19	2.52	4.53
Estonia	1.42	0.71	1.72
Finland	2.52	2.04	3.89
France	2.05	0.65	2.94
Germany	2.95	2.19	3.85
Greece	1.06	0.64	1.69
Hungary	0.81	0.52	1.17
Italy	1.37	0.36	2.77
Latvia	1.14	0.95	1.44
Lithuania	1.26	0.53	2.00
Luxembourg	3.15	3.15	3.15
Malta	2.73	2.73	2.73
Netherlands	2.21	1.84	2.44
Poland	1.38	0.78	1.98
Portugal	1.53	0.78	2.72
Romania	1.33	0.61	1.96
Slovakia	1.47	1.20	1.83
Slovenia	1.22	0.99	1.49
Spain	1.89	0.72	2,42
Sweden	2.90	1.27	4.06
EU 27*	1.91	0.36 (IT)	4.53 (DK)

(*) At EU scale: simple average from all national averages, absolute minimum and absolute maximum observed across all Member States.

Exchange rate 1 EUR = 1.08 USD from: European Central Bank https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-usd.en.html observed on 22 October 2024.

Source: New International Benchmarking Network for Water and Sanitation Services (New IBNet) https://tariffs.ib-net.org/sites/IBNET/VisualSearch?RegionId=3&Weight=0&ServiceId=2&Yearid=0&perPage=50

Detergent costs

The market in Europe (European Union 27 + UK + CH + NO) for household detergents for laundry care was split in 2023, as described by the European Association of detergents and maintenance products (AISE), is summarised in **Table 3-32** below.

Table 3-32: EU (+UK + CH + NO) market of household detergents for laundry care in 2023.

Category of household laundry care detergent	Value of European market in 2023 (EUR bio.)	% of total
Liquid detergents	5.6	32.7 %
Powder detergents	2.3	13.5 %
Detergent unit doses	2.7	15.8 %
Fabric conditioners	3.1	18.1 %
Laundry aids; others	3.4	19.9 %
All	**17.1**	**100.0 %**

Source: European Association of detergents and maintenance products (AISE) A.I.S.E. in Facts and Figures 2024, available at: https://aise.eu/app/uploads/2024/06/A.I.S.E.-in-Facts-and-Figures-2024.pdf

The data for commercial and industrial products, i.e. those relevant for our study, provided by AISE (same source) does not provide the breakdown per category. The overall market for laundry detergents for commercial and industrial laundry machines is however provided, and amounted to **EUR 600 M** in 2023, experiencing a +7.8 % growth compared to 2022 values.

This sum has been used to process a total of ca. 7.3 M tonnes of laundry per year (as per the approximation of **Section 3.2.3.2**).

As a consequence, we will assume a cost of detergent in the range of EUR 82 per tonne of processed laundry, or **EUR 0.082 / kg of laundry**.

3.2.4.4. Maintenance and service costs

Stakeholders have commented that service contracts are usually included as part of the purchase of commercial and industrial laundry equipment. The exact nature of the contracts can vary and depends on the type of equipment, complexity and capital cost. Normally more sophisticated and expensive equipment have more elaborate and comprehensive service contracts to help ensure a long product lifetime and payback period on capital investments. For smaller appliances dealers or wholesalers may provide warranty services to clients on behalf of the manufacturer, or they may also provide the warranty services at their own expense as part of the dealer arrangement between themselves and the manufacturers. For heavy duty appliances, the manufacturer typically services the product as these products are also typically sold directly from the manufacturer themselves. The amount of money represented by the maintenance and repair costs is not negligible in the assessment of the LCC of commercial and industrial laundry appliances. Stakeholders have estimated that maintenance and repair costs represent approximately:

- 3 % of the purchase price of the product over the whole lifetime for categories WM1-2-3 and D 1-2-3;
- 25 % of the purchase price over the whole lifetime for categories WM 4-5;
- 18 % of the purchase price over the whole lifetime for categories D4.

These values will be used to estimate the LCC of the appliances later in the study.

A study[57] in the US also assessed the annual repair and maintenance costs of commercial and industrial washer equipment. The ratios of the repair and maintenance costs (over the lifetime) on the purchase price of three product categories are presented in **Table 3-33**.

Table 3-33: Repair and maintenance costs over lifetime of commercial and industrial laundry equipment.

Category	Purchase price	Repair and maintenance costs over lifetime	Ratio
Single-load	$ 1,090	$ 274	25 %
Washer extractor	$ 190,000	$ 112,500	59 %
Tunnel washer	$ 1,100,000	$ 209,000	19 %

Despite slight differences in the product category definitions between the two studies, single-load machines are similar to WM1 while washer extractors correspond to WM2-3 and tunnel washers to WM7. The amount of money spent for repair and maintenance over the lifetime of the appliances is much larger according to this table, than the 3% indicated by stakeholders but is similar for tunnel washers (19 %). This is most likely due to differences in definition and differences between the US and EU markets, for example in terms of service contracts. The feedback from the manufacturers was therefore used as estimations of the maintenance and repair costs.

Stakeholders have commented that the most common items for maintenance on commercial and industrial laundry equipment are control panels, doors, drive belts, and heating elements. All these components in commercial and industrial laundry machines and dryers are easily replaceable and generally justify maintenance rather than replacing the entire machine. The most common cause for commercial or industrial laundry machine breaking is operator misuse or abuse.

3.2.4.5. Disposal costs

In general, most commercial laundry service establishments need a working laundry appliance for daily operation. As a result, for all replacement sales, the old laundry unit is removed at the same time as the new unit is provided.

Many commercial or industrial laundry machines can be refurbished and resold as second-hand products by dealers. These products generally are given some new elements (drive

[57] Navigant Consulting (2009); Energy Savings Potential and RD&D Opportunities for Commercial Building Appliances, for US Department of Energy.

belts, doors...) as was described as the most common items to fail in the maintenance section. Commercial and industrial laundry equipment that is not refurbished is almost always recycled for scrap parts. A large majority of the materials is valuable metallic parts (stainless steel) and the value for scraps is high. As a result, most dealers or manufacturers will offer to remove the old appliances on purchase and delivery for new units and may even provide the customer with a discount for the salvaged product.

As a result, this study will assume the **disposal cost for commercial and industrial laundry equipment is 0 Euro per product.**

3.2.4.6. Inflation and interest rates

Table 3-34 below provides the Harmonised Index of Consumer Prices (HICP) for the European Union (EU27 as of 2020) over the period 2014-2023, for all items, as provided by Eurostat. This index is the standard indicator to account for **inflation**. It is presented as an index and in the form of the relative year-to-year increase (in percentage points). Inflation has remained very low (below 1 % per annum) until 2021 and increased sharply in 2022 following the Russian aggression war in Ukraine and decreases since that date. The annual rate of change of prices in November 2024 in the EU had returned to 2.5 % per annum[58].

Table 3-34: Inflation in the EU27: All-items Harmonised Index of Consumer Prices, 2014-2023.

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Index	99.89	100.00	100.18	101.74	103.57	105.04	105.76	108.82	118.82	126.38
Year to year change (%)	0.4	0.1	0.2	1.6	1.8	1.4	0.7	2.9	9.2	6.4

Source: Eurostat (2025) HICP - annual data (average index and rate of change) Online data code: prc_hicp_aind, available at: https://ec.europa.eu/eurostat/databrowser/view/prc_hicp_aind__custom_14906453/default/table?lang=en

Figure 3-8 below shows the **long-term interest rates** in the EU27 as of 2020, defined by Eurostat as the yield of State bonds with a maturity of 10 years and as defined by the Maastricht Treaty convergence criteria, over the period 2010-2024. As can be seen, these interest rates have decreased between 2012 and 2015 from 4 % per annum to ca. 1 %, then further to below 0.5 % during the Covid-19 pandemic period. It rose again sharply to 3 % per annum as of February 2022, when the Russian aggression war in Ukraine triggered a strong inflation.

[58] Eurostat (2025) HICP - monthly data (annual rate of change) Online data code: prc_hicp_manr, available at: https://ec.europa.eu/eurostat/databrowser/view/prc_hicp_manr__custom_14907240/default/table?lang=en

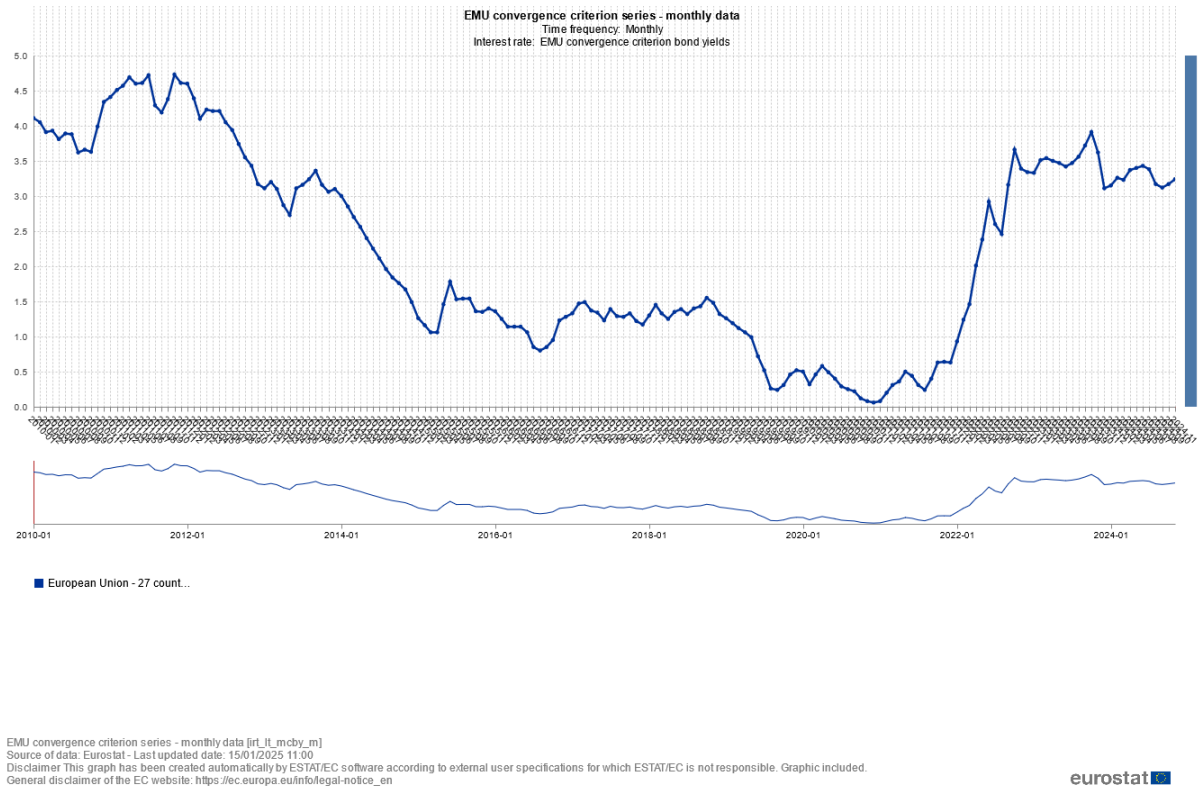

Figure 3-8: Long-term interest rates in the EU27 (2010-2024), in percentage points / year.

Source: Eurostat (2025) EMU convergence criterion series - monthly data Online data code: irt_lt_mcby_m, MEErP Task 3 – Users[59]

Consumer behaviour can be influenced by product design, making it a relevant input for assessing a product's environmental impact and LCC. The objective of MEERrP Task 3 is to identify, retrieve and analyse data on user behaviour and associated environmental impacts during the product's use phase. The demands and behaviour can be influenced by product design, and information can influence behaviour, and vice versa. The modalities of the application phase of commercial and industrial laundry equipment, as well as the usage parameters, are important inputs for the assessment of the environmental impact of the product group. Among others, this task seeks to identify obstacles to possible ecodesign measures relating to consumer behaviour, which sometimes stem from social, cultural or infrastructural factors. The assessment will also seek to quantify relevant user parameters that influence the product's environmental impact over its lifetime, taking into account parameters that may differ from the standard test conditions described in MEErP Task 1 (see **Section 3.1**). The choice of the appropriate washing machine or dryer type depends, amongst other criteria, on the amount of laundry to be cleaned or dried in the establishment. Thus, **Section 3.2.6** provides a first overview of the main application areas and capacity ranges of the different product categories. Combined with the typical use intensity for each washing machine and dryer category, the total amount of cleaned and dried laundry per year for each product category is calculated (**Section 3.2.7**).

[59] available at: https://ec.europa.eu/eurostat/databrowser/view/irt_lt_mcby_m__custom_14906987/default/table?lang=en

In **Section 3.2.8**, ideal user behaviour is described in general, which is intended to correlate to the specific consumption values (i.e. per kilogram laundry) given by manufacturers. By multiplying the typical weight of laundry cleaned or dried per year with the specific consumption values, the energy, water and detergent consumption per year under ideal conditions are calculated for each product category.

Aspects of real-life operating conditions and their influence on the consumption of the appliances is quantified (if possible) are described in **Section 3.2.9**, measures to optimise user behaviour and consumption parameters in **Section 3.2.9.2**, and infrastructure parameters in **Section 3.2.10**. Finally, **Section 3.2.11** gives information about the end-of-life behaviour, i.e. repair-, maintenance and disposal practice.

3.2.5. Collection of data and its quality

The initial phase of the preparatory study involved the preparation of a draft report, which was based on data from the 2011 study. This report was then reviewed and contextualised with publicly available information. Concurrently, a stakeholder consultation questionnaire was developed, drawing on the data from the 2011 study. Stakeholders were invited to provide updated information on all relevant aspects addressed in MEErP Tasks 3 and 4. However, the stakeholder consultation yielded very few new data. Consequently, the draft report, which was to serve as the backgrounder for the 1st stakeholder workshop, presented an interim dataset derived from the 2011 dataset, with an assumed generic 10 % increase in efficiency assumed for all efficiency-related aspects concerning the seven categories of commercial and industrial washing machines and the five categories of commercial and industrial dryers mentioned in the 2011 Study. The 10 % efficiency increase has been applied in order to reflect the general progress in the technological development of the sector during the 13-year period since 2011.

The dataset pertaining to MEErP Tasks 3 and 4, having undergone the aforementioned adjustments, was presented and discussed during the first stakeholder workshop. Subsequently, the stakeholder consultation was extended and a second call for updated information was issued. The results of the extended consultation, as outlined in the present report of the preparatory study, have been incorporated into the report. However, it should be noted that no new information has been provided concerning a number of aspects that are addressed in MEErP Tasks 3 and 4. In these cases, the extrapolation of a 10 % efficiency increase in comparison to the 2011 data has been retained.

3.2.6. Typical capacity and use intensity

There is a wide variety of commercial and industrial washing machines and dryers in terms of performance parameters and washing efficiency. These fall into a number of different product categories (see MEErP Task 1 in **Section 2.1**) that meet different customer needs, depending on the market segments and the specific application scenarios. Factors such as the periodicity of laundry, standby times during weekends, the skill of the workforce and the choice of specific laundry presets all play a part in this. User-related aspects also determine the size and capacity requirements of laundry machines, which influence the performance characteristics.

Moreover, the lifespan of laundry machines (comprising both washing and drying appliances) is contingent upon a number of factors, including the decisions made by the users. These decisions are largely shaped by economic considerations, as well as the specific performance requirements of the users. Since the different categories of washing machines and dryers identified in MEErP Task 1 differ in their intended usage scenarios, these categories are assigned to key market / customer areas (see MEErP Task 2 in **Section 0**).

Table 3-35 and **Table 3-36** give an overview of the main applications of these product categories thus providing a first indication of a possible use intensity of commercial and industrial washing machines and dryers.

Table 3-35: Key market segments of commercial and industrial washing machines according to spatial requirements and operator skills.

Product category	Key market segment	Spatial requirements	Filling ratio[60]	Main operator / user type	Lifetime
WM1: Light duty commercial washer extractor	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Rather small amount of space necessary, fit in existing customer premises	1:8–1:10	Mainly private customers and semi-skilled personnel (with few exemptions)	5,000 up to 15,000 cycles
WM2: Commercial washer extractor (designed for extra long durability)	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL); Hospitality Laundry (HPL); Commercial Industrial Laundry (CIL).	Used in different market segments; Medium to large space necessary, fit in existing customer premises	1:8-1:10	Semi-skilled workers under supervision of trained personnel; Trained personnel.	30,000 up to 80,000 cycles
WM3: Commercial washer dryer	Hospitality Laundry (HPL)	Medium amount of space necessary. Used in different market segments.	1:9–1:12	Semi-skilled workers under supervision of trained personnel	30,000 up to 80,000 cycles
WM4: Commercial barrier washer	Healthcare Laundry (HCL)	Medium amount of space necessary. Customised user premises required	1:9–1:12	Trained personnel	45,000 cycles
WM5: Industrial continuous tunnel washer	Commercial Industrial Laundry (CIL)	Large amount of space required in laundries	1:10–1:12	Trained personnel	41,000 hours

Source: own compilation based on information received during stakeholder consultation and workshop.

60 The applicable filling ratio depends on the density of the laundry to be washed/dried

Table 3-36: Key market segments of commercial and industrial dryers according to spatial requirements and operator skills.

Product category	Key market segment	Spatial requirements	Filling ratio[60]	Main operator / user type	Lifetime
D1: Light duty commercial tumble dryer	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Rather small amount of space necessary, fit in existing customer premises	1:18–1:25	Mainly private customers and semi-skilled personnel (with few exemptions)	5,000 up to 15,000 cycles
D2: Commercial tumble dryer (designed for extra long durability)	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL); Hospitality Laundry (HPL); Commercial Industrial Laundry (CIL).	Rather small amount of space necessary, fit in existing customer premises; Medium amount of space necessary. Used in different market segments; Large amount of space required in laundries.	1:18-1:25	Private customers and semi-skilled personnel; Trained personnel.	30,000 up to 80,000 cycles
D3: Commercial cabinet dryer	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Rather small amount of space necessary, fit in existing customer premises	1:18–1:25	Mainly private customers and semi-skilled personnel (with few exemptions)	30,000 up to 80,000 cycles
D4: Industrial pass-through (transfer) tumble dryer	Commercial Industrial Laundry (CIL)	Large amount of space required in large laundries	1:20–1:25	Trained personnel	50,000 – 100,000 hours

Source: own compilation based on information received during stakeholder consultation and workshop.

Light duty commercial and small size commercial washing machines and dryers are used mainly in coin & card operated laundromats as well as in apartment house laundries (WM1 and smaller machines in WM2 as well as D1, D3 and smaller machines in D2). The quantity of laundry to be cleaned on a daily basis is relatively modest, and the washing machines are operated in a discontinuous/intermittent mode. The end-users, who are predominantly private consumers and small businesses, do not receive any specialised training apart from that which is provided in the manuals supplied by the equipment manufacturer. Light duty commercial machines may also be operated by trained people, for example when setting up a machine in a commercial laundromat.

Categories WM3 and smaller machines of WM2 as well as smaller machines of D2 are often used both by semi-skilled workforce or (and supervised by) trained employees – it depends

on the respective customer segments. In contrast, the industrial or heavy-duty appliances WM4 and WM5 as well as D4 and bigger machines of D2 are generally operated by well-trained persons. The customers within the market segments and the respective countries obtain their equipment e.g. by purchasing, leasing or renting contracts (see **Section 0**). Use of the heavy-duty categories (e.g. tunnel washers or pass-through dryers) generally means a relatively high throughput of laundry to be cleaned on a daily basis, as well as a continuous supply of textiles for laundering. Heavy-duty equipment requires a large amount of space and adequate auxiliary installations, such as loading ramps, logistic area etc. They are therefore mainly used in commercial or industrial laundries, for example in large hospitals or specialised laundry contractors. The categories WM3 and part of D2 are used in the hospitality sector (hotels, restaurants etc.). The barrier washer (WM4) is installed in spaces with very high hygiene demands.

In relation to the operational lifespan of laundry machines, the initial service life is generally between 10 and 30 years. It is noteworthy that the WM5 and D4 models are likely to have the longest service life, with a maximum runtime of 50,000 to 100,000 hours in both categories. The stakeholder consultation yielded only limited information of a detailed nature concerning the anticipated service lives of the respective categories.

As indicated by the statements provided by the relevant stakeholders, the repair and refurbishment of commercial and industrial laundry appliances have been a common practice among manufacturers for years. Refurbishment is practiced for several laundry appliance categories and there seems to be a second-hand market for refurbished components that are used as spare parts. The extent to which this practice can extend the planned lifetime of an appliance remains largely unclear. Some stakeholder responses indicate a possible lifetime extension by 5-10 years, at least for the large industrial equipment.

3.2.7. Annual weight of cleaned and dried laundry

The intensity of use depends mainly on the main customer segment for each category, as it defines the number of cycles per day, the number of working days per year and the amount of load to be treated per cycle. The following sections describe typical operating conditions for each appliance type across different customer segments, with the aim of calculating the amount of laundry typically cleaned per year. **Table 3-37** and **Table 3-38** set out the assumptions made regarding the following parameters:

Typical nominal capacity for each product category

- in kg per cycle (WM1-4 and D1-3);
- in kg per hour (WM5 and D4);
  - Average load workload (%) in different customer segments;
  - Number of average washing and drying cycles per day (categories WM1-4, D1-3);
- typical time span (hours) of operation mode per day (categories WM5 and D4)
- Number of working days per year (all categories).

The data provided by stakeholders during the initial consultation[61] was then used to calculate the annual amount (in tons) of cleaned or dried laundry for each product category. This serves as the basis for calculations of annual energy consumption. The consumption of water and detergent under both ideal and real-world conditions is also considered.

[61] Please note that later stakeholder input led to a revision of this data, see Section 3.4.7.

3.2.7.1. Intensity of use of commercial and industrial washing machines

Table 3-37: Typical intensity of use of the regarded washing machine categories.

Washing machine category	Customer segment*	Typical nominal capacity in kg/cycle	Average workload in %	Washing cycles per day	Daily cleaned laundry in kg/day	Number of working days per year	Annually cleaned laundry in tons/year
WM1 Light duty commercial washer extractor	Coin & Card / AHL	6	65 %	6	23	300	7
	Hospitality	6	70 %	8	34	220	7
	Health care Hospital	6	70 %	8	34	220	7
	Health care Nursing home	6	70 %	6	25	220	6
	Commercial Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Speciality Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
WM2 Commercial washer extractor	Coin & Card / AHL	10	60 %	8	48	300	14.4
	Hospitality	10-24	80 %	10	80-192	220	18-42
	Health care Hospital	10-24	80 %	10	80-192	220	18-42
	Health care Nursing home	10-24	80 %	10	80-192	220	18-42
	Commercial Laundry	24	80 %	12	230	300	69
	Speciality Laundry	24	80 %	10	192	300	58
WM3 Commercial washer dryer	Coin & Card / AHL	6	60 %	10	36	300	11
	Hospitality	6	70 %	8	34	220	7.4
	Health care Hospital	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Health care Nursing home	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Commercial Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Speciality Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Washing machine category	Customer segment*	Typical nominal capacity in kg/cycle	Average workload in %	Washing cycles per day	Daily cleaned laundry in kg/day	Number of working days per year	Annually cleaned laundry in tons/year
WM4 Commercial barrier washer	Coin & Card / AHL	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Hospitality	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Health care Hospital	32	80 %	10	256	220	56
	Health care Nursing home	32	80 %	10	256	220	56
	Commercial Laundry	32	80 %	5	128	300	38
	Speciality Laundry	32	80 %	8	205	300	61
WM5 Industrial continuous tunnel washers[62]	Coin & Card / AHL	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Hospitality	n.a.	n.a.	n.a.	n.a.	n.a.	n.a
	Health care Hospital	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Health care Nursing home	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Commercial Industrial Laundry	1,500 kg/h (1,000–2 000)	85 %	10 h	12,750	300	3,825
	Speciality Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not applicable or no information available

[62] The production volumes of the individual laundries included in the survey varies quite a lot. A resource survey conducted in 2015 by SDU Life Cycle Engineering for ETSA related to 242 European laundries reveals different ranges of volumes depending on the processed textile categories: Workwear (91 plants in the survey): minimum 109.4 tons/year, maximum 7,347 tons/year, average 1,883 tons/year; linen (63 plants in the survey): minimum 280.6 tons/year, maximum 23,268 tons/year, average 5,935 tons/year; mats (31 plants in the survey): minimum 652.8 tons/year, maximum 12,548 tons/year, average 3,584 tons/year (SDU Life Cycle Engineering 2016.)

3.2.7.2. Intensity of use of commercial and industrial dryers

Table 3-38: Typical intensity of use of the regarded dryer categories.

Dryer category	Customer segment*	Typical nominal capacity in kg/cycle	Average workload in %	Drying cycles per day	Dried laundry per day in kg/day	Number of working days per year	Dried laundry per year in tons/year
D1 Light duty commercial tumble dryer	Coin & Card / AHL	6	60 %	6	22	300	7
	Hospitality	6	70 %	8	34	220	7
	Health care Hospital	6	70 %	6	25	220	6
	Health care Nursing home	6	70 %	6	25	220	6
	Commercial Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Speciality Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
D2 Commercial tumble dryer	Coin & Card / AHL	10	60 %	8	48	300	14
	Hospitality	10-23	80 %	10	80-184	220	18-41
	Health care Hospital	10-70	80 %	10	80-280	220	18-62
	Health care Nursing home	10-70	80 %	10	80-280	220	18-62
	Commercial Laundry	70	80 %	10	560	300	168
	Speciality Laundry	70	80 %	8	448	300	134
D3 Commercial cabinet dryer	Coin & Card / AHL	8	60 %	6	29	220	6
	Hospitality	8	70 %	6	34	220	7
	Health care Hospital	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Health care Nursing home	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Commercial Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Speciality Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
D4	Coin & Card / AHL	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Dryer category	Customer segment*	Typical nominal capacity in kg/cycle	Average workload in %	Drying cycles per day	Dried laundry per day in kg/day	Number of working days per year	Dried laundry per year in tons/year
Industrial Pass-through (transfer) tumble dryer	Hospitality	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Health care Hospital	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Health care Nursing home	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Commercial Industrial Laundry	400 kg/h (300–500)	85 %	10 h	3,400	300	1,020
	Speciality Laundry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not applicable or no information available so far

Source: own calculations based on stakeholder feedback from survey and literature

3.2.7.3. Dosage and consumption of detergents

Commercial customers typically seek to achieve optimal wash performance, defined as the lowest cost per wash, which may entail the lowest possible detergent concentration and temperature. Moreover, there is a clear demand from customers for products that offer enhanced safety and simplicity in handling, as well as a high level of automated service. Laundry operators tend to seek more automatic and controlled dosing systems, straightforward and user-friendly systems, convenience and ergonomics, multi-component systems, hygiene claims, powders and liquids, lower temperatures (40-60 °C), sustainable solutions – that is to say, energy, water, and cost savings.

It is therefore in the interest of professional laundries to purchase a comprehensive service package that addresses their specific laundry needs in order to optimise their operations. Suppliers to professional laundries must therefore offer complete systems including installations, control systems and dosing equipment or other hardware. In addition, laundries also demand other services such as training of personnel, advice on effluent control measures and monitoring of wash performance and hygiene.

Modern detergent systems, including powder, liquid, paste and combination systems, can be automatically or manually dosed into the washing machine. Many machines are equipped with pre-set washing programmes and temperatures, as determined by the manufacturer. There are several advantages to using automatic dosing equipment, including reduced workload, reduced manual handling, minimised chemical exposure, accurate and consistent dosing, and process validation.

Detergent consumption in commercial washing machines depends on a number of factors. Some of these are described below:

- There is a significant regional variance in water quality, with notable differences in water hardness levels. In Norway, water hardness is relatively low, while in Spain, Turkey, and Switzerland, it exceeds 30 °DH in some places. This necessitates the use of detergents tailored to specific water hardness levels to achieve optimal wash results (soft, medium or hard water).
- Detergents vary in ingredients, affecting the amount needed for concentrated vs. non-concentrated products, as well as powder vs. liquid forms. To compare washing machines, specify the detergent type and amount, as different detergents yield different results. Despite formulation changes, using a standard detergent is necessary.
- In addition to the EU Detergent Regulation, various national legislations exist, which may result in the restriction of certain washing-active ingredients (e.g. phosphate, EDTA) in detergent products.
- The customer's perception of product effectiveness may also vary depending on the ability of the detergent to clean specific textile stains in different application areas (e.g. blood in laundry from medical applications, oil in industrial applications).
- In addition, the different acceptance of costs by customers results in significant variations in product dosage across various European countries.

According to stakeholder feedback, for industrial washing machines, industrial strength powders, pastes and liquid with high alkalinity and adjuncts for adding more as well as separate chlorine and oxygen bleach additions are used.

The dosage of detergent and laundry aids during the operation of commercial and industrial washing machines can be determined by:

- the operators of the washing machines decide on the dosage based on their specific needs and based on experiences.
- Assistance by service providers of automatic dosing equipment or detergent suppliers
- Generic recommendations provided by the manufacturers of the washing machines.

The majority of commercial and industrial laundry equipment appears to be built and shipped with a set of pre-programmed washing and drying programmes defined by the manufacturers (with the exception of industrial apparatus WM5 and D4 which are fully programmable, for industrial washing machines in co-operation with detergent technical support). These programmes typically include the following specifications: intended type of textile, temperature, water level, number of wash and rinse segments, spinning profile.

There is no one-size-fits-all dosage solution for every customer. Most customers use more than one washing programme, which can be customised. In contrast to the household sector, some commercial laundry equipment allows users to modify the specifications of the washing processes or programme the laundry process individually. Should customers have the capability to customise their laundry settings, then the energy, water and detergent consumption will depend on the settings chosen for their individual washing recipe, rather than on the presets provided by the manufacturer. Moreover, discrepancies in detergent consumption across product categories can be attributed to varying load ratios, dosing system types and water consumption per functional unit.

During the stakeholder consultation, part of the preparatory study, no new information could be obtained regarding the actual use of detergents and laundry aids in professional laundry businesses in the EU. For the purposes of this study and the subsequent calculations, the following concentration values for detergents, including laundry aids, have been assumed on the basis of the former 2011 preparatory study (Lot 24) (in brackets: range of data):

- WM 1+2: 17 (17 – 20) g/kg
- WM 3+4: 12 (8-20) g/kg
- WM 5: 9 g/kg

Only at the latest status of this preparatory study, after finalising the LCA and LCC assessments of the MEErP Task 5 and Task 6 reports with the input data listed above, further stakeholder input was received on the detergent consumption for category WM5 at the level of laundry facilities. Depending on the processed textiles, a survey among 242 laundries in the year 2015 revealed that the weighted average detergent consumption (best practice consumption levels) of laundries with a focus on mats was 4.8 g/kg, of laundries with a focus on linen was 5.9 g/kg, and of laundries with a focus on workwear was 23 g/kg in the year 2015 (SDU Life Cycle Engineering 2016).

3.2.8. Ideal operating conditions and user behaviour

Manufacturers typically provide information about the energy and water consumption under 'ideal' use conditions, that means in regard to a standardised testing procedure. This means that:

- 'Standard' laundry type is used (e.g. cotton test stripes with standard soiling);
- The load capacity in kg (or drum volume in l) of the washing machine / dryer is fully used;
- The most common washing or drying programme (duration and temperature) is used;
- Consumption during performance tests is determined by the respective testing standard is, i.e. under specified ambient conditions, e.g. room-, water-, machine temperature, air humidity etc.
- External influences independent from the machine are not considered;
- Energy consumption in low-power modes (e.g. end-of-programme) is not included;
- Washing tunnels: average 'standard' model with a 'standard' configuration chosen (pre-wash, main wash, rinse, neutralisation, extraction);
- Dryers: The impact of washing and drying appliances on the overall process is considered, ensuring that the residual moisture of the laundry is optimally aligned with the specific requirements of each laundry type and market segment, thus facilitating the subsequent drying process.

Energy, water and detergent consumption under ideal conditions

Table 3-39 and **Table 3-40** provide an overview of the specific average energy, water and detergent (incl. laundry aid) consumption of the different washing machine and dryer categories. The given data is based on the main customer segment (see MEErP Task 2), on cold water connection (water temperature 15 °C) and on the main energy source, the consumption range given in brackets reflects the different ranges of capacity sizes and heating options within each machine category. The tables show the consumption values of washing machines and dryers with an average technology (not including special BAT) being offered currently on the market. They are used for preliminary calculation of energy, water and detergent consumption during the use phase under ideal conditions in order to give an overview on the environmental relevance of the different washing machine and dryer categories and to subsequently determine the influence of specific aspects of user behaviour which are not included under ideal conditions.

Note: The following data correspond to 1 kg of laundry as specified by the manufacturer. The values are given with a degree of uncertainty. In addition, the values represent ideal conditions as described above. In order to compare the energy consumption of different machines, it is advisable to select an energy-saving programme with minimum performance requirements as the basis for comparison.

Table 3-39: Specific energy, water and detergent consumption of an average current device of different washing machines categories under ideal conditions.

Washing machine category	Energy consumption (range)	Water consumption (range)	Detergent / laundry aid consumption (range)
	kWh/kg laundry	l/kg laundry	g/kg laundry
WM1: Light duty commercial washer extractor	0.13 (0.13 – 0.32)	8 (7 – 13)	15 (15 – 18)
WM2: Commercial washer extractor	0.17 (0.14–0.50)	12 (10–18)	17 (8–20)
WM3: Commercial washer dryer	0.7	9 (8–12)	13 (8–20)
WM4: Commercial barrier washer	0.3 (0.28–0.50)	14.5 (14–18)	16 (15–20)
WM5: Industrial continuous tunnel washers	0.3 (0.30–0.40)	5.4 (4–8)	8

Source: data extrapolated from data of the Lot 24 study (2011) with adjustments based on stakeholder provided updates in 2024

Table 3-40: Specific energy consumption of an average current device of different dryer categories under ideal conditions.

Dryer category	Energy consumption (range) kWh/kg laundry
D1: Light duty commercial tumble dryer	0.54
D2: Commercial tumble dryer	0.65 (0.40–0.95)
D3: Commercial cabinet dryer	0.75 (0.60–0.90)
D4: Industrial Pass-through (transfer) tumble dryer	0.8 (0.70–0.90)

Source: data extrapolated from data of the Lot 24 study (2011) with adjustments based on stakeholder provided updates in 2024.

Based on the annual weight of cleaned and dried laundry given in **Table 3-37** and **Table 3-38**, the following **Table 3-41** and **Table** 3-42 show the annual consumption of energy, water and detergent (incl. laundry aid) for each of the washing machine and dryer categories **under ideal conditions.**

Table 3-41: Annual energy, water and detergent consumption of different commercial and industrial washing machine categories under ideal conditions.

Category	Cleaned laundry	Energy consumption	Water consumption	Detergent / laundry aid consumption
	tons/year	kWh/year	litres/year	kg/year
WM1: Light duty commercial washer extractor	7	910	56,000	105
WM2: Commercial washer extractor	69	11,730	828,000	1,173
WM3: Commercial washer dryer	7.4	5,180	66,600	96
WM4: Commercial barrier washer	56.3	16,890	816,000	901
WM5: Industrial continuous tunnel washers	3,825	1,147,500	21 Mio	30,600

Source: adopted from Lot 24 study (2011) and stakeholder provided updates in 2024.

Table 3-42: Annual energy consumption of different commercial and industrial dryer categories under ideal conditions.

Category	Dried laundry	Energy consumption
	tons/year	kWh/year
D1: Light duty commercial tumble dryer	6.5	3,380
D2: Commercial tumble dryer	15 - 168	71,160
D3: Commercial cabinet dryer	6.3	5,418
D4: Industrial Pass-through (transfer) tumble dryer	1,020	816,000

Source: adopted from Lot 24 study (2011) and stakeholder provided updates in 2024.

3.2.9. User behaviour in practice

In the technical information sheets of commercial and industrial washing machines and dryers, the energy, water consumption is typically specified under ideal conditions. It is important to recognise that there can be significant discrepancies between the energy, water, and detergent consumption under ideal (i.e. test) settings and the application of the same apparatus in real-life situations:

- The user behaviour during continuous operation is not 'ideal':
  - Customer segments: depending on the specific customer segment the machines might be used differently (cf. **Table 3-37** and **Table 3-38)**;

  - Workload: compared to the rated capacity the machines might not be fully loaded, leading to a higher consumption per kg laundry;
  - Other programmes: the consumption data usually represent the consumption of the most used programme. However, the machines are also used in other programmes;
  - Maloperation: Mistakes in user behaviour (e.g. incorrect dosage of the detergent and laundry aid) lead to increased consumption. Or: systemic influences (interaction of washing and drying appliances) are not taken into account so that the residual moisture of the laundry coming out of the washing process is not ideal with respect to each laundry type and market segment for the following drying process, leading to increased energy consumption;
- Washing machines or dryers can also be in low-power modes; the duration e.g. in left-on mode might represent a quite long period of time causing additional standby consumption.

The following sections provide a more detailed overview of these parameters and illustrate their impact in comparison to consumption under ideal conditions. However, some of the parameters included in the working paper are challenging for stakeholders to define. Therefore, the 'average' values represent the most accurate estimates, based on input from stakeholders or the authors of this study.

3.2.9.1. Influence of user behaviour

Customer Segments

It is important to note that typical user behaviour may vary significantly across different customer segments. For instance, the use of a light duty commercial washer extractor (category WM1) in the Hospitality Laundry (HPL) sector may result in different energy and water consumption compared to the use of the same machine type in the Coin & Card Laundry (CCL) sector. This is due to differences in the types of laundry and the average user behaviour (private customers vs. trained personnel) across the two segments. For instance, in view of the need for enhanced hygiene standards, the typical washing temperature in the HPL sector may be higher than that required for use in hotels. The same applies to the use of special detergents and bleaching agents.

In the course of the consultation, stakeholders were asked to specify the different consumption values with regard to all relevant customer segments. However, no detailed consumption data at this level of quantification was obtained from stakeholders. As the preparatory study addresses the average energy and other resources consumption, the typical machines and applications in the key customer segment for each washing machine and dryer category were approximated.

Partial workload

Technical information sheets for commercial and industrial washing machines and dryers typically specify the energy and water consumption under standardised performance test

conditions and full load. However, in real-life operating conditions, the workload (in kilograms of laundry in the drum) of washing machines and dryers may be considerably lower. This is due to the fact that, despite the commercial or industrial operation of the machines, the processes are customer and laundry type specific; i.e. no mix of laundry from different customers or different laundry types is applied, reducing the possibility of always using full load capacities. This is particularly relevant in the -segments WM1 and D1. Furthermore, in application areas where machines are operated by less experienced users, such as Coin & Card Laundry or Apartment House Laundry, the partial workload can be assumed to be similar to that in household applications. This partially extends to categories WM2 and D2. The impact of lower workload is difficult to quantify and can vary depending on the customer segments. Furthermore, it is contingent on the laundry process's organisational structure in its entirety.

For the purposes of the preparatory study and further calculations we assume that in the respective main customer segment the influence of real workload on the consumption of energy, water and detergent is in the range of

- Washing machines - Energy and water consumption under real life conditions:
  - Categories WM1-2: +20 % compared to the ideal operating conditions;
  - Category WM3: +10 % compared to the ideal operating conditions.
- No change for large commercial and industrial appliances (WM4-5).

Note: The concentration of the detergent solution has always to be kept at a constant level (less concentration would lead to insufficient cleaning results; overdosage on the other hand should be avoided as it might result in undesirable detergent remains on the laundry and also is a cost factor). The concentration of the detergent depends on the amount of water used for cleaning the laundry. Thus, the proportionally increased water consumption due to partial load leads to an equivalent increase of the detergent consumption.

- Dryers - Energy and water consumption under real life conditions:
  - D1: +20 % compared to the ideal operating conditions;
  - D2: +10 % compared to the ideal operating conditions. No change for large commercial and industrial appliances (D3 and D4).

Use of other programmes

The performance of the washing process depends on the following factors:

- Thermal action (i.e. water temperature),
- Mechanical action,
- Chemical action (i.e. detergent concentration), and
- Time.

Thus, choosing another temperature or programme duration by the selection of different washing or drying programmes in the use phase would also influence the overall energy, water and detergent consumption.

Table 3-43 and **Table 3-44** provide an overview of the typically used programmes (temperature, programme duration) for each product category in the respective main customer segment.

Besides the most used programme, other common programmes are selectable which mainly differ by their duration, temperature and the respective cleaning performance as well as water level and number of wash and rinse segments, thus also resulting in different consumption values. However, as many of the commercial and industrial washing machine and dryer categories are operated by trained personnel the influence of the use of other – less effective – programmes would be relevant most likely for the appliances used by non-trained personnel in CCL and AHL market segments.

A quantified influence of the use of other programmes will be presented within the next section (influence of maloperation on energy, water and detergent consumption).

Table 3-43: Programme selection of commercial and industrial washing machine categories.

Type of appliance	Duration of the typically used washing programme	Share of the typically used washing programme	Temperature of the typically used washing programme
WM1: Light duty commercial washer extractor	35–55 min	60 %	40 °C
WM2: Commercial washer extractor	35–55 min	60 %	60 °C
WM3: Commercial washer dryer	75 min (wash+dry) 50 min (wash)	60 %	60 °C
WM4: Commercial barrier washer	60 min (programmable)	60 %	60 °C
WM5: Industrial continuous tunnel washers	30 min	>90 %	>60 °C

Table 3-44: Programme selection of commercial and industrial dryer categories.

Type of appliance	Duration of the typically used washing programme	Share of the typically used washing programme	Temperature of the typically used washing programme
D1: Light duty commercial tumble dryer	30–45 min	100 %	70 °C
D2: Commercial tumble dryer	30–45 min	100 %	70 °C

Type of appliance	Duration of the typically used washing programme	Share of the typically used washing programme	Temperature of the typically used washing programme
D3: Commercial cabinet dryer	130 min	60 %	90 °C
D4: Industrial Pass-through (transfer) tumble dryer	15–25 min	> 90 min	Fresh air ~200 °C Exhaust air ~100 °C

Maloperation

Maloperation of commercial and industrial washing machines and dryers can influence the energy, water and detergent and laundry aid consumption. There are following main reasons for the maloperation of commercial and industrial washing machines and dryers:

- The 'wrong' programme, e.g. with regard to temperature and time is chosen (see also the Section above) and the laundry process has to be repeated because the result of the washing or drying process is not satisfactory. This effect arises e.g. in case of mixed laundry, as temperature is usually oriented to the most delicate laundry item.
- The concentration of detergent and laundry aid is not sufficient and the result of the washing process therefore not acceptable. The washing process has to be repeated. This occurs when the container for the detergent or laundry aid is empty, and the user does not pay attention to the corresponding signal.
- The concentration of detergent is too high resulting in a high wastewater amount and possibly residues on the textiles. This effect arises e.g. in case of mixed heavily and light soiled laundry, as the detergent concentration is usually oriented to the most soiled laundry item.

The dosage of the detergent and laundry aid can be determined by:

- Detergent manufacturers,
- Special service providers,
- The manufacturers of the washing machines or
- The operators of the washing machines.

In cases two and three, incorrect dosage of the detergent rarely occurs because service providers and manufacturers have a strong interest to deliver good washing results with least possible detergent input and will therefore pay high attention to ensure that the right concentration of detergent and laundry aid will be available. In the third case, incorrect dosage might occur from time to time, e.g. in the case of non-trained personnel.

The impact of maloperation is difficult to quantify as it can vary significantly from user to user and also depends on the overall organisation of the laundry process. For example, in market segments with commercial washing machines and dryers used by manual programme settings, manual dosage and rather untrained personnel, the error rate might be higher than in commercial and industrial market segments with highly trained personnel and machines

with higher automatisation rate. Thus, due to lack of differentiated feedback from customers, for the purposes of the study and further calculations we assume that the influence on the consumption of energy, water and detergent is on average:

- Washing machines: Impact of maloperation compared to ideal operation:
  - Categories WM1-2: +15 %
  - Categories WM3: +10 %
  - WM4 -5: 0 % (no change)
- Dryers: Impact of maloperation compared to ideal operation:
  - Categories D1-3: +15 %
  - Category D4: 0 % (no change)

Influence of low-power modes consumption

Washing machines and dryers might not be switched off directly after the end of the programme and therefore remain a certain time in 'left-on mode'. In this low-power mode, the equipment may persist for an indefinite time after completion of the programme without any further intervention by the end-user besides unloading of the appliances. Commercially used laundry machines are thought to be used more frequently and operated by more experienced personnel than household appliances, where private users may forget to switch off the appliance after use. It should also be noted that for larger commercial or industrial machines and dryers, the consumption of low-power mode is negligible due to the optimised machine performance. Therefore, in the case of commercial and industrial washing machines and dryers, the low-power mode plays a less important role to reduce power consumption.

Only for washing machine and dryer categories WM1 and D1, standby data could be quantified. The power consumption in off-mode has not been considered as it is negligible compared to the overall energy consumption of the machines. **Table 3-45** and **Table 3-46** below show the typical time and power consumption of in low-power mode.

Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.

Washing machine category	Time in low-power modes per day	low power modes consumption (in kWh/h)
WM1: Light duty commercial washer extractor	120 min	~0.003
WM2: Commercial washer extractor	60 min	~0.003
WM3: Commercial washer dryer	60 min	~0.003
WM4: Commercial barrier washer	negligible	negligible
WM5: Industrial continuous tunnel washer	negligible	negligible[63]

[63] Washing tunnel machines and transfer dryers are usually heated by steam or gas (sometimes hot water or thermo oil). Only 5 % (washing tunnels) resp. 10 % (transfer dryers) of the total energy consumption is by electricity (e.g. motor) (see MEErP Task 4). The time in low-power mode is negligible due to the optimised machine performance, resulting in standby consumption in a per million area.

n.a. = no information available

Source: manufacturers' data

Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.

Dryer category	Time in low-power mode per day	Low-power mode consumption (in kWh/h)
D1: Light duty commercial tumble dryer	180 min	~0.0025
D2: Commercial tumble dryer	n.a.	n.a.
D3: Commercial cabinet dryer	180 min	~0.003
D4: Industrial Pass-through (transfer) tumble dryer	negligible	negligible[63]

n.a. = no information available

Source: manufacturers' data

3.2.9.2. Measures to optimise user behaviour and consumption parameters

According to the analysis of MEErP Task 3 and Task 4 it is evident that a better use of laundry appliances can save a substantial amount of resources and costs. On the other hand, the additional consumption which is due to real-life conditions and behaviour will be reduced with the development and use of more efficient washing machines and dryers.

The additional consumption through real-life use results from five major reasons which could be improved by education, incentives and responsibilities. For example, it is important to explain the consequences of partial loading the machine to users as this aspect leads to increased energy, water and detergent consumption. To avoid maloperation during the washing process, responsibilities clearly assigned to users might be helpful, e.g. concerning the dosage of the detergent and laundry aid.

In case of washing machine and dryer operators not being well informed about low power modes consumption, a first step could be to educate them about such consumption in order to facilitate reduced times in low power modes of the machines (e.g. not switching on machines until needed, switching off if not needed any more).

A more detailed discussion of technical improvement options (BAT) compensation real life user behaviour, like for example automatic information and control systems, sensor systems regulating the water consumption of washing machines or the residual moisture control of dryers, will be accomplished in MEErP Task 6.

3.2.10. Infrastructure

This section aims to identify opportunities and obstacles linked to the local infrastructure which can influence the choice of commercial and industrial washing machines and dryers.

3.2.10.1. Water supply

The water for the laundry process can be received by municipal supply or by usage of self-supply (e.g. fresh water taken from wells, springs, rivers and – theoretically – rain water that mainly has to be pre-treated before application in laundry). Water acts as heating medium, transport medium and solvent for detergents and soil.

Commercial and industrial washing machines can either be connected to cold and/or hot water supply. The machines also include a drain valve for the wastewater. According to stakeholders' feedback, connection only to hot water does not make sense; also, low temperatures are needed as using only hot water could fix stains like blood or other proteins on the textiles.

3.2.10.2. Energy infrastructure of different heating options

This section aims at identifying the different ways to heat the water of washing machines and the air of dryers depending on the infrastructure available on site, which might influence the overall choice for a specific type of washing machine or dryer. On the other side, the different heating systems result in different environmental impacts and different operating costs accordingly.

For heating processes in laundries, different energy sources can be used[64]: electricity, steam, hot water, natural or propane gas, and thermo oil[65] (extra light or heavy). Hot water or steam is generally used to generate process heat; electricity and gas are used for direct machine heating as well as for indirect application to heat transfer media. Thermo oil is normally applied in industrial plants (see following figure).

The specific advantages or disadvantages of the different heating mediums will be described in MEErP Task 6.

[64] The energy consumption of a washing machine or a dryer is defined as the number of kilowatts hours of steam, gas, electricity or heat-transport fluid required for washing, extraction as well for drying of the load.

[65] Thermo or thermal oil in heat transfer systems is used to transmit thermal energy. It is heated in a heater and transported by pipeline to the places where a machine needs to be heated. An advantage of thermal oil compared to conventional heat sources such as hot water is the much higher boiling point. For example, the temperature reaches above 300 °C. Thermal oil can be produced from both synthetic and organic oils.

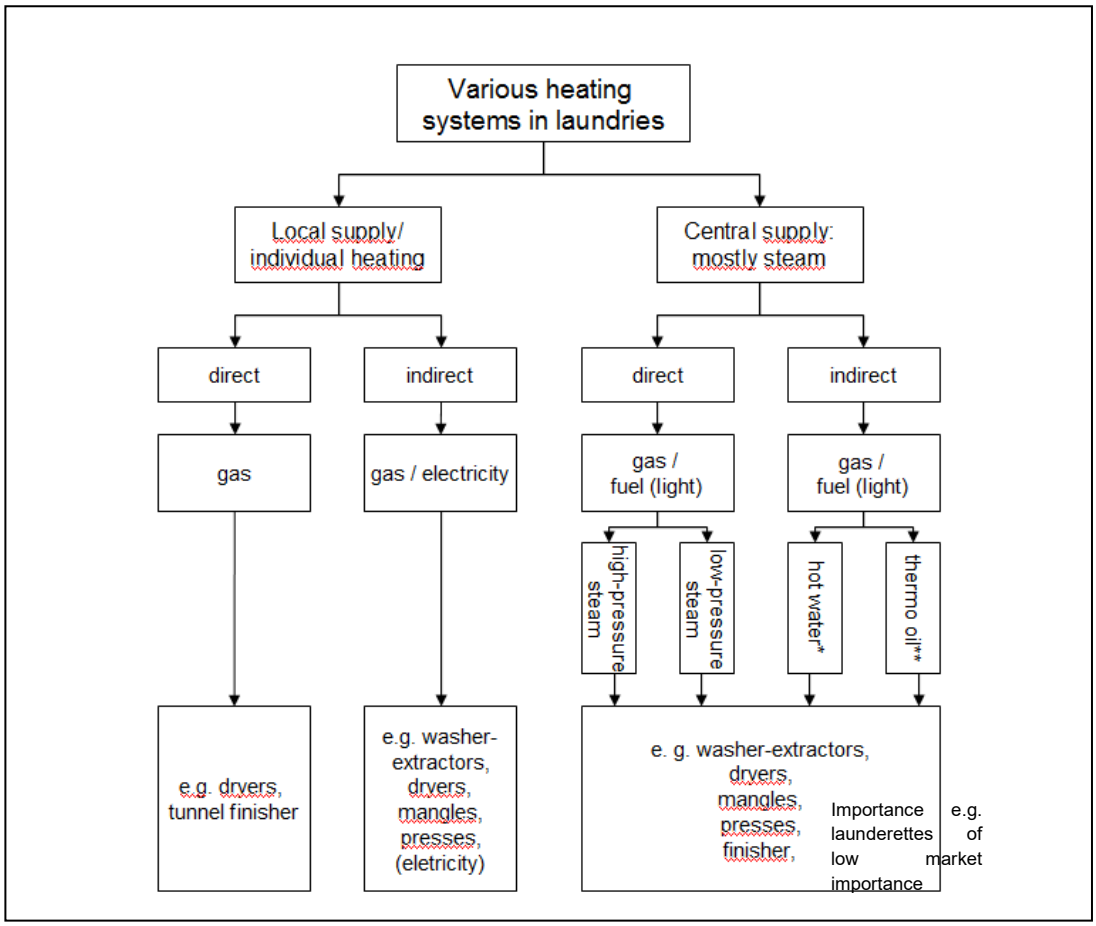

Figure 3-9: Various heating systems in laundries.

Source: BDEW, http://www.gewerbegas-online.de/index.php?id=262

Regarding the internal or external heating[66] for washing machines and dryers, the different water or air heating options can be structured as follows:

- internal
  - electric heating,
  - (natural or propane) gas heating,
  - steam heating,
- external heating (washing machines: the supplied water is already warm; dryers: hot air input from external source) by any sources like e.g. gas or fuel, and
- others.

The following tables show the share of different energy sources to heat up the water for washing machines and the air for dryers in the main customer segments.

[66] **Internal heating** refers to a heating process that takes place within the machine (direct heating); whereas **external heating** refers to a process that takes place outside the machine (i.e. the air or water already arriving at the machine is already heated up so that the machine itself does not need any more energy for heating).

Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.

Washing machine category	Internal heating, Electricity in %	Internal heating, Natural gas in %	Internal heating, Steam in %	External heating (warm water input), any source (gas, fuel, …)
WM1: Light duty commercial washer extractor	60	0	<5	35
WM2: Commercial washer extractor	5 - 55	2 - 18	8	35
WM3: Commercial washer dryer	100	0	0	0
WM4: Commercial barrier washer	5	0	95	0
WM5: Industrial continuous tunnel washers	0	2	95	3

Source: own assumptions based on Lot 24 study (2011)

Table 3-48: Energy Sources for heating in new commercial and industrial dryers.

Dryer category	Internal heating, Electricity in %	Internal heating, Natural gas in %	Internal heating, Steam in %	External heating (hot air input), any source (gas, fuel, …)
D1: Light duty commercial dryer	100	0	0	0
D2: Commercial tumble dryer	45	50	5	0
D3: Commercial cabinet dryer	100	0	0	0
D4: Industrial Pass-through (transfer) tumble dryer	0	90	10	0

Source: own assumptions based on Lot 24 study (2011).

Washer-dryers, light duty commercial dryers and commercial cabinet dryers are only available with electric heating. For such comparatively small appliances, external heating sources do not make sense as throughputs are lower, and the necessary infrastructure is often not available for these categories.

Only a small share of washing machines (5 to 18 %) uses internal heating with (natural) gas. For dryers, gas heating is significantly more common (35 to 60 %). The use of gas as energy source for heating is economically and ecologically more efficient compared to the average European electricity generation mix, however it requires special connections and a special tube for exhausting the air.

In most categories of washing machines, except for washer dryers, large washer extractors and tunnel washing machines, a certain share of appliances is heated by means of hot water that is heated externally. Washing tunnel machines (WM5) and heavy-duty dryers (D4) are either heated by steam or by gas.

Further findings can be drawn:

- Other heating options, e.g. solar energy, are not yet adopted in practice. The producers of laundry equipment do not have any experience in this field.
- No significant variations of the existing infrastructure between the different EU Member States have been reported by stakeholders.

In large-scale professional laundries, a diverse array of machinery and processing options are typically employed to accommodate the varying types of laundry. In order to optimise the laundry operation in terms of both economy and the environment, the machines used for washing, extraction, drying and finishing are frequently integrated into a comprehensive energy and water management system. Consequently, the water and energy consumption per kg of laundry is frequently reduced in such laundries in comparison to the operation of individual machines. However, infrastructural optimisation cannot be conducted on a single-product basis; rather, it must be considered within the context of the entire laundry process system, taking into account key factors such as the availability of energy and water sources, the quantity of laundry, and the existing floor space.

3.2.11. Maintenance and repairs, end-of-life behaviour

Regular maintenance of the machines has a preventive function, thus ensuring that signs of wear at the machinery can be detected and replaced betimes. Furthermore, it can be assumed that damaged devices are rather repaired than replaced due to the relatively high purchase costs of commercial and industrial washing machines and dryers. At a certain point, however, the customer will replace the machine with a new one.

It is standard practice for commercial and industrial washing machines and dryers with high capacities to be regularly maintained, at least once a year. It is common practice for laundries with a high demand for wash ware (and therefore a high risk in case of failure) to have a service and inspection contract with the manufacturer or a special service provider. This is less common for smaller devices (light duty commercial). Repairs are usually carried out at the customer's premises, with no additional transport of the devices required. In this context, it is important that customer service can provide a qualified technician quickly when needed.

If a customer's washing and drying needs change, they can sell their washing machine or dryer on the second-hand market. These devices often have lower performance and higher consumption data than new models. There is a small market for used washing machines and dryers. The purchaser usually gets no warranty. Sometimes, manufacturers or sellers can act as brokers for exchanging appliances.

It is unlikely that any of the commercial or industrial washing machines and dryers will ultimately be deposited in a landfill, given that the materials (predominantly stainless steel)

are of significant value. Consequently, the products are likely to either be refurbished or recycled for use as scrap parts or materials. However, it cannot be ruled out that difficult recyclable residues, such as certain plastic components may be disposed of. In the EU, final disposal of non-recyclable plastic components is controlled incineration rather than landfilling but exports of used machines of components thereof outside the EU cannot be ruled out. The fate of non-recyclable materials outside the EU is uncertain. At the end of their life, commercial and industrial washing machines and dryers are usually received in payment by the manufacturer of the new machine as the largest proportion of the machine is of valuable stainless steel. They are sold by the user to be scrapped or to second hand dealers. Some parts of the machine can directly be reused; the rest of the machine will be sold to recycling companies.

The smaller light duty commercial machines are collected by certified scrap dealers. According to stakeholder feedback, the owner of an old washing machine or dryer will usually get small revenue of about 50 to 100 Euros from the scrap dealer, depending on the prices of commodities.

3.3. MEErP Task 4 – Technologies

MEErP Task 4 pertains the technical analysis of commercial and industrial laundry equipment products on the EU market (and world-wide) as well as best available and best not yet available technologies with the aim to provide general inputs for the definition of the base case(s) (MEErP Task 5) as well as the identification of the improvement potential (MEErP Task 6).

3.3.1. Technical analysis of commercial and industrial washing machines

This chapter provides a general technical analysis and description of each category of washing machine. This description explains the function of the different components of a washing machine and is completed with an average bill of materials (BOM) for each technology.

3.3.1.1. Main operating principles of commercial and industrial washing machines

The following table gives an overview of the washing machine categories identified in MEErP Task 1 and their main characteristics. A more detailed description can be found in Task 1.

Table 3-49: Categorisation of commercial and industrial washing machines.

Product category	Key market segment	Main operator / user type	Filling ratio	Type of loading	Product dimensions	Application
WM1: Light duty commercial washer extractor	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Mainly private customers and non-trained personnel (with few exceptions)	1:8-1:10	Manual, front loading	Typical dimension: height x width x depth 850 x 600 x 600 mm	Semi-commercial
WM2: Commercial washer extractor	Hospitality Laundry (HPL) / >40 kg also Commercial Industrial Laundry (CIL)	Non- and trained personnel	1.9-1:12		Dimensions are rather variable depending on amount / type of textiles to be washed and dried spatial possibilities	Commercial/ >40 kg also Industrial
WM3: Commercial washer dryer						
WM4: Commercial barrier washer	Healthcare Laundry (HCL)	Trained personnel		Manual, front loading		
WM5: Industrial continuous tunnel washers	Commercial Industrial Laundry (CIL)	Trained personnel	1.9-1:12	Pass-through		Industrial

Overview of all commercial and industrial washing machine categories

In the following table an overview of the shares of the material categories according to MEErP (incl. packaging material) is shown for the different categories of commercial and industrial washing machines.

Table 3-50: Share of material categories (according to MEErP) for the different categories of commercial and industrial washing machines (including packaging).

Materials-category	WM1	WM2	WM3	WM4	WM5
Stainless steel	27.9 %-25 %	22 %	8 %	44 %	80 %
Steel tube		12 %	5 %	17 %	
(Steel sheet) galvanised steel	0.8 %-50 %	27 %	70 %	5 %	10 %
Cast iron	15.2 %-9 %	17 %	4 %	8 %	5 %
Polypropylene (PP)	10.9 %				

Materials-category	WM1	WM2	WM3	WM4	WM5
Polyethylene					<1 %
Polyamide (PA)	0.1 %-0.5 %	0.6 %		2 %	
Polycarbonate	0.3 %				
Epoxy	1.6 %				
Acrylonitrile Butadiene Styrene (ABS)	0.9 %				
Polybutylene Terephthalate (PBT)	0.3 %				
Polyvinylchloride (PVC)	2.4 %-*0.1 %	0.3 %	0.2 %	0.2 %	<1 %
EPDM rubber	1.5 %-1.3 %	1.5 %		2 %	<1 %
Plastics – others	3.0 %-2.5 %	2.1 %	2 %	4.8 %	
Aluminium	1.8 %-6.6 %	9 %	2 %	3 %	
Brass				2 %	
Copper (Cu) wire	0.1 %	3.8 %	4 %	3 %	2 %
CuZn38 cast	2.4 %-1.7 %				
Chrome	0.1 %				
Bitumen	24.6 %				
Concrete	2.4 %				
Glass	0.4 %-1 %	1.3 %		1 %	
Wood	3.3 %				
Zinc	0.3 %	0.4	2 %	2 %	
Electronics	0.2 %-2 %	3.0 %	2.8 %	6 %	1 %
Total weight (kg)	**77**	**229**	**407**	**1,006**	**12,120**
Packaging:					
Coniferous wood pallet	87 %				
corrugated/honeycomb cardboard	12.7 %				
wrap stretch film	0.3 %				

WM1: Light duty commercial washer extractor – reflecting WM1 and WM2 in the 2011 study, for WM2 plastics are summed together under other plastics unless otherwise specified

WM2: Commercial washer extractor

WM3: Commercial washer dryer

WM4: Commercial barrier washer

WM5: Industrial continuous tunnel washers

In all categories, ferrous metal (mainly stainless steel) dominates, accounting for between 60 % and 99 % (including packaging). New data from manufacturers[67] regarding WM1 suggests that 91-92 % ferrous metals make up the composition of washing machines as well as 3-5 % plastics. Other materials specified included copper, aluminium and glass. However, these were not reported in all cases. Based on one manufacturer, in the W1 category, 30 % of non-alloyed steels are produced from recycled steel, 99 % of grey cast iron steel and 90 % of stainless steels. For electronics, the percentage of the weight share is based on the values of the previous preparatory study of 2011. No feedback was received on these assumptions in the stakeholder consultation of the current preparatory study. See also **Section 3.4.7.4** for further explanation of the understanding and adjustment of these values.

3.3.1.2. Technical analysis of the distribution phase

The following table illustrates the mean volume of the final packaged product. These values are employed to calculate the environmental impacts resulting from distribution. It is recognised that there can be considerable variations, particularly with regard to the transportation of industrial washing machines. However, for the ERT, only the mean volume of the final product is required.

Table 3-51: Average volume of the final packaged product of the different categories of commercial and industrial washing machines.

Washing machine category	Average volume of the final packaged product	Source of information
WM1: Light duty commercial washer extractor	0.75–1.14 m³	According to Lot 24
WM2: Commercial washer extractor	4.3 m³ - 30,21 m³	Stakeholder provided data (2024)
WM3: Commercial washer dryer	1.61–2.42 m³	According to Lot 24
WM4: Commercial barrier washer	14,92 m³	Stakeholder provided data (2024)
WM5: Industrial continuous tunnel washers[68]	Up to 156 m³	Stakeholder provided data (2024)

3.3.1.3. Technical product description and analysis in the use phase

This section presents an analysis of the annual resource-consumption (energy, water, detergent) associated with the product over its lifespan. Typically, the consumption values should be quantified in accordance with established technical and functional performance parameters as defined by the test standards EN 17116-4:2019, EN 17116-3:2019, EN 17116-2:2019, EN 50640:2019 and EN 50594:2019. Though the mentioned standards specify

[67] Data submitted in the consultation launched to collect data for task 5.
[68] Corresponds to the average volume of the machine as the distribution is realised without packaging.

standardised measurement methods, their use is voluntary, and manufacturers have explained that they are not broadly applied. Data quantifying the energy and water consumption of commercial and industrial washing machines (see MEErP Task 1) is thus only scarcely available and may not always be representative. Consequently, the assessment of data quality and comparability in the following sections should be contextualised within this framework.

Ratio of energy use in commercial and industrial washing machines

This section exemplifies how much energy is used for the different washing phases in a typical commercial or industrial washing process.

The energy consumption of commercial and industrial washing machines can be divided into two main categories: energy used for water heating and energy needed for the motor, mechanical action and electronic components. The following table shows the respective energy consumption for each machine category.

Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.

Washing machine category	Percentage of energy consumed for water heating
WM1: Light duty commercial washer extractor	79 %
WM2: Commercial washer extractor	87 %
WM3: Commercial washer dryer	80 %
WM4: Commercial barrier washer	88 %
WM5: Industrial continuous tunnel washers[69]	95 %

[69] Only the average volume of the machine due to the distribution ensued without packaging.

Typical composition of detergents and laundry aids for commercial and industrial washing machines

Soiling	Mineral oil, Pigment		
Textile	PES/Cotton 65/35		
Washing Machine	CBW		
Water hardness	0-2°dH		
Water Consumption total	12 l/kg		
Liquor/Cloth Ratio	1:5		
Temperature	Pre-wash: 35°C		
	Main wash: 70°C		
Wash time total	45 Minutes		
Dosage: (g/kg Wash)	Pre-wash	Main wash	Total
Main wash Detergent A	12	12	24
Booster B	3	2	5
Acid C (Rinse)		0.5	0.5
Formulation Model-Products			
Main wash Detergent A	**%**		**Ingredients in Liquor g/kg Wash**
Sodiummetasilicate 5aq	50		12
Sodium triphosphate	15		3.6
Soda ash	24		5.76
Polycarboxylate	2		0.48
LAS	2		0.48
Fatty alcohol ethoxylate C12-14, 5 EO	5		1.2
Carboxymethylcellulose	1		0.24
Methylcellulose	1		0.24
Water	0		0
Sum	**100**		**24**
Booster B			
Fatty alcohol ethoxylate C12-14, 5 EO	97		4.85
Water	0		0
Alcohol	3		0.15
Sum	**100**		**5**
Acid C			
Formic acid	100		0.5
Water	0		0
Sum	**100**		**0.5**

Remark : Dosage dependent on: Degree of soiling, machine type, quality level

Figure 3-10: Example of a modular detergent system and wash programme for blue work wear.

Energy, water and detergent consumption

A commercial or industrial washing machine's principal function is to clean and rinse textiles using water. Additionally, the machine may feature a system for extracting excess water from the textiles. Other crucial functional parameters include the hygienic performance, energy consumption, water consumption, and detergent consumption (see MEErP Task 1).

It is essential to consider the specific requirements of commercial and industrial laundry appliances, which vary considerably depending on the customer group in question.

- The amount of laundry and types of fabrics to be washed are very different depending on the application.
- High capacities / short running cycles are usually important.
- The spatial requirements are different depending on the customer segments.

As outlined in MEErP Task 3, the energy, water and detergent consumption of commercial and industrial washing machines is contingent upon a multitude of real-world usage parameters, in addition to the specific market or customer segment to which they are targeted.

The following input parameters were specified in order to define the respective energy, water and detergent consumptions of commercial and industrial washing machines during the use phase. The parameters have already been compiled and discussed in MEErP Task 3 on user behaviour. The following sections present a summary of the assumptions and the annual consumption of the different laundry appliance categories.

Category WM1: Light duty commercial washer extractor

The following data are based on cold water connection of the washing machines.

Table 3-53: Energy, water and detergent consumption of a light duty commercial washer extractor (category WM1).

	Energy	Water	Detergent
Main customer segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)		
Typical use intensity: Annual amount of cleaned laundry (kg/year) for a typical machine capacity of 6 kg	7,000		
Specific consumption operation (ideal conditions)	0.13 kWh/kg laundry	8 litres/kg laundry	15 g/kg laundry
Real-life user behaviour			
Additional consumption through partial workload	+ 20 %	+ 20 %	+ 20 %
Additional consumption through maloperation	+ 15 %	+ 15 %	+ 15 %
Specific consumption operation (real life user behaviour)	*0.18 kWh/kg laundry*	*11 litres/kg laundry*	*20 g/kg laundry*
Annual consumption (real life)	1,260 kWh	76,600 litres	142 kg

Category WM2: Commercial washer extractor

The following data are based on cold water connection of the washing machines.

Table 3-54: Energy, water and detergent consumption of a commercial washer extractor (category WM2).

	Energy	Water	Detergent
Main customer segment	Commercial Laundry		
Typical use intensity: Annual amount of cleaned laundry (kg/year) for a typical machine capacity of 8 kg	69,000		
Specific consumption operation (ideal conditions)	0.17 kWh/kg laundry	12 litres/kg laundry	17 g/kg laundry
Real-life user behaviour			
Additional consumption through partial workload	+ 20 %	+ 20 %	+ 20 %
Additional consumption through maloperation	+ 10 %	+ 10 %	+ 10 %
Specific consumption operation (real life user behaviour)	*0.22 kWh/kg laundry*	*15.6 litres/kg laundry*	*22 g/kg laundry*
Annual consumption (real life)	15,180 kWh	1,076,000 litres	1,518 kg

Category WM3: Commercial washer dryer

Table 3-55: Energy, water and detergent consumption of a commercial washer dryer (category WM3).

	Energy	Water	Detergent
Main customer segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)		
Typical use intensity: Annual amount of cleaned laundry (kg/year) for a typical machine capacity of 8 kg	7,400		
Specific consumption operation (ideal conditions)	0.7 kWh/kg laundry	9 litre/kg laundry	13 g/kg laundry
Real-life user behaviour			
Additional consumption through partial workload	+ 10 %	+ 10 %	+ 10 %
Additional consumption through maloperation	+ 15 %	+ 15 %	+ 15 %
Specific consumption operation (real life user behaviour)	0,88	11	16
Annual consumption (real life)	6,475 kWh	81,400 litres	120 kg

Category WM4: Commercial barrier washer

Table 3-56: Energy, water and detergent consumption of a commercial barrier washer (category WM4).

	Energy	Water	Detergent
Main customer segment	Healthcare Laundry		
Typical use intensity: Annual amount of cleaned laundry (kg/year) for a typical machine capacity of 32 kg	56,300		
Specific consumption operation (ideal conditions)	0.3 kWh/kg laundry	14.5 litres/kg laundry	16 g/kg laundry
Real-life user behaviour			
Additional consumption through partial workload	+ 0 %	+ 0 %	+ 0 %
Additional consumption through maloperation	+ 0 %	+ 0 %	+ 0 %
Specific consumption operation (real life user behaviour)	0.3	15	16
Annual consumption (real life)	16,890 kWh	816,350 litres	901 kg

Category WM5: Industrial continuous tunnel washers

Table 3-57: Energy, water and detergent consumption of a industrial washing tunnel machine (category WM5).

	Energy	Water	Detergent
Main customer segment	Commercial Industrial Laundry		
Typical use intensity: Annual amount of cleaned laundry (kg/year)	3,825,000		
Specific consumption operation (ideal conditions)[70]	0.3 kWh/kg laundry	5.4 litres/kg laundry	8 g/kg laundry
Real-life user behaviour			

[70] Only at the latest status of this preparatory study, after finalising the LCA and LCC assessments of the MEErP Task 5 and Task 6 reports with the input data listed above, further stakeholder input was received on the consumption for category WM5 at the level of laundry facilities. Depending on the processed textiles, a survey among 242 laundries in the year 2015 revealed that weighted average electricity consumption (best practice consumption levels) of laundries with a focus on mats was 0.07 kWh/kg; of laundries with a focus on linen it was 0.16 kWh/kg, and of laundries with a focus on workwear it was 0.20 kWh/kg in the year 2015. The weighted average consumption of oil/gas (best practice consumption levels) of laundries with a focus on mats was 0.29 kWh/kg; of laundries with a focus on linen it was 0.64 kWh/kg, and of laundries with a focus on workwear it was 0.62 kWh/kg in the year 2015. The weighted average water consumption (best practice consumption levels) of laundries with a focus on mats was 5.8 L/kg; of laundries with a focus on linen it was 4.0 L/kg, and of laundries with a focus on workwear was 10.8 L/kg in the year 2015. Finally, the weighted average detergent consumption (best practice consumption levels) of laundries with a focus on mats was 4.8 g/kg; of laundries with a focus on linen it was 5.9 g/kg, and of laundries with a focus on workwear was 23 g/kg in the year 2015. (SDU Life Cycle Engineering, 2016)

	Energy	Water	Detergent
Additional consumption through partial workload	+ 0 %	+ 0 %	+ 0 %
Additional consumption through maloperation	+ 0 %	+ 0 %	+ 0 %
Specific consumption operation (real life user behaviour)	0.3	5.4	8
Annual consumption (real life)	1,147,500 kWh	21,037,500 litres	30,600 kg

Overview of all commercial and industrial washing machine categories

The summary below encompasses the real-life operation patterns described in the previous sections. The following **Table 3-58** summarises the annual energy, water and detergent consumption to be used as input data for MEErP Task 5 (environmental impact assessment of BCs).

Table 3-58: Annual energy, water and detergent consumption (real life conditions) of all commercial and industrial washing machine categories.

Category	Energy consumption	Water consumption	Detergent / laundry aid consumption
	kWh/year	litres/year	kg/year
WM1: Light duty commercial washer extractor	1,200	76,500	145
WM2: Commercial washer extractor	42,337	1,749,600	2,265
WM3: Commercial washer dryer	6,660	90,000	126
WM4: Commercial barrier washer	23,000	970,000	1,100
WM5: Industrial continuous tunnel washers	1,450,000	24,786,000	37,180

3.3.1.4. Technical analysis of the use phase (system)

Commercial and industrial washing machines are in use in a variety of businesses, including hotels, clinics, healthcare facilities, self-service laundries, and numerous other locations (see MEErP Task 3). The surrounding environment of these facilities can vary considerably, potentially affecting the energy and water consumption of the washing machines. This section presents an overview of the ways in which different ambient conditions can influence the energy, water, and detergent consumption of commercial and industrial washing machines.

Stiksma (2023) interviewed repair shop personnel to elicit the most common failure modes of washing machines. Though the data is understood to refer to domestic washing machines, it is assumed to provide some insight as to potential failures of non-domestic machines as a means to consider how repairability can be ensured. **Table 3-59** presents the most common washing machine failure mode. The data demonstrates that most failure modes in non-functioning washing machines can be traced back to electronics, the door, the pump and pump

filter, and foreign objects. Diagnosis of malfunctioning bearings, shock absorbers, and carbon brushes was also common.

Table 3-59: Most frequent failure modes in washing machines.

Failure Modes	Obbink	RTV Stegeman	Expert	Fenix	Techio et al. (2019)
1. Bearings	X		X		X
2. Electronics	X	X	X		X
3. Door	X	X	X		X
4. Pump	X	X	X		X
5. Pump filter	X			X	
6. Inlet valves			X	X	
7. Drain system				X	
8. Heating element			X		
9. Shock absorbers		X		X	X
10. Foreign objects	X	X		X	X
11. Switches		X			
12. Detergent system		X			
13. Carbon brushes			X	X	X
14. Drive belt				X	

Source: (Stiksma 2023)

3.3.1.5. Technical analysis of the end-of-life phase

This section provides information regarding the end-of-life management of commercial and industrial washing machines and their constituent materials. It considers the potential for the materials to be handled as pure waste (landfill, pyrolytic incineration), for heat recovery (non-hazardous incineration optimised for energy recovery) and/or for reuse or closed-loop recycling.

Once a heavy-duty or larger washing machine has reached the end of its useful life, it is typically returned to the manufacturer. In certain instances, the machine's components may be reused, while the remaining components, predominantly comprising valuable stainless steel, are sold to recycling companies for processing. These companies clean, shred and disassemble the machines before returning the reusable materials to the production of new products. Light duty commercial and smaller commercial washing machines may also be dismantled by certified scrap dealers.

Table 3-60: Disposable fraction of commercial and industrial washing machines that is not recovered.

Washing machine category	Fraction of products not recovered in %
WM1: Light duty commercial washer extractor	5
WM2: Commercial washer extractor	5
WM3: Commercial washer dryer	5
WM4: Commercial barrier washer	~1
WM5: Industrial continuous tunnel washers	~1

3.3.2. Technical analysis of commercial and industrial dryers

3.3.2.1. Technical analysis of the production phase

This chapter provides a general technical analysis and description of each category of dryer. This description explains the function of the different components of a dryer and is completed with an average BOM for each technology.

Main operating principles of commercial and industrial dryers

The following table gives an overview of the dryer categories identified in MEErP Task 1 and their main characteristics. A more detailed description can be found in MEErP Task 1.

Table 3-61: Categorisation of commercial and industrial dryers.

Product category	Key market segment	Main operator / user type	Filling ratio	Type of loading	Product dimensions	Application
D1 Light duty commercial tumble dryer	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Mainly private customers and semi-skilled personnel (with few exemptions)	1:18 - 1:25	Manual, front loading	Typical dimension: height x width x depth 850 x 600 x 600 mm	Semi-professional (commercial)
D2 Commercial tumble dryer				Hangers, front loading	Dimensions are very variable de-pending on amount / type of textiles to be dried and	Commercial
D3 Commercial cabinet dryer	Hospitality Laundry (HPL)	Trained personnel		front loading manual or automatic		

Product category	Key market segment	Main operator / user type	Filling ratio	Type of loading	Product dimensions	Application
D4 Industrial Pass-through (transfer) dryer	Commercial Industrial Laundry (CIL)	Trained personnel	1:20 - 1:25	Pass-through, Automatically, loading and un-loading, doors on opposite sides	spatial possibilities	Industrial

Overview of all commercial and industrial dryer categories

In the following table an overview of the shares of the material categories according to MEErP (incl. packaging material) is shown for the different categories of commercial and industrial dryers.

Table 3-62: Share of material categories (according to MEErP) for the different categories of commercial and industrial dryers (including packaging).

Materials-category	D1	D2	D3	D4
Plastics	1 %	5 %	5 %	0.3 %
Ferrous	93 %	93 %	93 %	93 %
Non-ferrous	1 %	5.6 %	8.4 %	0.2 %
Electronics	>1 %	2 %	2 %	>1 %
Misc.	1 %	1 %	1 %	1 %

D1: Light duty commercial tumble dryer
D2: Light duty commercial tumble dryer
D3: Commercial cabinet dryer
D4: Industrial Pass-through (transfer) tumble dryer

In all categories, ferrous metal (mainly stainless steel) dominates, accounting for between 60 % and 99 % (including packaging). Based on one manufacturer, in the D1 category, 30 % of non-alloyed steels are produced from recycled steel and 90 % of stainless steels. For electronics, the percentage of the weight share is based on the values of the previous preparatory study of 2011. No feedback was received on these assumptions in the stakeholder consultation of the current preparatory study. See also **Section 3.4.7.4** for further explanation of the understanding and adjustment of these values.

3.3.2.2. Technical analysis of the distribution phase

The following table shows the average volume of the final packaged product. These values are used to calculate the environmental impact of distribution.

Table 3-63: Average volume of the final packaged product of the different categories of commercial and industrial dryers.

Dryer category	Average volume of the final packaged product
D 1: Light duty commercial tumble dryer	0.53 m³
D 2: Commercial tumble dryer	1.14–1.90 m³
D 3: Commercial cabinet dryer	1.76 m³
D 4: Industrial Pass-through (transfer) tumble dryer[71]	10.2 – 24.61 m³

Source: Information provided by data sheets

Based on information from a single manufacturer, packaging materials include wood (87 %), cardboard (13 %) and negligible amounts of wrap stretch film (0.3 %).

3.3.2.3. Technical analysis of the use phase (product)

The drying process is the removal of water from the wet textile using hot air. Evaporation of water and evacuation of residual steam require a certain amount of energy.

As set out in MEErP Task 3, different processes consume energy during a typical working day of commercial and industrial dryers. The following input parameters were specified to define the respective energy consumption of commercial and industrial dryers during the use phase. The parameters have already been compiled and discussed in MEErP Task 3 on user behaviour. The following sections summarise the assumptions and the annual consumption of the different dryer categories, differentiated according to the processes.

Based on input from single manufacturers, the lifetimes of D1 and D2 appliances ranges between 10 to 20 years.

Ratio of energy use in commercial and industrial dryers

This section provides an overview of the amount of energy used for the different process steps in a typical drying process. The relative energy consumption of commercial and industrial dryers can be mainly broken down into two categories: energy used for air heating and the motor energy for mechanical action or electronic devices. The following table shows the respective energy flows of each category.

[71] Corresponds to the average volume of the machine as the distribution is realised without packaging

Table 3-64: Share of the average energy consumption in the different categories of commercial and industrial dryers (Source: information provided by manufacturers).

Dryer category	Percentage of energy for air heating
D1 Light duty commercial tumble dryer	95 %
D2 Commercial tumble dryer	85 – 92 %
D3 Commercial cabinet dryer	95 %
D4 Industrial Pass-through (transfer) tumble dryer	89 %

Energy consumption

The following input parameters were specified to define the energy consumption of commercial and industrial dryers during the use phase. These parameters have already been compiled and discussed in Task 3 on user behaviour. The following sections present a summary of the assumptions and the annual consumption of the different dryer categories.

Category D1: Light duty commercial tumble dryers

Table 3-65: Energy consumption of light duty commercial tumble dryers.

Dryer Category	Condenser dryer	Air vented dryer
	Energy	Energy
Main customer segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	
Typical use intensity: Annual amount of dried laundry (kg/year) (typical machine's capacity of 6 kg)	6,500	6,500
Specific consumption operation (ideal conditions)	0.39 kWh/kg laundry	0.54 kWh/kg laundry
Real-life user behaviour:		
Additional consumption through partial workload	+ 20 %	+ 20 %
Additional consumption through maloperation	+ 15 %	+ 15 %
Specific consumption (operation, real life user behaviour)	0.52 kWh/kg laundry	0.76 kWh/kg laundry
Annual consumption (real life)	3,380 kWh	4,914 kWh
Annual consumption (average)	4,147 kWh	

Category D2: Commercial tumble dryer

Table 3-66: Energy consumption of commercial tumble dryers (category D4-5-6).

Dryer Category	<15 kg	15–40 kg	>40 kg
	Energy	Energy	Energy
Main customer segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Hospitality Laundry	Commercial Industrial Laundry
Typical use intensity: Annual amount of dried laundry (kg/year)	14,400 (typical capacity of 10 kg machine)	40,500 (typical capacity of 23 kg machine)	168,000 (typical capacity of 70 kg machine)
Specific consumption operation (ideal conditions)	0.33 kWh/kg laundry (with heat pump) (0.67 w/o heat pump)	0.65 kWh/kg laundry	0.85 kWh/kg laundry
Real-life user behaviour:			
▪ Additional consumption through partial workload	+ 10 %	+ 10 %	+ 10 %
▪ Additional consumption through maloperation	+ 15 %	+ 15 %	+ 10 %
Specific consumption (operation, real life user behaviour)	0.45 kWh/kg laundry	0.88 kWh/kg laundry	1.02 kWh/kg laundry
Annual consumption (real life)	6,480 kWh	35,640 kWh	171,360 kWh
Annual consumption (average)	71,160 kWh		

Category D3: Commercial cabinet dryer

Table 3-67: Energy consumption of commercial cabinet dryers.

Dryer category D3	Energy
Main customer segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)
Typical use intensity: Annual amount of dried laundry (kg/year) (typical machine's capacity of 8 kg)	6,300
Specific consumption operation (ideal conditions)	0.75 kWh/kg laundry
Real-life user behaviour:	
Additional consumption through partial workload	+ 10 %
Additional consumption through maloperation	+ 5 %
Specific consumption (operation, real life user behaviour)	0.86 kWh/kg laundry
Annual consumption (real life)	5,418 kWh

Category D4: Industrial Pass-through (transfer) tumble dryer

Table 3-68: Energy consumption of industrial pass-through dryers.

Dryer category D4	Energy
Main customer segment	Commercial Industrial Laundry
Typical use intensity: Annual amount of dried laundry (kg/year) (typical machine's capacity of 400 kg/h)	1,020,000
Specific consumption operation (ideal conditions)	0.8 kWh/kg laundry
Real-life user behaviour:	
Additional consumption through partial workload	+ 0 %
Additional consumption through maloperation	+ 0 %
Specific consumption (operation, real life user behaviour)	0.8 kWh/kg laundry
Annual consumption (real life)	816,000 kWh

Overview of all dryer categories

Table 3-69 summarises the annual energy consumption to be used as input data for MEErP Task 5 (environmental impact assessment of BCs).

Table 3-69: Annual energy consumption (real life conditions) of all dryer categories.

Category	Energy consumption
	kWh/year
D1: Light duty commercial tumble dryer	4,147
D2: Commercial tumble dryer	71,160
D3: Commercial cabinet dryer	5,418
D4: Industrial pass-through (transfer) tumble dryer	816,000

3.3.2.4. Technical analysis use phase (system)

Commercial and industrial laundry dryers are utilised in a multitude of settings, including hotels, clinics, healthcare facilities, laundrettes, and numerous other locations (see MEErP Task 3). This section presents an overview of the manner in which diverse ambient conditions can impact the energy consumption of commercial and industrial laundry dryers.

The **drying temperature** has a significant impact on energy consumption. As the temperature increases, so does the energy required.

Type of laundry: Textiles can be made from different materials and fabrics (cotton, wool, mineral, synthetic etc.) and result in particular types of laundry (work wear, hospital linen, high visibility garments etc.). The majority of the laundry is dried using the cotton programme. However, some fabrics retain water more than others, increasing the amount of energy needed to dry them. Different products and systems take account of varying needs in accordance with the different types of clothes to be dried.

The spin speed (g-factor) of the washer extractor is a significant factor influencing the energy demand of the laundry dryer. The efficiency of the spin process directly impacts the energy required for drying, with a higher spin speed and g-factor leading to shorter drying times and lower energy consumption.

Ambient Air Humidity: In the case of air-vented dryers, the energy demand is also dependent on the air humidity. It has been observed that a lower air humidity results in a decreased energy demand.

3.3.2.5. Technical analysis of the end-of-life phase

The following assumptions have been made regarding the end-of-life phase for dryers: While the large heavy-duty machines can last for up to 20 or more years, the light duty commercial and smaller dryers will have an average lifetime of 10 to 15 years. Industrial machines are used as intensively as commercial (category D3–D6) and light duty commercial machines of categories D1–2 and therefore have a longer lifespan. The average lifetime is estimated to be approximately 12 years. At the end of their useful life, heavy-duty and larger dryers are typically returned to the manufacturer. In some cases, parts of the machine can be reused, while the rest, mostly comprising valuable stainless steel, is disassembled and sold to metal recyclers. As the materials (predominantly stainless steel comprising over 60 %) are deemed to be of significant value, there is economic incentive to undertake recycling. As Recoverable

materials are separated and returned to the raw material production process. Light duty commercial dryers may also be dismantled by certified scrap dealers.

As previously outlined in MEErP Task 3, the majority (ca. 95 %) of materials contained in commercial and industrial laundry appliances are recyclable, with a mere 1 to 5 % of materials being unsuitable for recycling and therefore requiring disposal.

The proportion of plastic in all commercial and industrial dryers is less than 10 % of the total weight. All plastic components with a weight exceeding 50 grams are marked in accordance with the ISO 1043 standard. Non-recyclable plastic parts are disposed of as follows:

Table 3-70: Landfill (fraction of products not recovered) in % of commercial and industrial dryers (based on stakeholder input).

Dryer category	Landfill (fraction of products not recovered) %
D1: Light duty commercial tumble dryer	5
D2: Commercial tumble dryer	5
D3: Commercial cabinet dryer	5
D4: Industrial pass-through (transfer) tumble dryer	~1

3.4. MEErP Task 5 – Environment and Economics (Base Case LCA and LCC)

3.4.1. Objectives of MEErP Task 5

This study aims to provide an objective assessment of the environmental Life Cycle Assessment (LCA) and Life Cycle Costs (LCC) for the commercial and industrial laundry appliances. The foundation of this analysis is the establishment of a 'Base Case' (BC), a conceptual representation of the average product or product category for the EU market. The BC is essential for conducting environmental and cost assessments efficiently, given practical constraints such as data availability, time, and budget. The results of this study will serve as a baseline for evaluating design options for Ecodesign requirements in Task 6 of the MEErP. Additionally, the BC approach will be critically assessed in MEErP Task 7 for its applicability across different market segments through scenarios.

In addition to the LCA and LCC analyses, a new task has been introduced to identify Substances of Concern (SoC). This task encompasses a stakeholder consultation process and a subsequent evaluation of the need for information and performance requirements. A concise overview of its findings appears immediately after the conclusion of the LCA and LCC sections, with further details laid out in **Annex VIII: Substances of Concern**.

Environmental analysis

The assessment serves to quantify the environmental impacts and associated LCC of a BC product throughout its lifecycle. This includes the entire process from the extraction of raw materials to the disposal of components at the end-of-life. The key method employed for this assessment is LCA, which entails:

- Life cycle inventory development: Detailing all incoming and outgoing material and energy flows for each lifecycle stage – design and manufacturing, transportation, usage, and end-of-life processing through the life cycle inventory per BC.
- Impact aggregation: Aggregating these flows over the product's lifetime to compute total environmental impacts. This computation uses a functional unit that aligns with the product's performance in its intended application.
- Environmental indicators: The study employs 16 predefined environmental indicators established for all Ecodesign studies under the MEErP review, with detailed descriptions provided later in the report.

LCA calculations are performed using the latest version (1.6) of the ERT to ensure accuracy and consistency.

The LCA approach offers the advantage of a comprehensive understanding of the resources consumed and the environmental side effects caused by a product. However, its inherent challenge lies in accounting for the variability in life cycles across products in a market. To address this, BCs approximate the 'average' product and serve as a basis for extrapolating the environmental impacts across the entire market for the product category under review.

Life Cycle Costs

As part of the study, the LCC for each BC will be calculated using the structured methodology outlined in the MEErP. The LCC analysis encompasses key cost elements over the product's lifecycle, including product price and operational costs. Both the LCA and LCC calculations are then scaled to the EU27 level for each BC. This broader market-based perspective allows for an evaluation of implications at scale. This dual approach ensures the study delivers actionable insights for stakeholders, facilitates robust policy development, and identifies opportunities to optimise both environmental and economic outcomes across the market.

New considerations in environmental analysis and Life Cycle Costs

This assessment incorporates updates introduced to the MEErP process based on the review and the new aspects resulting from the ESPR. These updates address:

- Lifetime Extension: Factors such as durability, reliability, reusability, upgradability, reparability, maintenance, and refurbishment.
- Material Efficiency: Considerations such as recycled content usage.

The ERT has been revised to integrate these elements, enabling more comprehensive evaluations of environmental impacts and LCCs.

Data quality and sensitivity analysis

The study is based on data extrapolated from literature and stakeholder input. While every effort has been made to ensure accuracy, variations in real-world performance introduce an element of approximation that cannot be entirely avoided. To maintain transparency, the quality and sources of each data point used are documented for the BC according to the criteria indicated in **Table 3-71.**

Table 3-71: Data quality scoring.

Data source	Data quality scoring
Stakeholder input	High quality
Scientific literature	High quality
Previous preparatory study (2011)	Medium quality
Expert judgement	Medium quality
Literature	Medium quality
Internet search	Fair quality

The sensitivity analyses in MEErP Task 5 (see **Section 3.4.7**) will assess the impact of assumptions on the results, ensuring consistency and reliability.

Study outcomes

The LCA and LCC calculations for the BCs are rooted in the findings of MEErP Tasks 1 to 4. Together, the BCs serve as essential reference points for the subsequent stages of the study, including MEErP Task 6 (Design Options) and MEErP Task 7 (Scenarios).

Acknowledging the inherent uncertainties, this study provides the most robust and reliable estimates to date regarding the environmental impacts and LCC of commercial and industrial laundry machines within the EU.

3.4.2. Definition of Base Cases

This subsection defines and describes the BCs, building on insights from previous tasks, stakeholder input, and expert judgement. BCs do not represent individual real-world products but are instead an amalgamation of characteristics. When two or more products share similar Bills of Materials (BOM) and technical parameters, they may be grouped into a single BC.

The number of BCs is carefully optimised to strike a balance between simplicity and comprehensiveness. It is kept small enough to enable an efficient market analysis yet large enough to capture the full technological diversity of commercial and industrial washing

machines. Although the MEErP methodology generally recommends one or two BCs to represent the entire EU market for a given product category, this study has identified 5 BCs for the washing machines and 4 BCs for the dryers (**Table 3-72**). This approach ensures both a detailed representation of the market and analytical clarity. Specific details per BC are provided in **Table 3-78** to **Table 3-81**. The main sources of the data used in the BC definition are the following two reports:

- Current Preparatory study on commercial and industrial laundry appliances – Tasks 1-4.
- Preparatory studies for Ecodesign Requirements of Energy-using products – Lot 24: Professional Washing Machines, Dryers and Dishwashers – Part: Washing machines and dryers (Graulich et al., 2011).

Table 3-72: Overview of Base Cases for commercial and industrial washing machines and dryers.

Washing machines	Dryers
WM1: Light duty commercial washer extractor	D1: Light duty commercial tumble dryer
WM2: Commercial washer extractor	D2: Commercial tumble dryer
WM3: Commercial washer dryer	D3: Commercial cabinet dryer
WM4: Commercial barrier washer	D4: Industrial pass-through (transfer) tumble dryer
WM5: Industrial continuous tunnel washers	

Please note that the following preliminary input data had to be revised in light of stakeholder feedback which was only received at a late stage in the study. A detailed breakdown of the revised input data and revised results of MEErP Task 5 that consider all updated input data according to stakeholders' feedback (see sensitivity analyses in **Section 3.4.7.2** and **Section 3.4.7.3**) and the revised dataset for electronics (see sensitivity analysis in **Section 3.4.7.4**) is provided in **Annex V: Inputs for LCA / LCC per Base Case** and **Annex VI – Results of LCA / LCC per Base Case**

Table 3-73: Overview of Base Case WM1: Light duty commercial washer extractor.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case corresponds to Base Case WM1 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg)	7	(Graulich et al., 2011)
Product weight (kg)	73.86	(Graulich et al., 2011)
Dominant market segment	Coin & Card laundry (CCL) and Apartment household laundry (AHL)	Table 3-53
Lifetime (years)	5.6	Average cycles per lifetime (5,000-15,000)

Description	Characteristic	Comments (Sources)
Average price (€)	2,136	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices
Cycles per year	1,800	Cycles per day * Number of working days per year (Graulich et al., 2011)
Annual sales (mln units per year)	0.0243	Average number of estimated numbers of batch-loaded units. Based on stakeholder data (APPLiA)
Maintenance and repair costs (€/lifetime)	64.08	3 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption wash (kWh/cycle)	0.7	Real life conditions, see Task 1-4, derived from Table 3-53
Water consumption (m^3/cycle)	0.04	Real life conditions, see Task 1-4, derived from Table 3-53
Detergent consumption (kg per cycle)	0.08	Annual detergent consumption (real life conditions) / number of cycles per year, see Task 1-4, derived from Table 3-53
Cycle time (hours)	0.75	Duration of the typically used washing programme, see Task 1-4, Table 3-53

Table 3-74: Overview of Base Case WM2: Commercial washer extractor.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case is a combination of Base Cases WM2, WM3 and WM4 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg)	24	Capacity for dominant customer segment as per Table 3-37
Product weight (kg)	210.45	(Graulich et al., 2011)
Dominant market segment	Commercial Laundry (CL)	Task 1-4, Table 3-54
Lifetime (years)	15.3	Average cycles per lifetime (30,000-80,000)
Average price (€)	34,775	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices (Average price between WM2, WM3 and WM4 categories)
Cycles per year	3,600	Cycles per day* Number of working days per year (Graulich et al., 2011)
Annual sales (mln units per year)	0.02	Average number of estimated numbers of batch-loaded units for WM2, WM3 and WM4 Base Cases of the 2011 study. Based on stakeholder data (APPLiA)

Description	Characteristic	Comments (Sources)
Maintenance and repair costs (€/lifetime)	1043.3	3 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption wash (kWh/cycle)	4.2	Real life conditions, see Task 1-4, derived from Table 3-54
Water consumption (m^3/cycle)	0.30	Real life conditions, see Task 1-4, derived from Table 3-54
Detergent consumption (kg per cycle)	0.42	Annual detergent consumption (real life conditions) / number of cycles per year, see Task 1-4, derived from Table 3-54
Cycle time (hours)	0.75	Duration of the typically used washing programme, see Task 1-4, Table 3-54

Table 3-75: Overview of Base Case WM3: Commercial washer dryer.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case corresponds to Base Case WM5 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg)	6	Capacity for dominant customer segment as per Table 3-37
Product weight (kg)	382	(Graulich et al., 2011)
Dominant market segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Task 1-4, Table 3-55
Lifetime (years)	31.25	Average cycles per lifetime (30,000-80,000)
Average price (€)	12,200	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices.
Cycles per year	1,760	Cycles per day * Number of working days per year (Graulich et al., 2011)
Annual sales (mln units per year)	0.000405	Average number of estimated numbers of batch-loaded units for WM5 Base Case of the 2011 study. Based on stakeholder data (APPLiA)
Maintenance and repair costs (€/lifetime)	366	3 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption wash (kWh/cycle)	3.68	Real life conditions, see Task 1-4, derived from Table 3-55
Water consumption (m^3/cycle)	0.05	Real life conditions, see Task 1-4, derived from Table 3-55
Detergent consumption (kg per cycle)	0.07	Annual detergent consumption (real life conditions) / number of cycles per year, see Task 1-4, derived from Table 3-55

Description	Characteristic	Comments (Sources)
Cycle time (hours)	1.25	Duration of the typically used washing programme, see Task 1-4, Table 3-55

Table 3-76: Overview of Base Case WM4: Commercial barrier washer.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case corresponds to Base Case WM6 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg)	32	Capacity for dominant customer segment as per Table 3-37
Product weight (kg)	1,003.5	(Graulich et al., 2011)
Dominant market segment	Healthcare Laundry (HCL)	Task 1-4, Table 3-56
Lifetime (years)	20.5	
Average price (€)	57,375	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices.
Cycles per year	2,200	Cycles per day * Number of working days per year (Graulich et al., 2011)
Annual sales (mln units per year)	0.0012	Average number of estimated numbers of batch-loaded units for WM6 Base Case of the 2011 study. Based on stakeholder data (APPLiA)
Maintenance and repair costs (€/lifetime)	14,343.8	25 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption wash (kWh/cycle)	7.68	Real life conditions, see Task 1-4, derived from Table 3-56
Water consumption (m^3/cycle)	0.37	Real life conditions, see Task 1-4, derived from Table 3-56
Detergent consumption (kg per cycle)	0.41	Annual detergent consumption (real life conditions) / number of cycles per year, see Task 1-4, derived from Table 3-56
Cycle time (hours)	1	Duration of the typically used washing programme, see Task 1-4, Table 3-56

Table 3-77: Overview of Base Case WM5: Industrial continuous tunnel washer.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case corresponds to Base Case WM7 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg/h)	1,500	Capacity for dominant customer segment as per Table 3-37
Product weight (kg)	12,120	(Graulich et al., 2011)

Description	Characteristic	Comments (Sources)
Dominant market segment	Commercial Industrial Laundry (CIL)	Task 1-4, Table 3-57
Lifetime (years)	13.7	
Average price (€)	585,000	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices.
Hours per year	3,000	Hours per day * Number of working days per year (Graulich et al., 2011)
Annual sales (mln units per year)	0.00025	Estimated numbers of batch-loaded units for WM7 Base Case of the 2011 study.
Maintenance and repair costs (€/lifetime)	146,250	25 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption wash (kWh/hour)	382.50 (heat: 363.38; electricity: 19.12)	Real life condition, see Task 1-4, derived from Table 3-57
Water consumption (m^3/hour)	7	Real life conditions, see Task 1-4, derived from Table 3-57
Detergent consumption (kg per hour)	10.20	Annual detergent consumption (real life conditions) / number of cycles per year, see Task 1-4, derived from Table 3-57
Cycle time (hours)	0.75	Duration of the typically used washing programme, see Task 1-4, Table 3-57

Table 3-78: Overview of Base Case D1: Light duty commercial tumble dryer.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case is a combination of Base Cases D1 and D2 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg)	6	Capacity for dominant customer segment as per Table 4-38
Product weight (kg)	60.2	(Graulich et al., 2011)
Dominant market segment	Coin & Card laundry (CCL) and Apartment household laundry (AHL)	Task 1-4, Table 4-65
Lifetime (years)	5.6	Average cycles per lifetime (5000-15000)
Average price (€)	1,460	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices.
Cycles per year	1,800	Cycles per day * Number of working days per year (Graulich et al., 2011)

Description	Characteristic	Comments (Sources)
Annual sales (mln units per year)	0.008	Average number of estimated numbers of batch-loaded units for D1 and D2 Base Cases of the 2011 study. Based on stakeholder data (APPLiA)
Maintenance and repair costs (€/lifetime)	43.8	3 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption drying (kWh/cycle)	2.3	Real life conditions, see Task 1-4, derived from Table 3-65
Cycle time (hours)	0.67	Duration of the typically used drying programme

Table 3-79: Overview of Base Case D2: Commercial tumble dryer.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case is a combination of Base Cases D4, D5 and D6 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg)	32	Capacity for dominant customer segment as per Table 3-38
Product weight (kg)	57.2	(Graulich et al., 2011)
Dominant market segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL), Hospitality Laundry (HPL), Commercial Industrial Laundry (CIL)	Task 1-4, Table 3-66
Lifetime (years)	21.6	Average cycles per lifetime (30,000-80,000)
Average price (€)	8,700	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices.
Cycles per year	2,551	Cycles per day * Number of working days per year (Graulich et al., 2011)
Annual sales (mln units per year)	0.0077	Average number of estimated numbers of batch-loaded units for D4, D5 and D6 Base Cases of the 2011 study. Based on stakeholder data (APPLiA)
Maintenance and repair costs (€/lifetime)	261	3 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption drying (kWh/cycle)	27.9	Real life conditions, see Task 1-4, derived from Table 3-66
Cycle time (hours)	0.67	Duration of the typically used drying programme

Table 3-80: Overview of Base Case D3: Commercial cabinet dryer.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case corresponds to Base Case D3 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg)	8	Capacity for dominant customer segment as per Table 3-38
Product weight (kg)	145.15	(Graulich et al., 2011)
Dominant market segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Task 1-4, Table 3-67
Lifetime (years)	41.7	Calculated based on average cycles per lifetime (30,000-80,000, see Table 3-36) divided by number of cycles per year (see below)
Average price (€)	2,800	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices.
Cycles per year	1,320	Cycles per day (see Task 1-4, Table 3-38) * Number of working days per year
Annual sales (mln units per year)	0.01	Estimated numbers of batch-loaded units for D3 Base Case of the 2011 study. Based on stakeholder data (APPLiA)
Maintenance and repair costs (€/lifetime)	84	3 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption drying (kWh/cycle)	4.1	Real life conditions, see Task 1-4, derived from Table 3-67
Cycle time (hours)	2.16	Duration of the typically used drying programme

Table 3-81: Overview of Base Case D4: Industrial pass-through tumble dryer.

Description	Characteristic	Comments (Sources)
Base Case description	Base Case corresponds to Base Case D7 as defined in the 2011 preparatory study (Graulich et al., 2011)	
Nominal rated capacity (kg/h)	400	Capacity for dominant customer segment as per Table 3-38
Product weight (kg)	2,870.88	(Graulich et al., 2011)
Dominant market segment	Commercial Industrial Laundry (CIL)	Task 1-4, Table 3-68
Lifetime (years)	25	Average lifetime in hours (50,000-100,000)
Average price (€)	50,000	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices.

Description	Characteristic	Comments (Sources)
Cycles per year	3,000	Cycles per day * Number of working days per year (Graulich et al., 2011)
Annual sales (mln units per year)	0.0012	Estimated numbers of batch-loaded units for D7 Base Case of the 2011 study.
Maintenance and repair costs (€/lifetime)	1,500	3 % of the purchase price over its lifetime based on stakeholder's estimation
Energy consumption drying (kWh/hour)	272.00	Real life conditions, see Task 1-4, derived from Table 3-68
Cycle time (hours)	0.33	Duration of the typically used drying programme

3.4.3. Product-specific inputs

In this section, the specific inputs for the ERT are described per life cycle stage of the BCs. Detailed input tables per BC are in **Annex V**: **Inputs for LCA / LCC per Base Case.**

3.4.3.1. Raw materials

The life cycle stage Raw Materials is the production of all materials of the product, according to the BOM (see **Annex V**: **Inputs for LCA / LCC per Base Case**). For all raw material inputs, the default ERT recycled content was modelled. For several raw materials, no specific dataset was available, and a proxy dataset was used instead (**Table 3-82**).

Table 3-82: Overview of missing datasets and proxies used for raw materials.

Missing dataset	Proxy modelled
Polyamide (PA)	11-Nylon 6 fibre extrusion into fibre production mix, at plant 5 % loss, 3,5 MJ electricity
Polybutylene Terephthalate (PBT)	Polyethylene terephthalate (PET), petrochemical based polymerisation of ethylene glycol and terephthalic acid production mix, at plant petrochemical based
Plastics others (assumed polypropylene)	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based
Wood (assumed plywood box)	284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture
Plastics (PP, Polyester, ABS, etc.)	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based
Other materials (assumed plastics – PP)	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based

Note: for cast iron, the dataset '*cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2.06 % carbon content*' gave an error in the tool but was manually added as a user dataset to include the full impact of cast iron production. However, no dataset for recycling was available.

3.4.3.2. Packaging

Packaging per BC was modelled in the ERT based on the specific input data for each BC. For some BCs, no data was available. For several datasets, a proxy was used (**Table 3-83**).

Table 3-83: Overview of missing datasets and proxies used for packaging.

Missing dataset	Proxy modelled
Wood	284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture
PE foil	7-HDPE granulates Polymerisation of ethylene production mix, at plant 0.91- 0.96 g/cm^3, 28 g/mol per repeating unit

3.4.3.3. Manufacturing & Assembly

The manufacturing of the raw materials (e.g. polypropylene granulates) into a component was modelled with a process (e.g. injection moulding for plastics) in the Manufacturing & Assembly life cycle. The datasets used are provided per BC in **Annex V: Inputs for LCA / LCC per Base Case**. For several raw materials however, proxy datasets were used as no specific manufacturing process was available (**Table 3-84**).

Table 3-84: Overview of missing and proxy datasets used for manufacturing.

Missing dataset	Proxy modelled
Plastics (PP, Polyester, ABS, polycarbonate, PBT, etc.)	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polyamide (PA)	
Polyvinylchloride (PVC)	
Acrylonitrile Butadiene Styrene (ABS)	
Styropor expandable polystyrene (EPS)	
EDPM-rubber	
Plastics others	
Other (assumed plastics)	
Cast Iron	42-Aluminium casting primary production, aluminium casting single route, at plant 2.7 g/cm^3
Zinc	56-Brass Die-Casting die casting, from copper and zinc, primary production, production mix, at plant 8.41-8.86 g/cm^3
Bitumen	Excluded, no relevant dataset
Concrete	Excluded, no relevant dataset
Wood	Excluded, no relevant dataset

In addition, the electricity consumption for assembly of the product was included in this life cycle. The electricity consumption was derived from literature (based on a 7 kg nominal rated

capacity machine) and adjusted per BC to the nominal rated capacity of each BC (Yuan et al. 2016).

3.4.3.4. Distribution

Distribution of the product was modelled with the product weight including the packaging with transport modes and distances according to PEF default values (European Commission, 2013) (**Table 3-85**) as no stakeholder specific data was available.

Table 3-85: Transport scenarios for all Base Cases.

Description	Distance	Unit	Mode of transport
From supplier to factory	130	km	Truck
	240	km	Train
	270	km	Ship
Factory to final client	1200	km	Truck

3.4.3.5. Use phase

In the use phase, energy (both electricity and heat), water and detergent use (if applicable) were modelled according to the input data derived from MEErP Tasks 1 to 4 of this study. Real life annual energy, water and detergent use were modelled as inputs for the LCA instead of ideal conditions, as described in **Table 3-86** and **Table 3-87**. Detailed and updated data input and calculations according to the sensitivity analyses (see **Section 3.4.7**) can be found in **Annex V**: **Inputs for LCA / LCC per Base Case**.

Table 3-86: Initial use phase input data for washing machine Base Cases.

Use phase input	Unit	WM1	WM2	WM3	WM4	WM5
Electricity consumption (including standby mode when applicable)	kWh/year	864	9,237	6,476	2,770	57,375
Heat consumption	kWh/year	398	5,943	-	14,120	1,090,125
Water consumption	m^3/year	77	1,076	81.4	816	21,038
Detergent consumption	kg/year	142	1,518	120	901	30,600

Table 3-87: Initial use phase input data for dryer Base Cases

Use phase input	Unit	D1	D2	D3	D4
Electricity consumption (including standby mode when applicable)	kWh/year	4,149	49,118	5,420	89,760

Use phase input	Unit	D1	D2	D3	D4
Heat consumption	kWh/year	-	22,042	-	726,240

Total energy use was provided, which was subdivided into electricity and heat for water heating and electricity for the motor of the machine. The shares are based on MeerP Tasks 1-4 of the current preparatory study and provided in the updated input tables in **Annex V**: **Inputs for LCA / LCC per Base Case**. Electricity was modelled with an EU general dataset ('243-Electricity grid mix 1 kV-60 kV technology mix consumption mix, to consumer 1 kV – 60 kV'). Additionally, heat was modelled with a dataset for natural gas boiler ('252-10 kW central heating (ch) boiler production, fuelled by natural gas 10 kW Capacity lifespan 20 y production mix 1 MJ of thermal energy') for which the heat consumption of each BC was back calculated to the heat power output (as this is the format to model it in the ERT) with the default efficiency of 95 %.

3.4.3.6. Maintenance and repair

Maintenance & Repair was modelled for all BCs with the default value of 1 % spare parts of raw materials inputs.

3.4.3.7. End of life

The EoL of the product is calculated with a simplified circular footprint formula, incorporated in the ERT. For this, the BoM inputs and the additional spare parts indicated at the Maintenance & Repair life cycle are included to calculate both the EoL impacts for recycling of materials and credits for avoiding use of primary materials. Default values of the ERT for recyclability (R2) and the allocation factor (A coefficient) were used. Impacts of energy recovery and disposal to landfill were excluded in the ERT to simplify the EoL calculations (European Commission, 2024).

3.4.3.8. LCC

For the economic input parameters, data was derived from stakeholders, previous study or literature data. The specific inputs (updated after sensitivity analyses, see **Section 3.4.7**) are provided per BC in **Annex V**: **Inputs for LCA / LCC per Base Case**. One of the parameters for the LCC is the escalation rate, which is the real (inflation-corrected) annual growth of running costs. The running costs included in the ERT are the costs for electricity, heat, water and detergent (**Table 3-88** and **Table 3-89**). The escalation rate can be calculated from the extrapolated prices growth rate after correcting for inflation (using historical data both for prices and for inflation). Eurostat data for the years 2014 - 2024 was used for the prices of the energy, water, detergent and general inflation (harmonised index of consumer prices, HICP; see **Annex V Table 5-84**). For all prices, EU27 data was taken. For heat, natural gas prices were used, as heat was modelled with a natural gas boiler for all BCs. An overview of the calculation is provided in **Annex V, Annex V: Inputs for LCA / LCC per Base Case**

Table 3-88: Initial life cycle costing input data for all washing machine Base Cases.

Use phase input	Unit	WM1	WM2	WM3	WM4	WM5
Product price	Euro/unit	2,136	34,775	12,200	57,375	585,000
Installation/acquisition costs	Euro/unit	85.44	1,391	488	2,295	52,650
Fuel rate (natural gas)	Euro/MJ	0.023				
Electricity rate	Euro/kWh	0.234				
Water rate	Euro/m^3	1.91				
Detergent price	Euro/kg laundry	0.082				
Repair and maintenance costs	Euro/unit	64	1,043	366	14,344	146,250

Table 3-89: Initial life cycle costing input data for all dryer Base Cases.

Use phase input	Unit	D1	D2	D3	D4
Product price	Euro/unit	1,460	8,700	2,800	50,000
Installation/acquisition costs	Euro/unit	58	348	112	4500
Fuel rate (natural gas)	Euro/MJ	0.023			
Electricity rate	Euro/kWh	0.234			
Repair and maintenance costs	Euro/unit	44	261	84	1,500

3.4.4. Base Case Environmental Impact Assessment

In this section, the initial LCA results for each BC are presented, followed by a contribution analysis of the main contributors to the life cycle environmental impact for each BC, and an interpretation of these results.

The environmental impacts of the BCs were calculated using the MEErP ERT (version 1.6) and the data inputs presented in the previous section (updated after sensitivity analyses in **Annex V: Inputs for LCA / LCC per Base Case**). **T**he results are presented in the MEErP format, following the Product Environmental Footprint (PEF) impact assessment method, as calculated in the ERT. Sixteen environmental impact categories are available in the ERT, which are:

- Climate change, total, in kg CO_2-equivalent
- Ozone depletion, in kg CFC-11-equivalent
- Human toxicity, cancer, in CTUh
- Human toxicity, non-caner, in CTUh
- Particulate matter, in disease incidence
- Ionising radiation, human health, in kBq U235-equivalent
- Photochemical ozone formation, human health, in kg NMVOC-equivalent
- Acidification, in mol H+-equivalent

- Eutrophication, terrestrial, in mol N-equivalent
- Eutrophication, freshwater, in kg P-equivalent
- Eutrophication, marine, in kg N-equivalent
- Ecotoxicity, freshwater
- Land use, in pt
- Water use, in m^3 water-equivalent of deprived water
- Resource use, minerals and metals, in kg Sb-equivalent
- Resource use, fossils, in MJ

The LCA results are reported for each impact category and each life cycle stage:

- Raw materials
- Manufacturing
- Distribution
- Packaging
- Use
- Maintenance and repair
- End-of-life (impacts and credits)

3.4.4.1. Results overview LCA

Table 3-90 and **Table 3-91** contain an overview of the initially calculated total life cycle impact for washing machines and dryers respectively. It can be observed from the tables that BCs WM5 and D4 have the highest energy use for washing machines and dryers respectively. For these industrial categories, the main contributor to the energy consumption is not electricity, but gas or steam for heating. As a consequence, WM5 and D4 also have the highest impact across all impact categories, whereas BCs WM1, WM4 and D1 have the lowest impact across all impact categories. This can be attributed mainly to the size of each product and the higher nominal capacity. Specifically, WM5 and D4 are the heaviest products and WM1, WM4 and D1 are the least heavy. Furthermore, products with higher nominal capacity (WM5 and D4) have a higher energy (gas or steam for heating), water and detergent consumption, leading to higher impacts across most impact categories compared to products with a lower weight and nominal capacity (e.g. WM1 and D1).

Additionally, the ERT calculates the results per BC per year of use. The initially totals are presented in **Table 3-92** and **Table 3-93;** updated data after sensitivity analyses (see **Section 3.4.7**) is provided per BC and life cycle in **Annex VI – Results of LCA / LCC per Base Cas.** In general, BC WM5 still shows the highest impact per year of use, although the difference between BCs is slightly lower.

Table 3-90: Preliminary total life cycle impact per washing machine Base Case total lifetime (WM1, WM2, WM3, WM4, WM5).

Environmental aspect	Unit	WM1	WM2	WM3	WM4	WM5
Energy consumption						
Electricity	kWh	4,847	141,376	202,743	56,905	787,573
Thermal energy	MJ	8,451	344,551	0	1,096,870	56,594,700
PEF Impact categories						
Climate change, total	kg CO_2 eq	4.86E+03	1.47E+05	1.06E+05	2.11E+05	5.25E+06
Ozone depletion	kg CFC-11 eq	8.13E-05	2.42E-03	4.18E-04	1.97E-03	4.35E-02
Human toxicity, cancer	CTUh	1.01E-05	1.90E-04	5.53E-05	3.20E-04	5.55E-03
Human toxicity, non-cancer	CTUh	6.50E-05	2.11E-03	7.07E-04	2.51E-03	3.86E-02
Particulate matter	disease incidence	3.13E-04	8.61E-03	5.47E-03	1.61E-02	1.59E-01
Ionising radiation, human health	kBq U235 eq	1.08E+03	3.16E+04	3.77E+04	1.97E+04	3.20E+05
Photochemical ozone formation, human health	kg NMVOC eq	1.04E+01	3.06E+02	2.14E+02	4.96E+02	6.72E+03
Acidification	mol H+ eq	2.08E+01	5.87E+02	5.06E+02	1.48E+03	1.13E+04
Eutrophication, terrestrial	mol N eq	4.34E+01	1.25E+03	7.96E+02	1.71E+03	2.30E+04
Eutrophication, freshwater	kg P eq	2.42E-01	7.68E+00	1.37E+00	7.07E+00	1.55E+02
Eutrophication, marine	kg N eq	7.03E+00	2.07E+02	8.90E+01	2.36E+02	3.91E+03
Ecotoxicity, freshwater	CTUe	4.26E+04	1.24E+06	6.05E+05	1.30E+06	2.09E+07
Land use	pt	1.30E+05	1.81E+06	1.46E+06	2.95E+06	4.02E+07
Water use	m^3 water eq. of deprived water	1.00E+04	3.56E+05	8.34E+04	3.48E+05	6.09E+06
Resource use, minerals and metals	kg Sb eq	5.78E-02	1.33E+00	1.59E+00	8.57E+00	3.85E+01
Resource use, fossils	MJ	7.66E+04	2.29E+06	1.77E+06	3.10E+06	7.98E+07

Table 3-91: Preliminary total life cycle impact per dryer Base Case total lifetime (D1, D2, D3, D4).

Environmental aspect	Unit	D1	D2	D3	D4
Energy consumption					
Electricity	kWh	23,248	1,060,935	226,060	2,244,364
Thermal energy	MJ	0	1,804,120	0	68,801,684
PEF Impact categories					
Climate change, total	kg CO_2 eq	1.19E+04	5.64E+05	9.82E+04	5.42E+06
Ozone depletion	kg CFC-11 eq	3.88E-06	1.72E-04	3.54E-05	6.22E-04
Human toxicity, cancer	CTUh	1.01E-05	9.30E-05	1.79E-05	5.94E-04
Human toxicity, non-cancer	CTUh	5.48E-05	1.61E-03	3.53E-04	7.07E-03
Particulate matter	disease incidence	6.44E-04	1.51E-02	3.54E-03	5.32E-02
Ionising radiation, human health	kBq U235 eq	4.25E+03	1.91E+05	4.04E+04	4.81E+05
Photochemical ozone formation, human health	kg NMVOC eq	2.46E+01	8.14E+02	1.69E+02	4.55E+03
Acidification	mol H+ eq	6.56E+01	1.45E+03	3.44E+02	5.54E+03
Eutrophication, terrestrial	mol N eq	8.67E+01	2.89E+03	6.22E+02	1.16E+04
Eutrophication, freshwater	kg P eq	2.51E-02	1.59E+00	2.00E-01	2.77E+01
Eutrophication, marine	kg N eq	8.13E+00	2.78E+02	5.86E+01	1.29E+03
Ecotoxicity, freshwater	CTUe	5.72E+04	2.09E+06	4.53E+05	6.40E+06
Land use	pt	1.91E+05	2.09E+06	4.97E+05	5.54E+06
Water use	m^3 water eq. of deprived water	3.72E+03	1.54E+05	3.29E+04	3.87E+05
Resource use, minerals and metals	kg Sb eq	2.63E-01	5.83E-01	4.17E-01	9.46E+00
Resource use, fossils	MJ	1.99E+05	9.56E+06	1.69E+06	8.53E+07

Table 3-92: Preliminary total life cycle impact per washing machine Base Case per year of use (WM1, WM2, WM3, WM4, WM5).

Environmental aspect	Unit	WM1	WM2	WM3	WM4	WM5
Energy consumption						
Electricity	kWh	866	9,240	6,477	2,776	57,487
Thermal energy	MJ	1,509	22,520	0	53,506	4,131,000

Environmental aspect	Unit	WM1	WM2	WM3	WM4	WM5
PEF Impact categories						
Climate change, total	kg CO_2 eq	8.7E+02	9.6E+03	3.4E+03	1.03E+04	3.83E+05
Ozone depletion	kg CFC-11 eq	1.5E-05	1.6E-04	1.3E-05	9.61E-05	3.17E-03
Human toxicity, cancer	CTUh	1.8E-06	1.2E-05	1.8E-06	1.56E-05	4.05E-04
Human toxicity, non-cancer	CTUh	1.2E-05	1.4E-04	2.3E-05	1.22E-04	2.82E-03
Particulate matter	disease incidence	5.6E-05	5.6E-04	1.7E-04	7.84E-04	1.16E-02
Ionising radiation, human health	kBq U235 eq	1.9E+02	2.1E+03	1.2E+03	9.60E+02	2.33E+04
Photochemical ozone formation, human health	kg NMVOC eq	1.9E+00	2.0E+01	6.8E+00	2.42E+01	4.91E+02
Acidification	mol H+ eq	3.7E+00	3.8E+01	1.6E+01	7.24E+01	8.24E+02
Eutrophication, terrestrial	mol N eq	7.7E+00	8.1E+01	2.5E+01	8.35E+01	1.68E+03
Eutrophication, freshwater	kg P eq	4.3E-02	5.0E-01	4.4E-02	3.45E-01	1.13E+01
Eutrophication, marine	kg N eq	1.3E+00	1.4E+01	2.8E+00	1.15E+01	2.85E+02
Ecotoxicity, freshwater	CTUe	7.6E+03	8.1E+04	1.9E+04	6.33E+04	1.52E+06
Land use	pt	2.3E+04	1.2E+05	4.7E+04	1.44E+05	2.93E+06
Water use	m^3 water eq. of deprived water	1.8E+03	2.3E+04	2.7E+03	1.70E+04	4.45E+05
Resource use, minerals and metals	kg Sb eq	1.0E-02	8.7E-02	5.1E-02	4.18E-01	2.81E+00
Resource use, fossils	MJ	1.4E+04	1.5E+05	5.7E+04	1.51E+05	5.83E+06

Table 3-93: Preliminary total life cycle impact per dryer Base Case per year of use (D1, D2, D3, D4).

Environmental aspect	Unit	D1	D2	D3	D4
Energy consumption					
Electricity	kWh	4,151	49,117	5,421	89,775
Thermal energy	MJ	0	83,524	0	2,752,067
PEF Impact categories					
Climate change, total	kg CO_2 eq	2.1E+03	2.6E+04	2.35E+03	2.2E+05
Ozone depletion	kg CFC-11 eq	6.9E-07	8.0E-06	8.49E-07	2.5E-05
Human toxicity, cancer	CTUh	1.8E-06	4.3E-06	4.28E-07	2.4E-05
Human toxicity, non-cancer	CTUh	9.8E-06	7.4E-05	8.46E-06	2.8E-04
Particulate matter	disease incidence	1.2E-04	7.0E-04	8.48E-05	2.1E-03
Ionising radiation, human health	kBq U235 eq	7.6E+02	8.8E+03	9.70E+02	1.9E+04
Photochemical ozone formation, human health	kg NMVOC eq	4.4E+00	3.8E+01	4.05E+00	1.8E+02
Acidification	mol H+ eq	1.2E+01	6.7E+01	8.26E+00	2.2E+02
Eutrophication, terrestrial	mol N eq	1.5E+01	1.3E+02	1.49E+01	4.6E+02
Eutrophication, freshwater	kg P eq	4.5E-03	7.3E-02	4.79E-03	1.1E+00
Eutrophication, marine	kg N eq	1.5E+00	1.3E+01	1.41E+00	5.1E+01
Ecotoxicity, freshwater	CTUe	1.0E+04	9.7E+04	1.09E+04	2.6E+05
Land use	pt	3.4E+04	9.7E+04	1.19E+04	2.2E+05
Water use	m^3 water eq. of deprived water	6.6E+02	7.1E+03	7.90E+02	1.5E+04
Resource use, minerals and metals	kg Sb eq	4.7E-02	2.7E-02	1.00E-02	3.8E-01
Resource use, fossils	MJ	3.5E+04	4.4E+05	4.06E+04	3.4E+06

3.4.4.2. Contribution analysis per Base Case

This section contains a detailed analysis on the contribution of each life cycle stage to the life cycle impact per BC. Furthermore, a contribution analysis is performed in the two highest contribution life cycle stages, namely use stage and raw materials production, per BC.

WM1: Light duty commercial washer extractor

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for WM1 BC, updated after sensitivity analyses, are presented in **Annex VI, WM1: Light duty commercial washer extractor.**

The majority of the lifetime impact of the light duty commercial washer extractor is derived from the use phase (>80 % for most impact categories) followed by the raw materials input (**Figure 3-11)** For impact indicators 'Human toxicity, cancer', 'Land use' and 'Resource use, minerals and metals', however, the raw materials provide the main contribution (50-75 %) followed by the use phase (**Figure 3-11**).

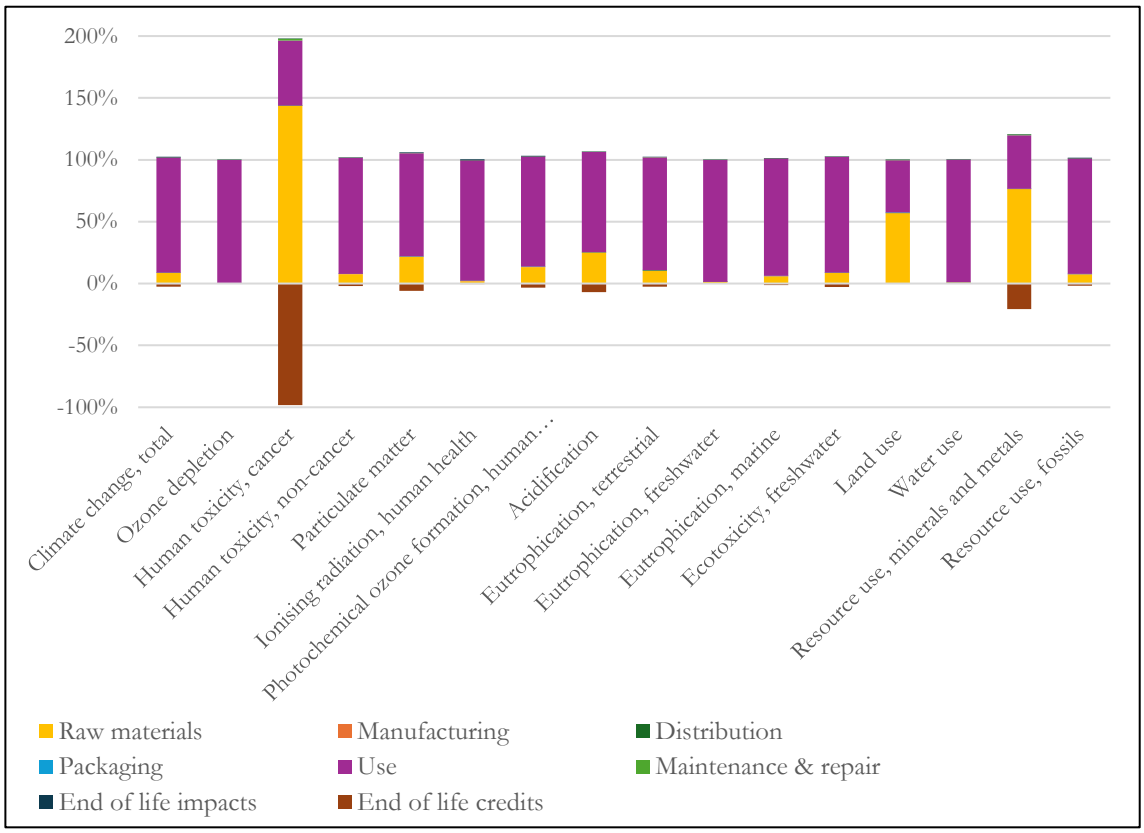

Figure 3-11: Preliminary contribution analysis (including EOL credits), WM1.

In the use phase, the major contributor differs per impact category. For 'Climate change', it is the electricity use, however, for several other impact categories, detergent and/or water use contribute the most (**Figure 3-12**). The major contribution of the raw materials to most impact categories is from the production of electronics (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset) and stainless steel (**Figure 3-13**). However, there are exceptions for certain impact categories. Specifically, for 'Human toxicity, cancer' the top contributing raw materials are polypropylene and epoxy and for 'Eutrophication, freshwater' polypropylene and chrome. Aluminium is the top contributing material to the impact category 'Ecotoxicity, freshwater' and copper contributes 98 % to the 'Land use' impact category. Other raw materials that share significant impact are cast iron and concrete (**Figure 3-13**).

In the EoL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For WM1, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' and 'Resource use, minerals and metals' (**Figure 3-11**) as a consequence of a credit for stainless steel due to its recyclability. Additionally, credits for aluminium, galvanised steel and the controller board also contribute to lowering the overall lifetime impact of WM1.

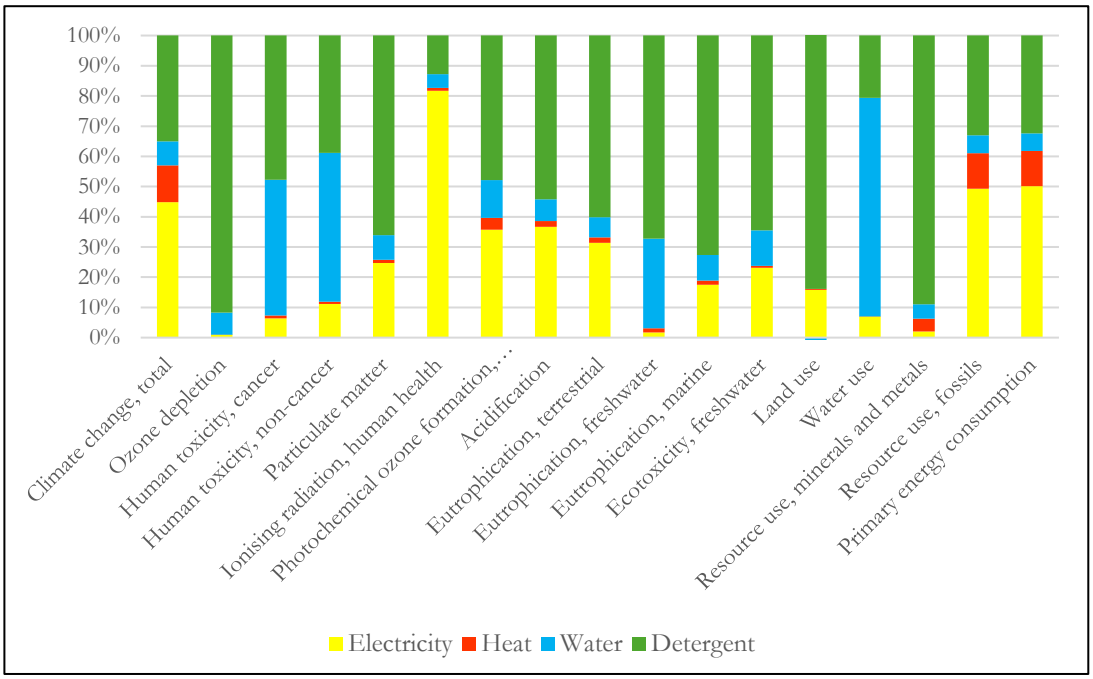

Figure 3-12: Preliminary contribution analysis – Use phase, WM1.

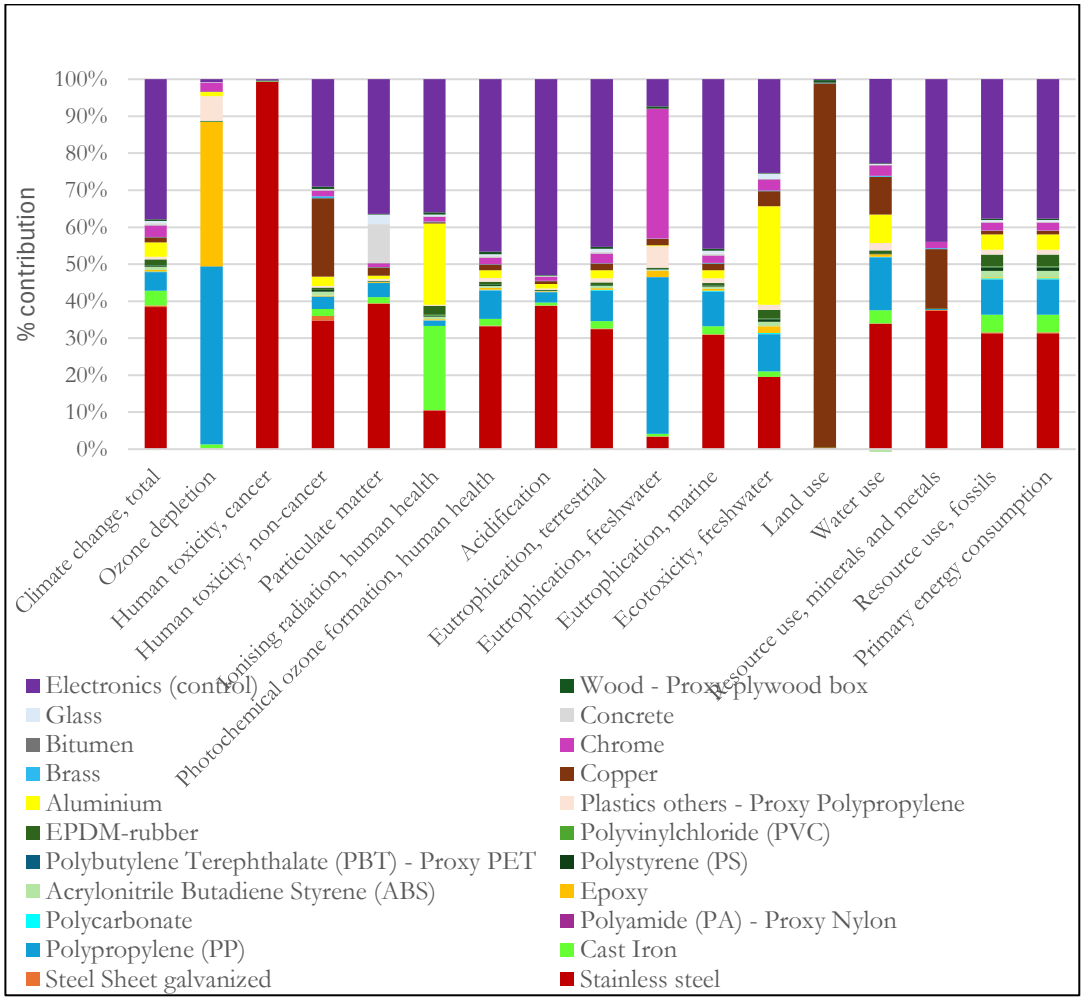

Figure 3-13: Preliminary contribution analysis – Raw materials, WM1.

WM2: Commercial washer extractor

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for WM2 BC, updated after sensitivity analyses, are presented in **Annex VI, WM2: Commercial washer extractor**.

The majority of the lifetime impact of the commercial washer extractor is derived from the use phase (>90 % for most impact categories) followed by the raw materials input (**Figure 3-14**). For impact categories 'Human toxicity, cancer' and 'Resource use, minerals and metals', the raw materials provide a larger share contribution (>20 %) compared to the other impact indicators (**Figure 3-14**).

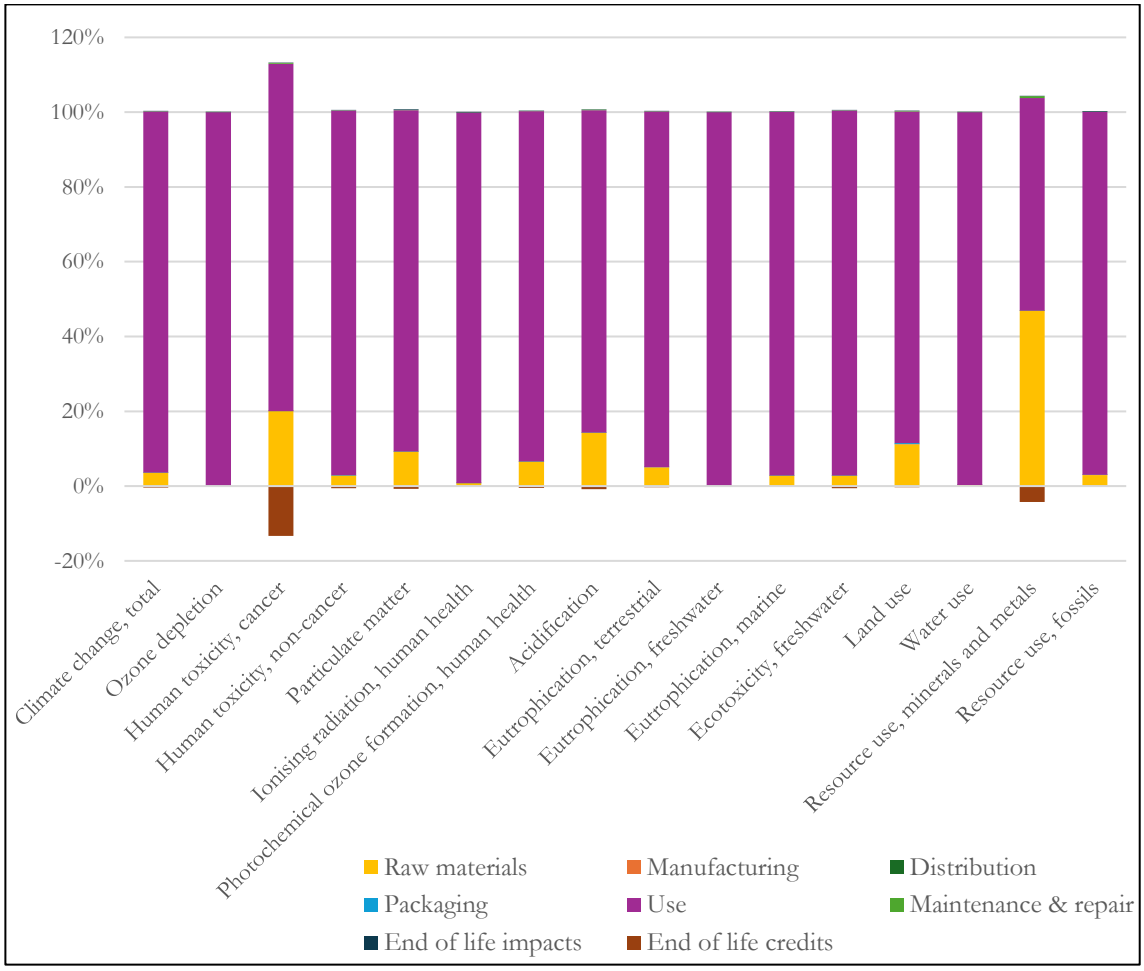

Figure 3-14: Prelimiary contribution analysis (including EoL credits), WM2.

In the use phase, the major contributor differs per impact category; for climate change, it is the electricity use, however, for several other impact categories, detergent and/or water use contribute the most (**Figure 3-15)**.

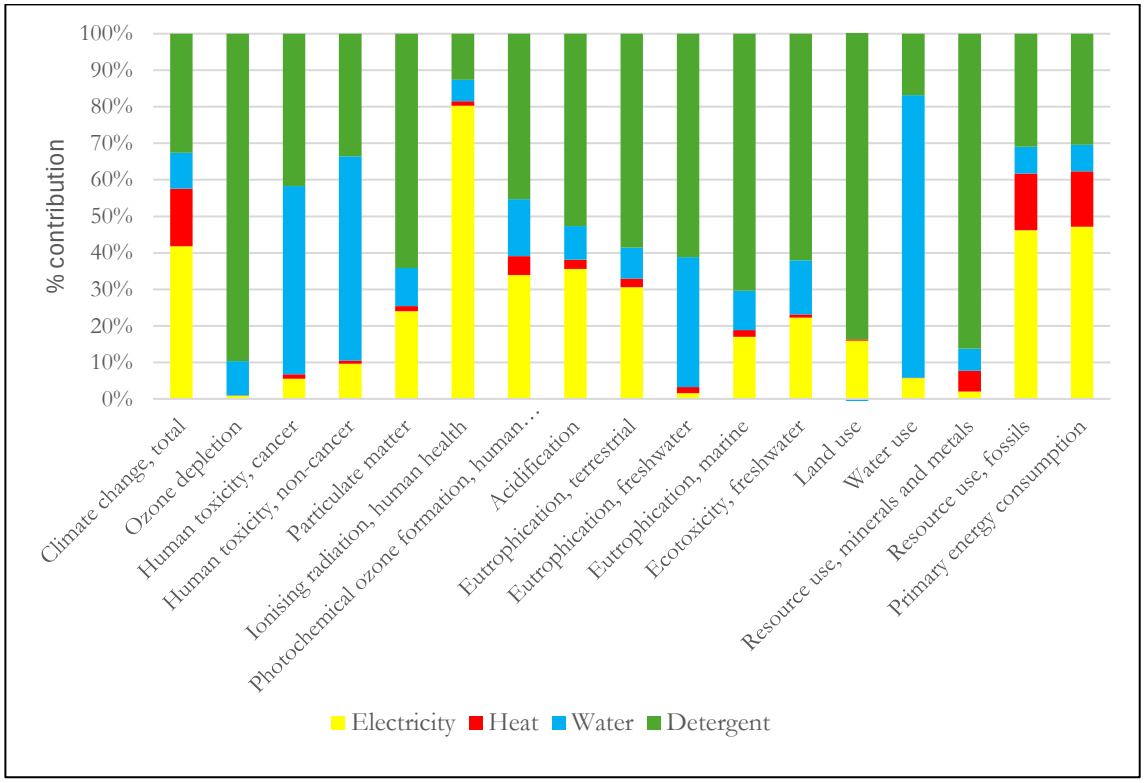

Figure 3-15: Preliminary contribution analysis – Use phase, WM2.

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset) (**Figure 3-16**). However, for the impact categories 'Ozone depletion', 'Human toxicity, cancer' and 'Land use', the dominant contributors are polypropylene, stainless steel and copper, respectively. Other raw materials contributing to the impact categories are aluminium and galvanised steel.

In the EOL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For WM2, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' and 'Resource use, minerals and metals' (**Figure 3-14**) as a consequence of a credit for galvanised steel and stainless steel due to its recyclability. Additionally, credits for aluminium and the controller board also contribute to lowering the overall lifetime impact of WM2.

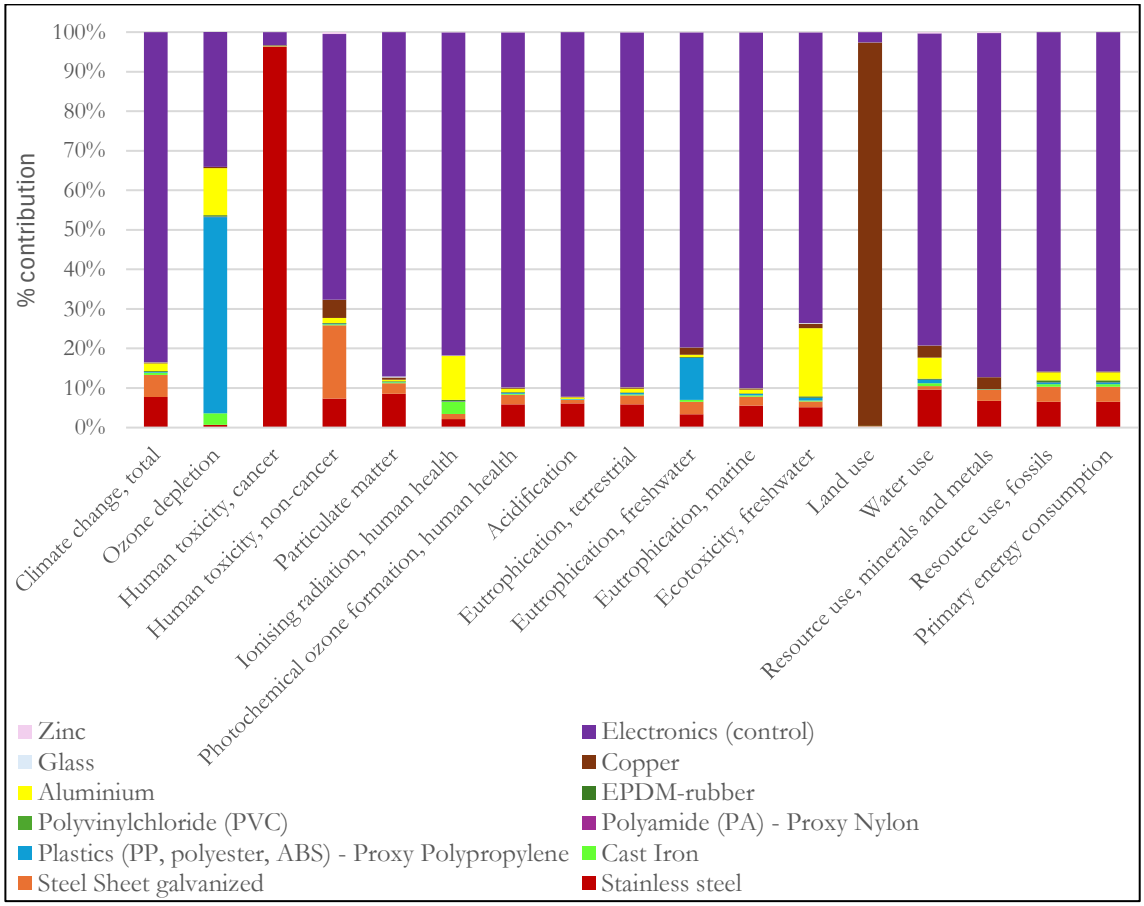

Figure 3-16: Preliminary contribution analysis – Raw materials – WM2.

WM3: Commercial washer dryer

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for WM3 BC, updated after sensitivity analyses, are presented in **Annex VI, WM3: Commercial washer dryer.**

The majority of the lifetime impact of the commercial washer dryer is derived from the use phase (>90 % for most impact categories) followed by the raw materials input (**Figure 3-17**). For impact indicators 'Human toxicity, cancer' and 'Resource use, minerals and metals', the raw materials provide a larger share contribution (>20 %) compared to the other impact indicators (**Figure 3-17**).

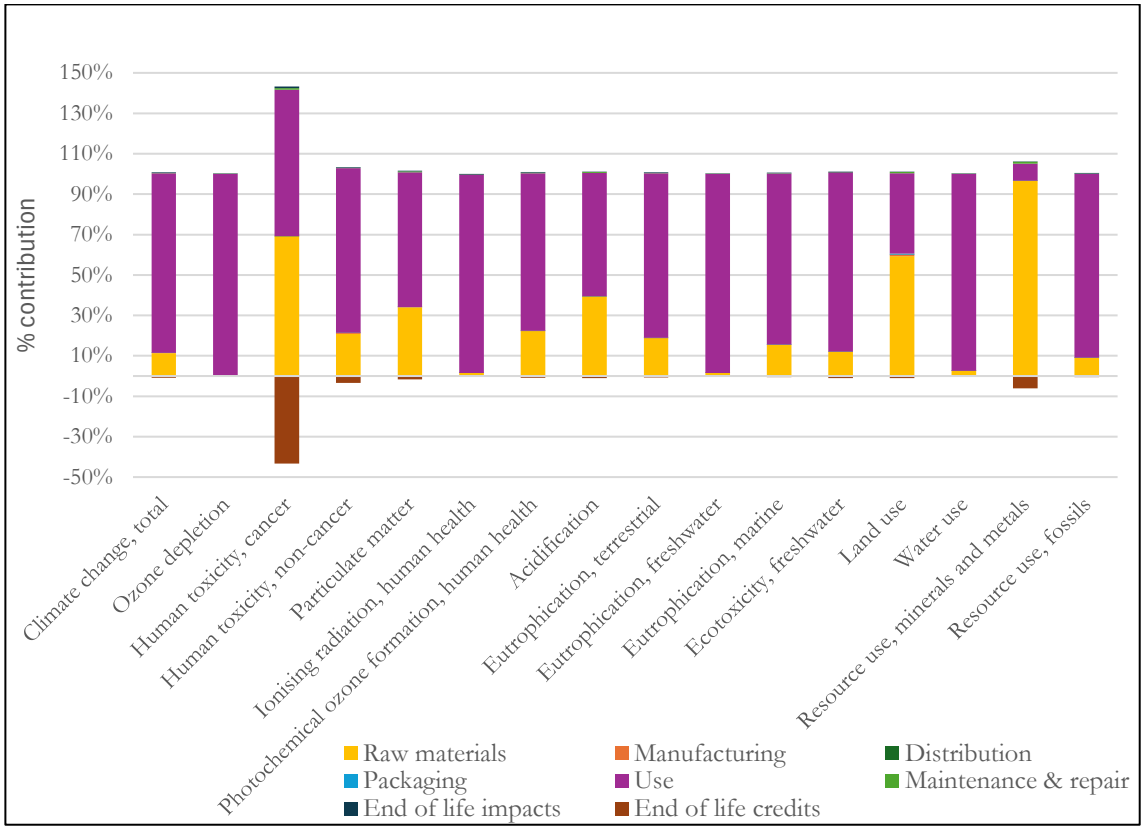

Figure 3-17: Preliminary contribution analysis (including EOL credits), WM3.

In the use phase, the major contributor differs per impact category. For 'Climate change', it is the electricity use, however, for several other impact categories, detergent and/or water use contribute the most (**Figure 3-18**).

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset). However, for the impact categories 'Human toxicity, cancer' and 'Land use', the dominant contributors are stainless steel and copper, respectively (**Figure 3-19**). Polypropylene is the second highest contributing raw material to the impact category 'Ozone depletion'.

In the EoL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For WM3, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' and 'Resource use, minerals and metals' (**Figure 3-17**) as a consequence of a credit for galvanised steel and stainless steel due to its recyclability. Additionally, credits for aluminium and the controller board also contribute to lowering the overall lifetime impact of WM3.

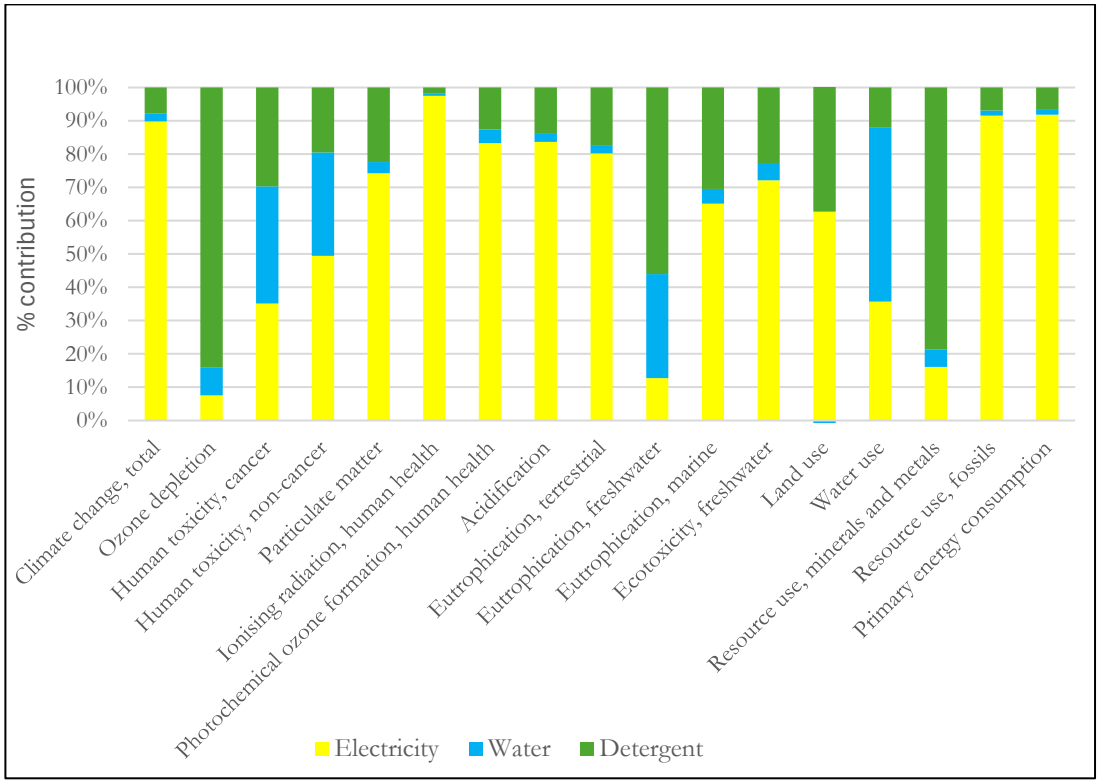

Figure 3-18: Preliminay contribution analysis – Use phase, WM3.

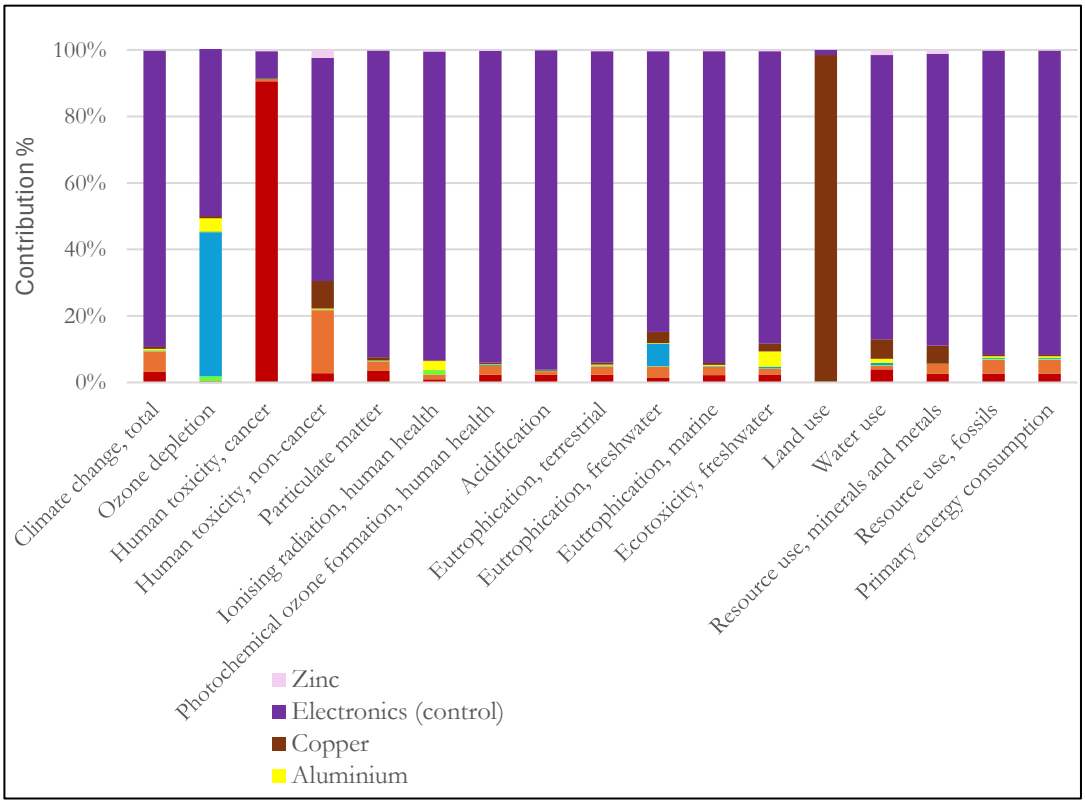

Figure 3-19: Preliminary contribution analysis – Raw materials, WM3.

WM4: Commercial barrier washer

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for WM4 BC, updated after sensitivity analyses, are presented in **Annex VI, WM4: Commercial barrier** washer.

The majority of the lifetime impact of the commercial barrier washer is derived from the use phase and the raw materials input (to different degrees for the various impact indicators (**Figure 3-20**).

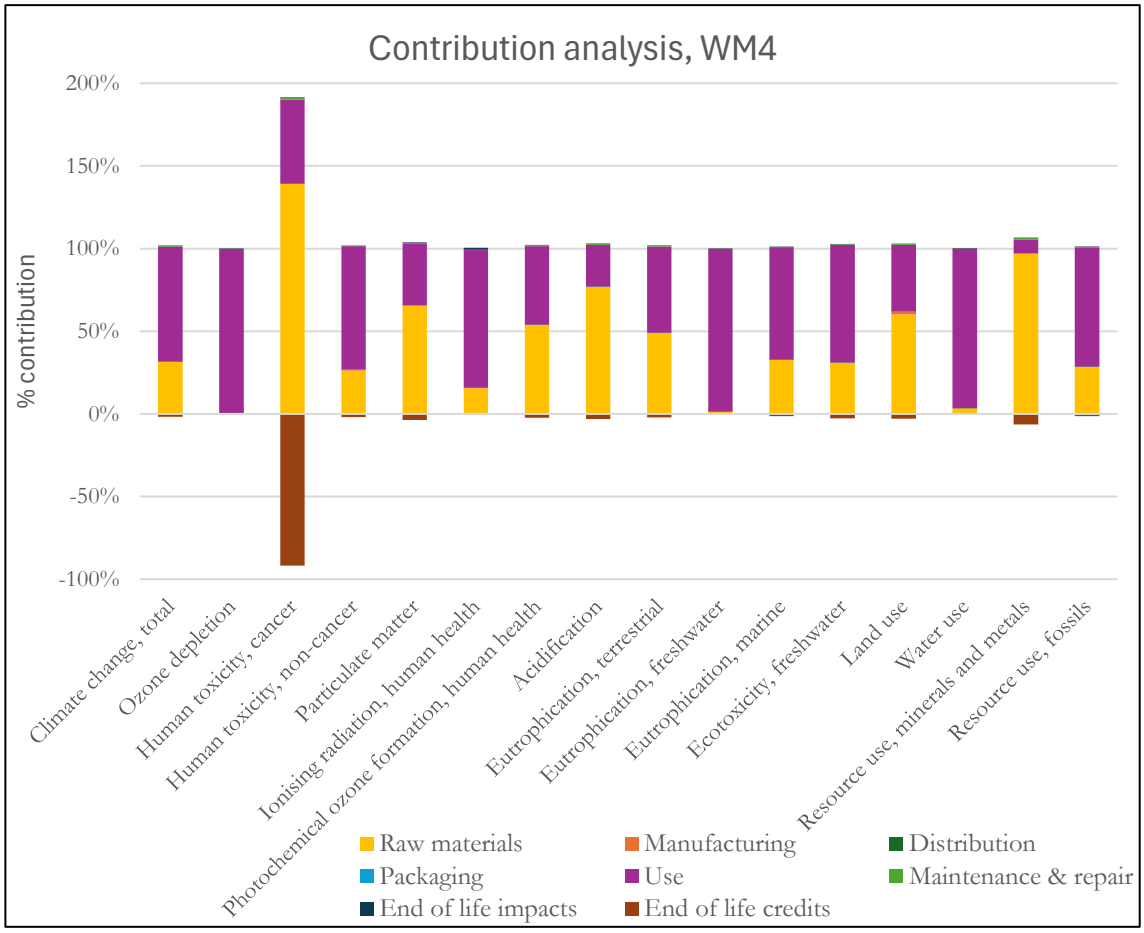

Figure 3-20: Preliminary contribution analysis (including EoL credits), WM4.

In the use phase, the major contributor differs per impact category; for climate change, it is the heat use (from natural gas combustion), however, for several other impact categories, detergent and/or water use contribute the most (**Figure 3-21)**.

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset). However, for the impact categories 'Human toxicity, cancer' and 'Land use', the dominant contributors are stainless steel and copper, respectively (**Figure 3-22**). Polypropylene is the second highest contributing raw material to the impact category 'Ozone depletion'.

In the EoL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For WM4, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' (**Figure 3-20**) as a consequence of a credit for stainless steel and galvanised steel, due to its recyclability. Additionally, credits for Aluminium and the controller board also contribute to lowering the overall lifetime impact of WM4.

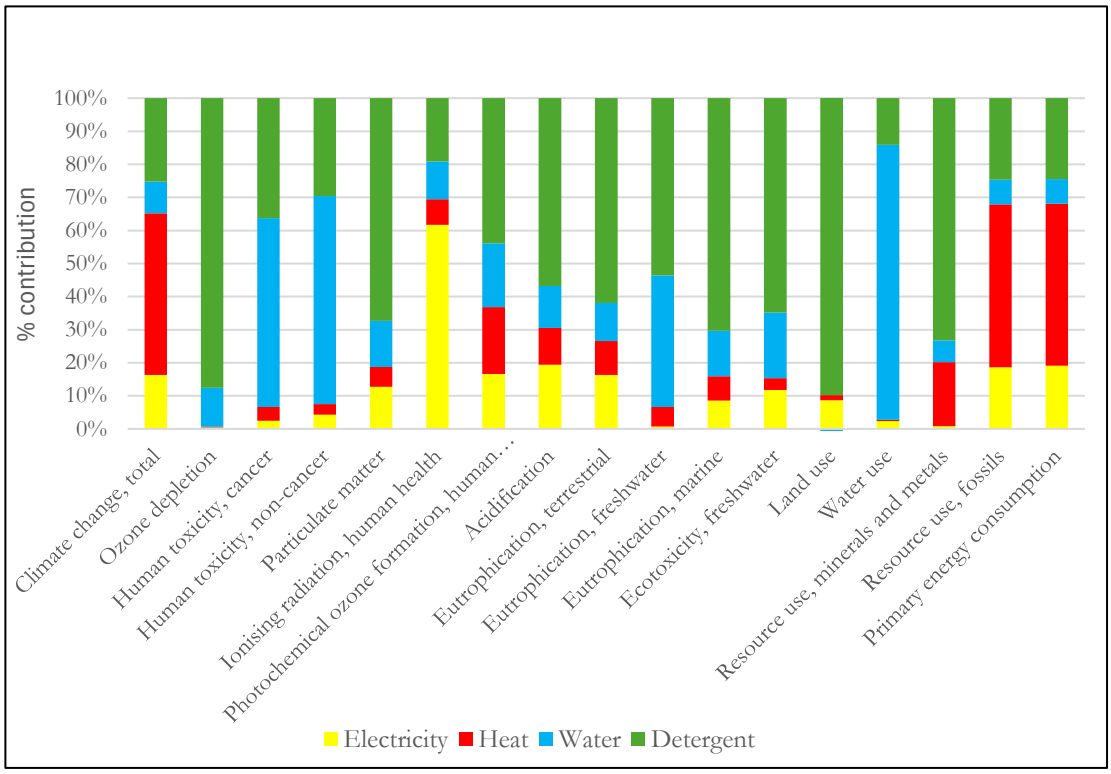

Figure 3-21: Preliminary contribution analysis – Use phase, WM4.

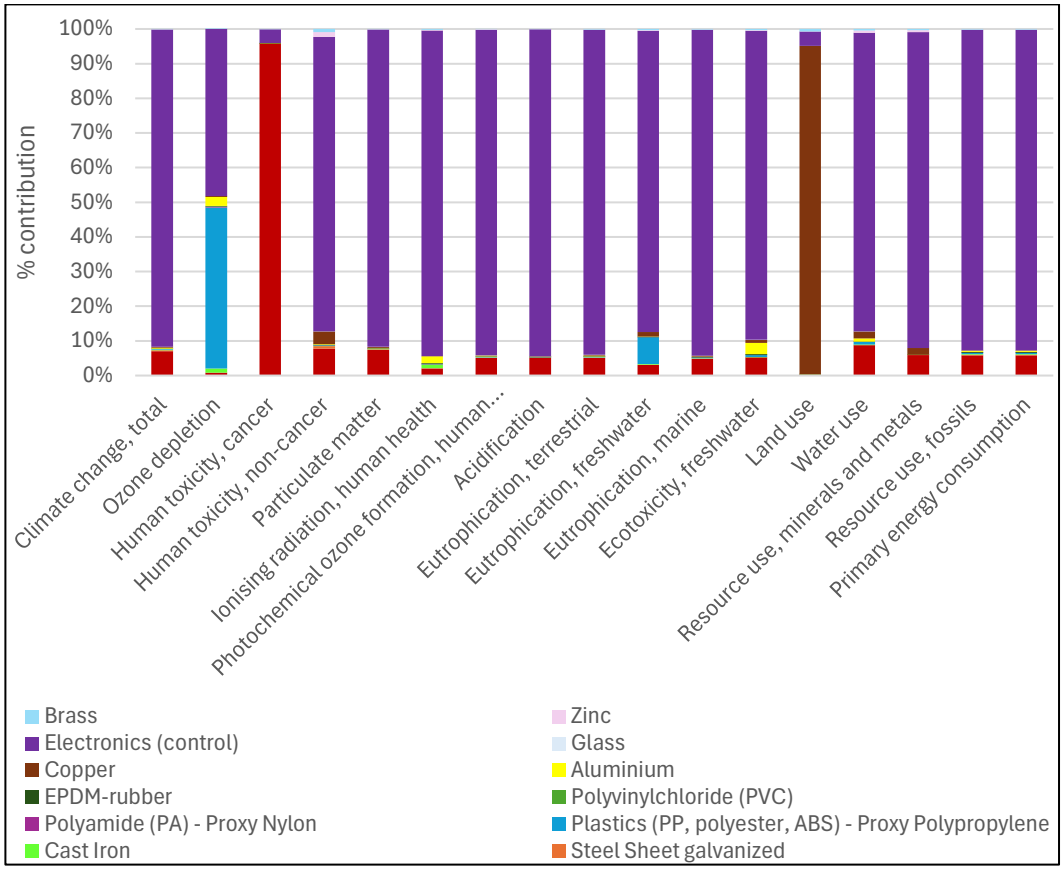

Figure 3-22: Preliminary contribution analysis – Raw materials, WM4.

WM5: Industrial continuous tunnel washers

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for WM5 BC, updated after sensitivity analyses, are presented in **Annex VI, WM5: Industrial continuous tunnel washers.**

The majority of the lifetime impact of the industrial continuous tunnel washer is derived from the use phase (>84 % for most impact categories) followed by the raw materials input (**Figure 3-23**). For the impact indicators 'Human toxicity, cancer' and 'Resource use, minerals and metals', however, the raw materials provide the main contribution followed by the use phase (**Figure 3-23**).

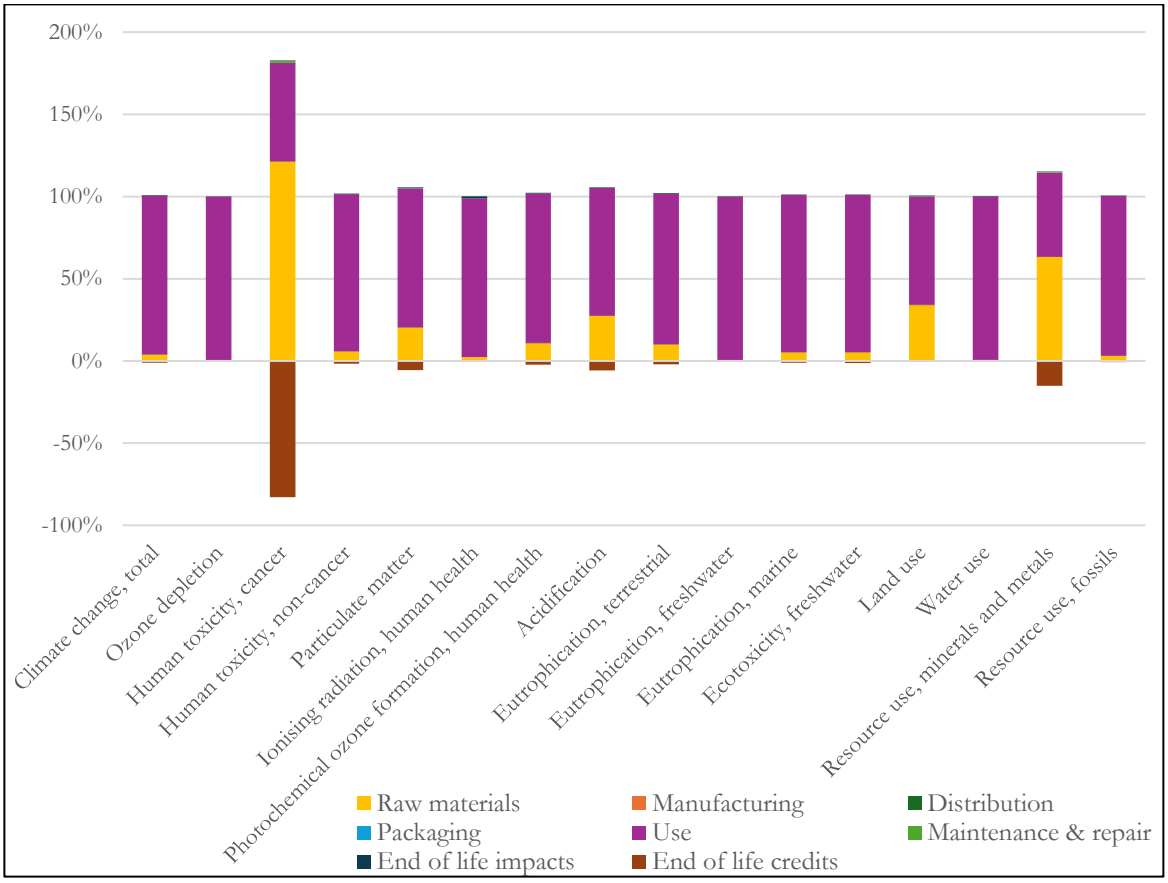

Figure 3-23: Preliminary contribution analysis (including EOL credits), WM5.

In the use phase, the major contributor differs per impact category; for most impact categories, it is detergent use, however, for the impact categories 'Climate change', 'Ionising radiation, human health', 'Primary energy consumption' and 'Resource use, fossils' energy use (gas or steam for heating) contributes the most (**Figure 3-24**). Water use contributes the most to the impact categories 'Human toxicity, cancer', 'Human toxicity, non-cancer' and 'Water use'.

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset) and stainless steel. However, for the impact categories 'Human toxicity, cancer' and 'Land use', the dominant contributors are stainless steel and copper, respectively (**Figure 3-25**).

In the EoL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For WM5, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' and 'Resource use, minerals and metals' (**Figure 3-23**) as a consequence of a credit for galvanised steel and stainless steel due to its recyclability. Additionally, a credit for the controller board also contributes to lowering the overall lifetime impact of WM5.

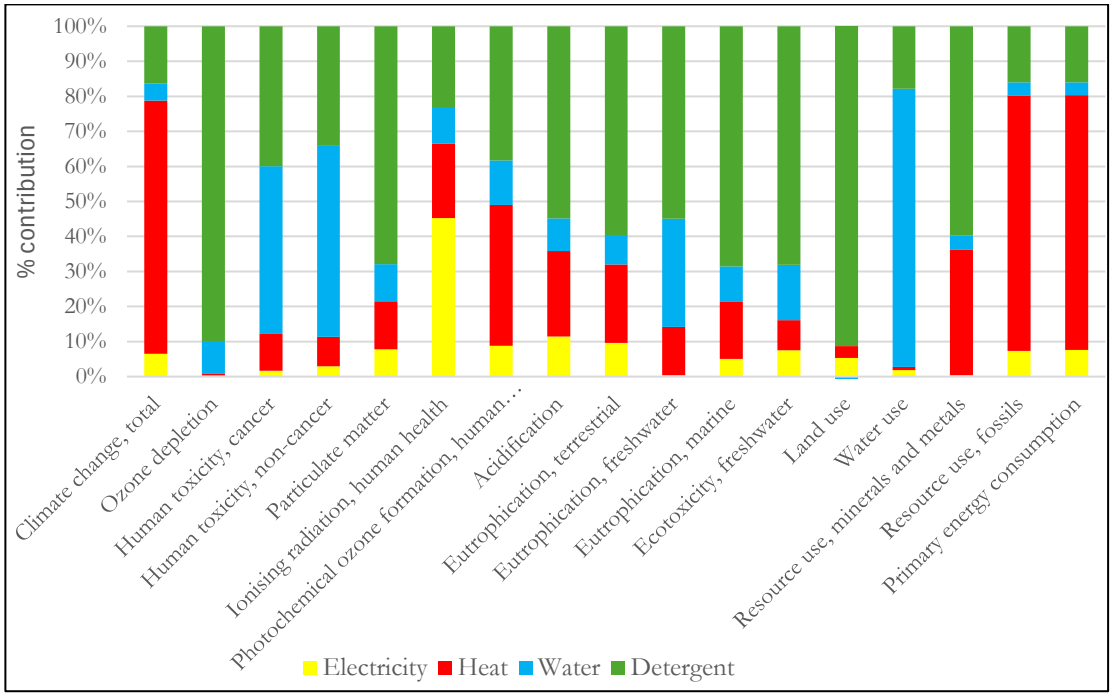

Figure 3-24: Preliminary contribution analysis – Use phase, WM5.

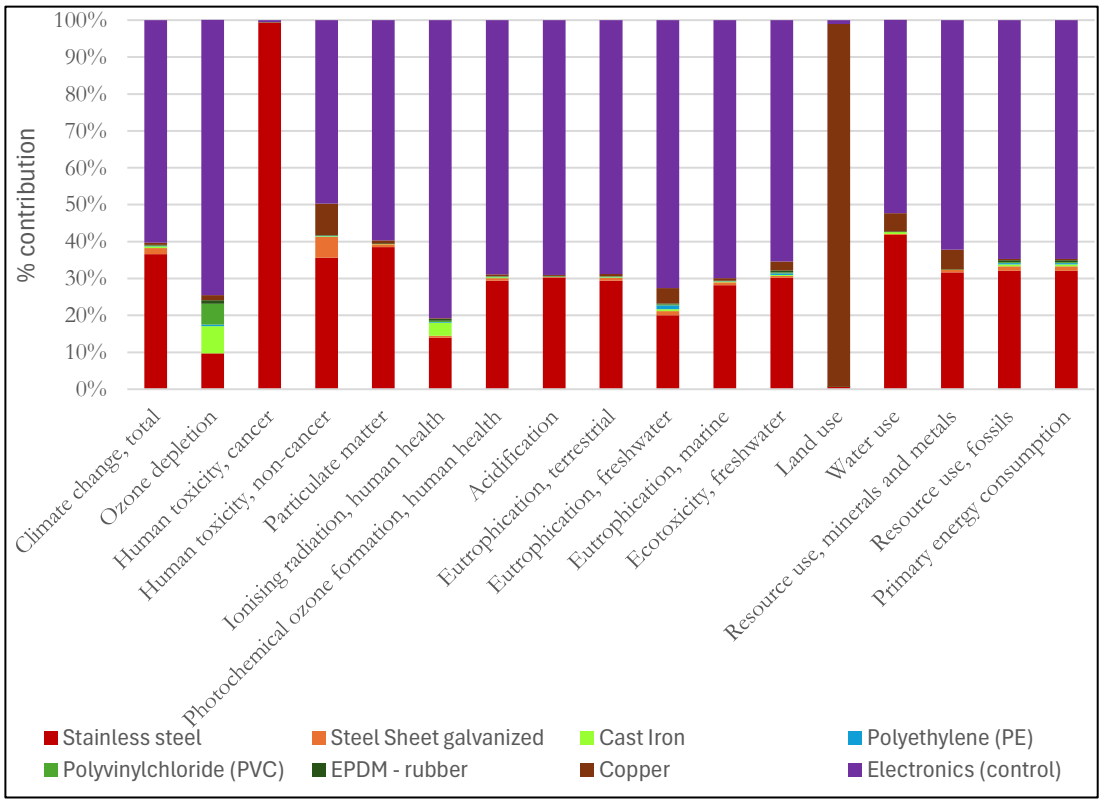

Figure 3-25: Preliminary contribution analysis – Raw materials, WM5.

D1: Light duty commercial tumble dryer

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for D1 BC, updated after sensitivity analyses, are presented in **Annex VI, D1: Light duty commercial tumble dryer.**

The majority of the lifetime impact of the light duty commercial tumble dryer is derived from the use phase and the raw materials input (to different degrees for the various impact indicators (**Figure 3-26**).

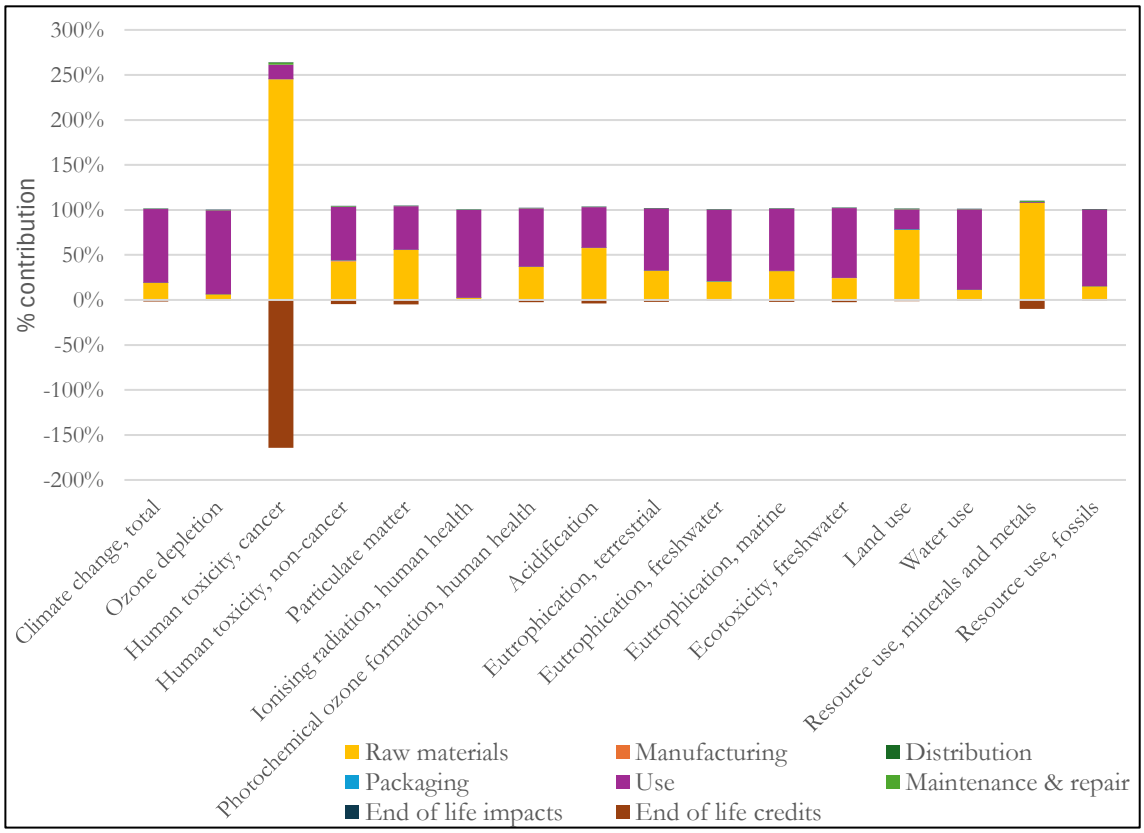

Figure 3-26: Preliminary contribution analysis (including EOL credits), D1.

The impact of the use phase is based only on the impact of electricity and thus electricity production is the main and only contributor (not shown).

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset) (**Figure 3-27**). However, for the impact categories 'Ozone depletion', 'Human toxicity, cancer' and 'Land use', the dominant contributors are polypropylene, stainless steel and copper, respectively. Other raw materials contributing to the impact categories are aluminium and galvanised steel.

In the EoL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For D1, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' (**Figure** 3-26) as a consequence of a credit for galvanised

steel and stainless steel due to its recyclability. Additionally, credits for Aluminium and the controller board also contribute to lowering the overall lifetime impact of D1.

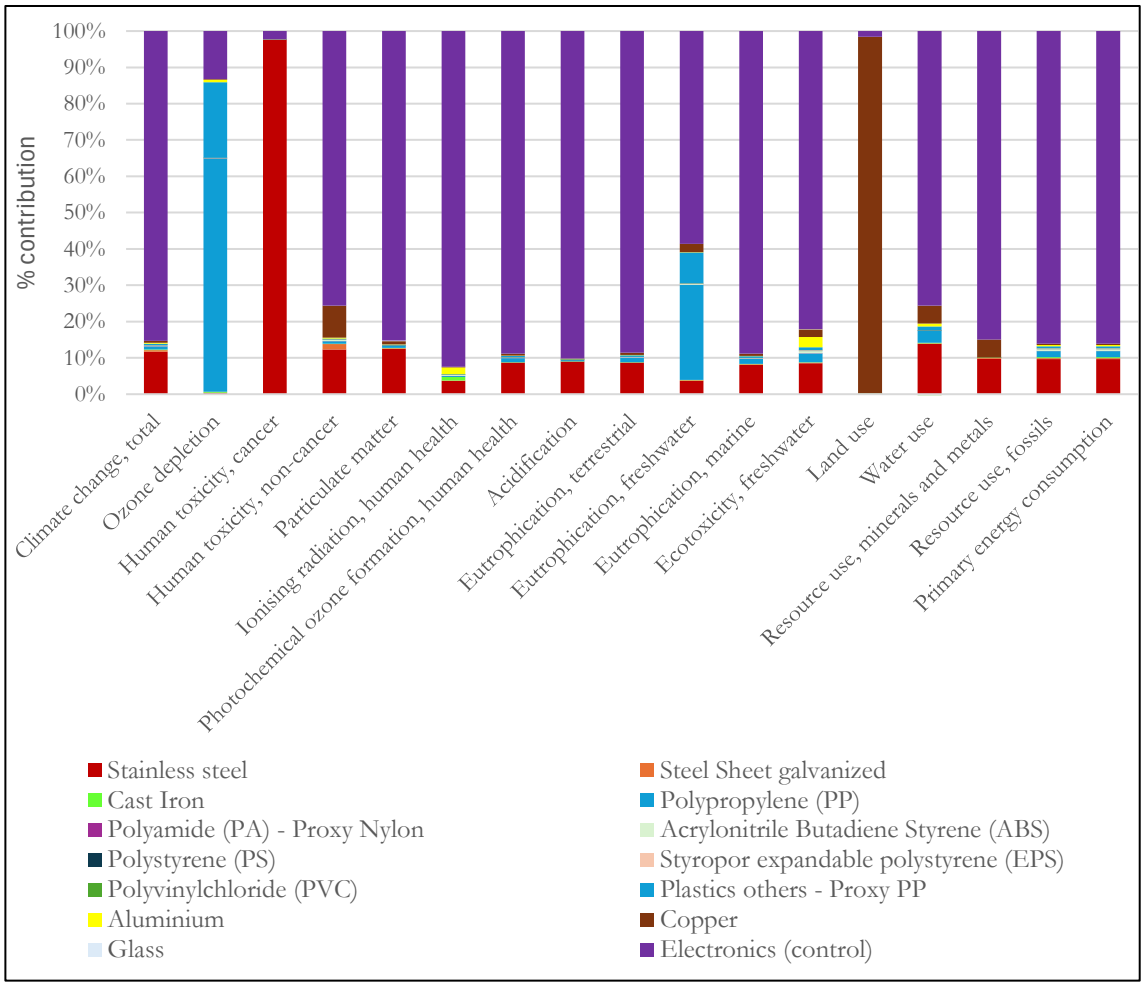

Figure 3-27: Preliminary contribution analysis – Raw materials, D1.

D2: Commercial tumble dryer

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for D2 BC, updated after sensitivity analyses, are presented in **Annex VI,**

D2: Commercial tumble dryer.

The majority of the lifetime impact of the commercial tumble dryer is derived from the use phase (>90 % for most impact categories) followed by the raw materials input (**Figure 3-28**). For impact indicators 'Human toxicity, cancer' and 'Resource use, minerals and metals', the raw materials provide a larger share contribution (25 % to 45 %) compared to the other impact indicators (**Figure 3-28**).

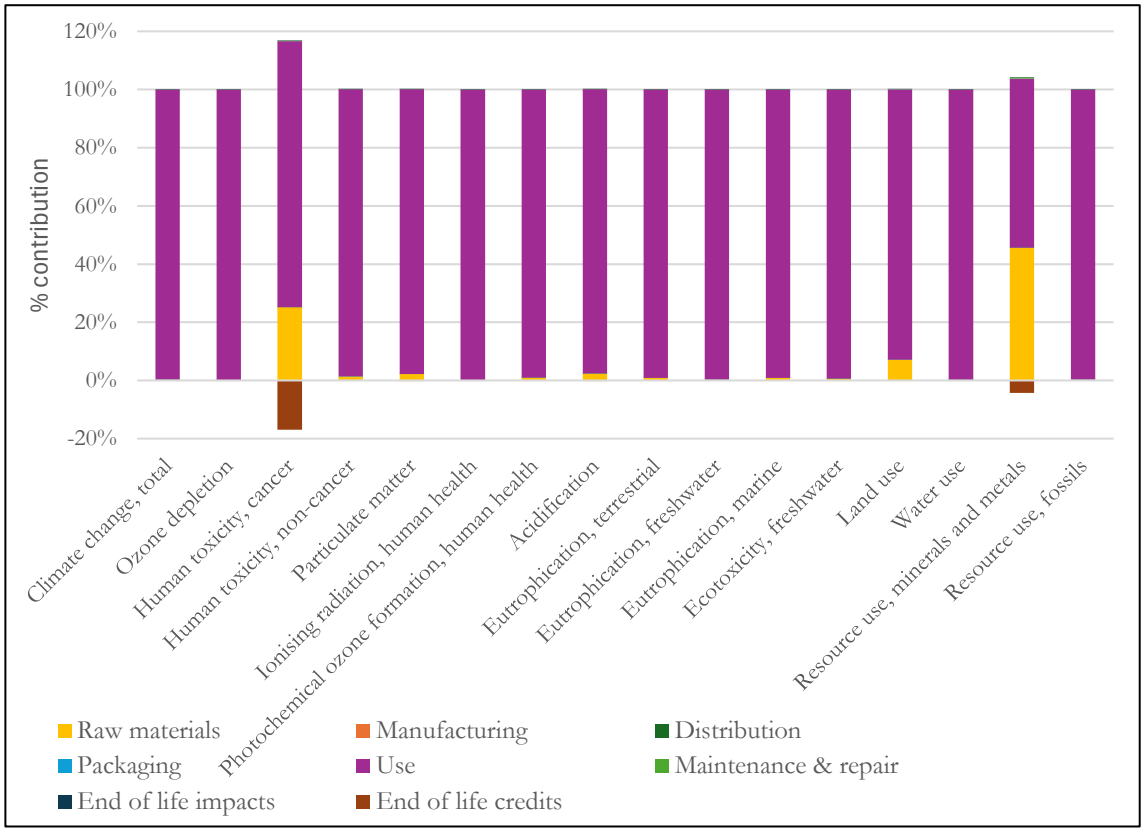

Figure 3-28: Preliminary contribution analysis (including EOL credits), D2.

In the use phase, the major contributor for most impact categories is the electricity use, with the exception of the impact category 'Resource use, minerals and metals', where heat is the dominant contributor (**Figure** 3-29).

The major contribution of the raw materials is from the production of electronic (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset). However, for the impact categories 'Ozone depletion', 'Human toxicity, cancer' and 'Land use', the dominant contributors are polypropylene, stainless steel and copper, respectively (**Figure 3-30**).

In the EoL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For D2, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' (**Figure 3-28**) as a consequence of a credit for galvanised steel and stainless steel due to its recyclability. Additionally, credits for aluminium and the controller board also contribute to lowering the overall lifetime impact of D2.

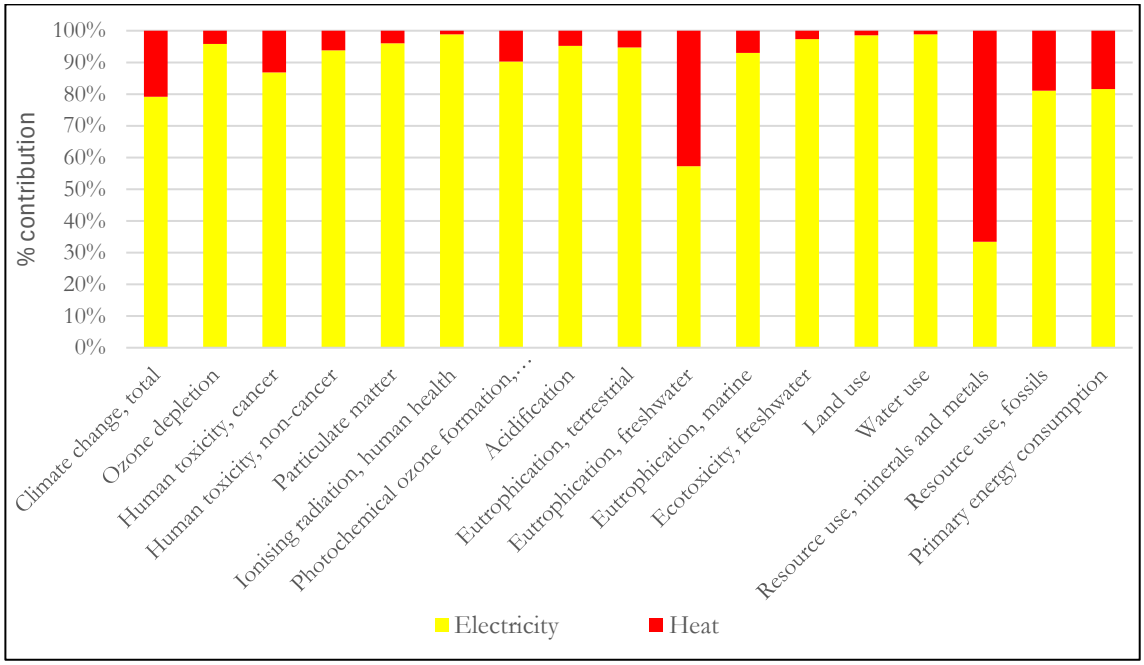

Figure 3-29: Preliminary contribution analysis – Use phase, D2.

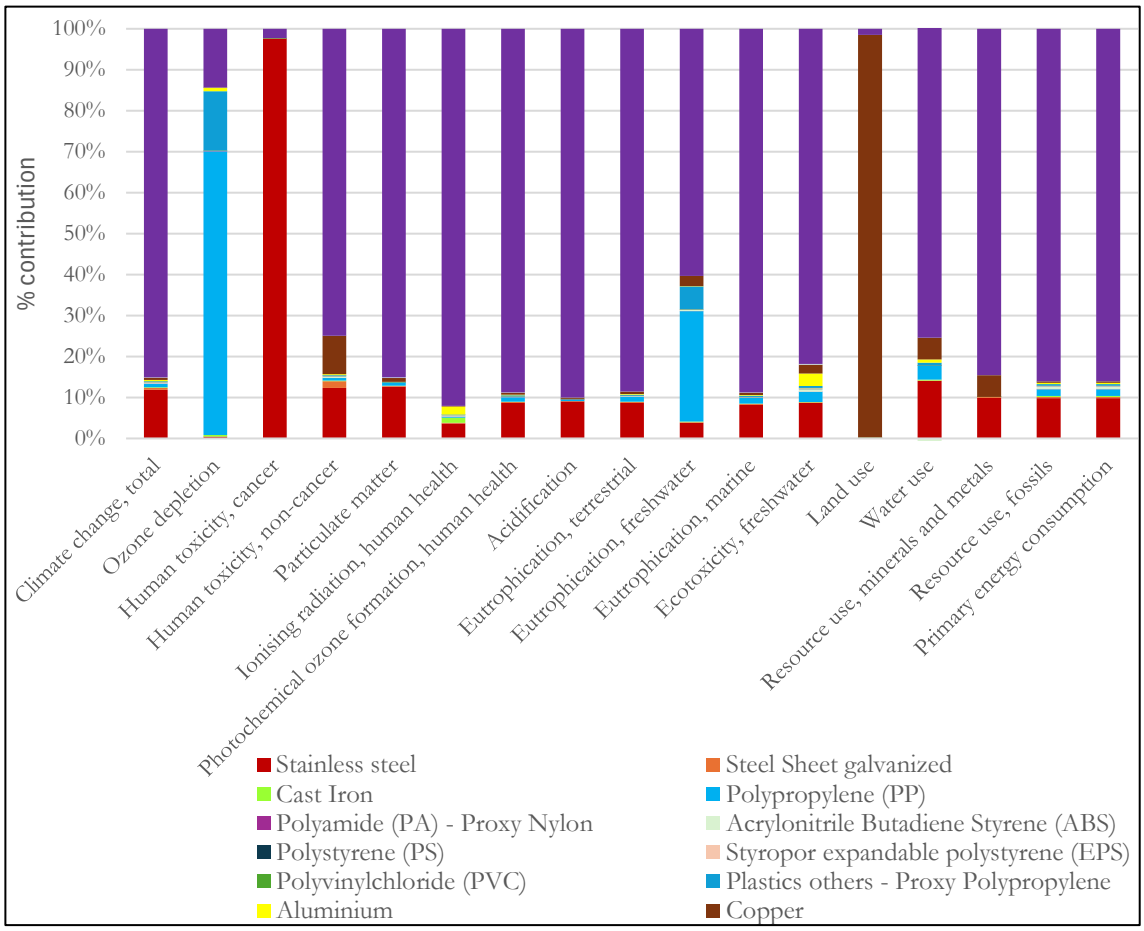

Figure 3-30: Preliminary contribution analysis – Raw materials, D2.

D3: Commercial cabinet dryer

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for D3 BC, updated after sensitivity analyses, are presented in **Annex VI, D3: Commercial cabinet dryer**.

The majority of the lifetime impact of the commercial cabinet dryer is derived from the use phase (>90 % for most impact categories) followed by the raw materials input **(Figure 3-31**), with the exception of the impact indicator 'Resource use, minerals and metals' where most of the impact is derived from the raw materials (>90 %). Furthermore, for impact indicator 'Human toxicity, cancer', the raw materials provide a larger share contribution (23 %) compared to the other impact indicators (**Figure 3-31**).

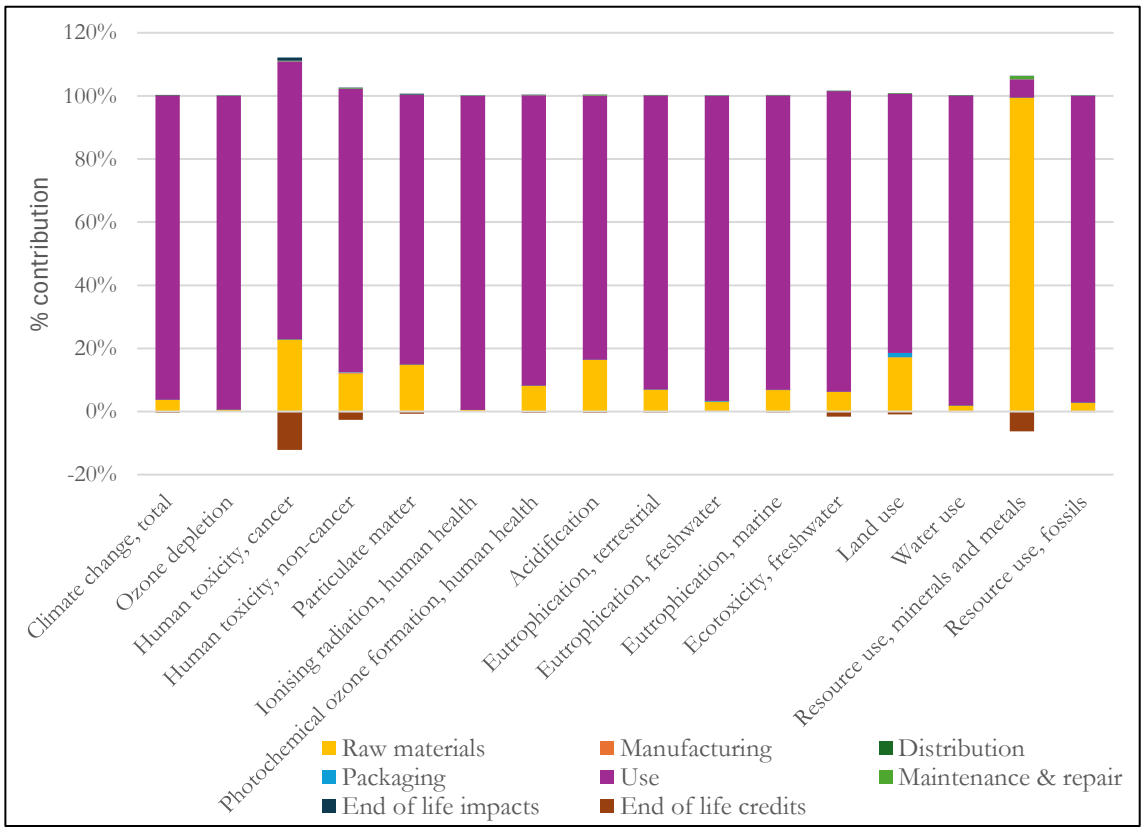

Figure 3-31: Preliminary contribution analysis (including EOL credits), D3.

The impact of the use phase is based only on the impact of electricity and thus electricity production is the main and only contributor (not shown).

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset) (**Figure 3-32**). However, for the impact categories 'Ozone depletion', 'Human toxicity, cancer' and 'Land use', the dominant contributors are polypropylene, stainless steel and copper, respectively. Other raw materials contributing to the impact categories are aluminium and galvanised steel.

In the EoL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For D3, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' (**Figure 3-31**) as a consequence of a credit for galvanised steel and stainless steel due to its recyclability. Additionally, credits for aluminium and the controller board also contribute to lowering the overall lifetime impact of D3.

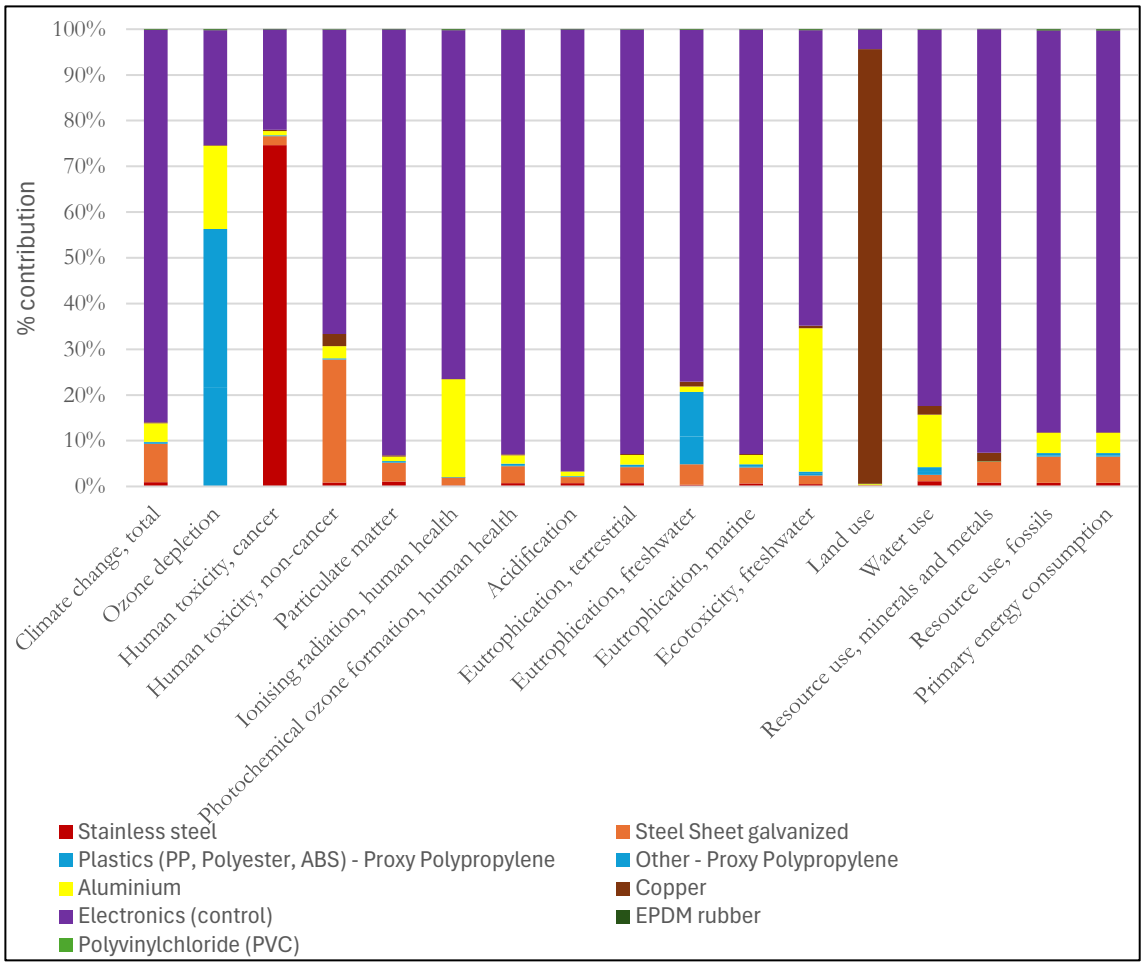

Figure 3-32: Preliminary contribution analysis – Raw materials, D3.

D4: Industrial pass-through tumble dryer

In this chapter the contribution analyses of the full results and of the two highest contributing life cycle stages are presented in detail. The detailed results for D4 BC, updated after sensitivity analyses, are presented in **Annex VI, D4: Industrial pass-through tumble** dryer**.**

The majority of the lifetime impact of the industrial pass-through (transfer) tumble dryer is derived from the use phase (>90 % for most impact categories) followed by the raw materials input (**Figure 3-33**).

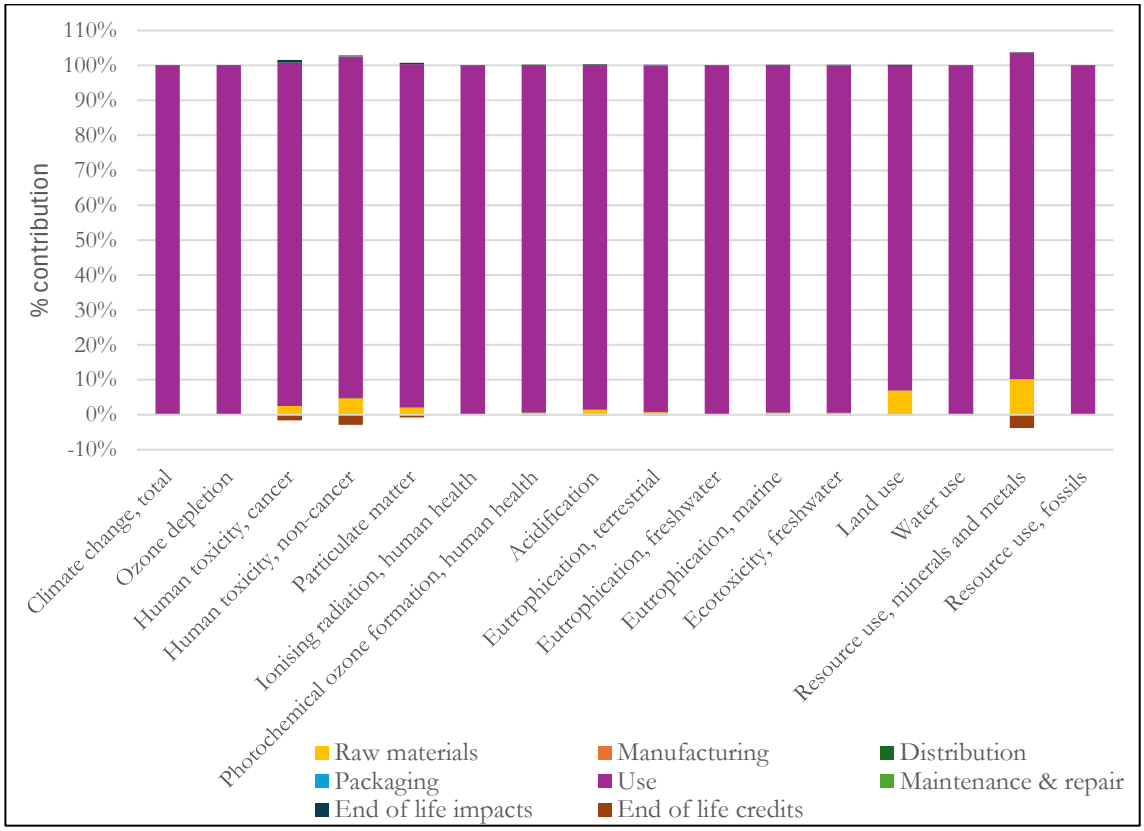

Figure 3-33: Preliminary contribution analysis (including EOL credits), D4.

In the use phase, heat use and electricity contribute to different degrees for the various impact indicators (**Figure 3-34**).

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board; see also sensitivity analysis in **Section 3.4.7.4** on this dataset) and galvanised steel. However, for the impact categories 'Human toxicity, cancer' and 'Land use', the dominant contributors are stainless steel and copper, respectively (**Figure 3-35**).

In the EoL modelling, a credit for recycling of raw materials is included as calculated with the circular footprint formula. For D4, the credit contributes negatively (i.e. lowering the impact) mainly for 'Human toxicity, cancer' (**Figure 3-33**) as a consequence of a credit for galvanised steel and stainless steel due to its recyclability. Additionally, credits for the controller board also contribute to lowering the overall lifetime impact of D4.

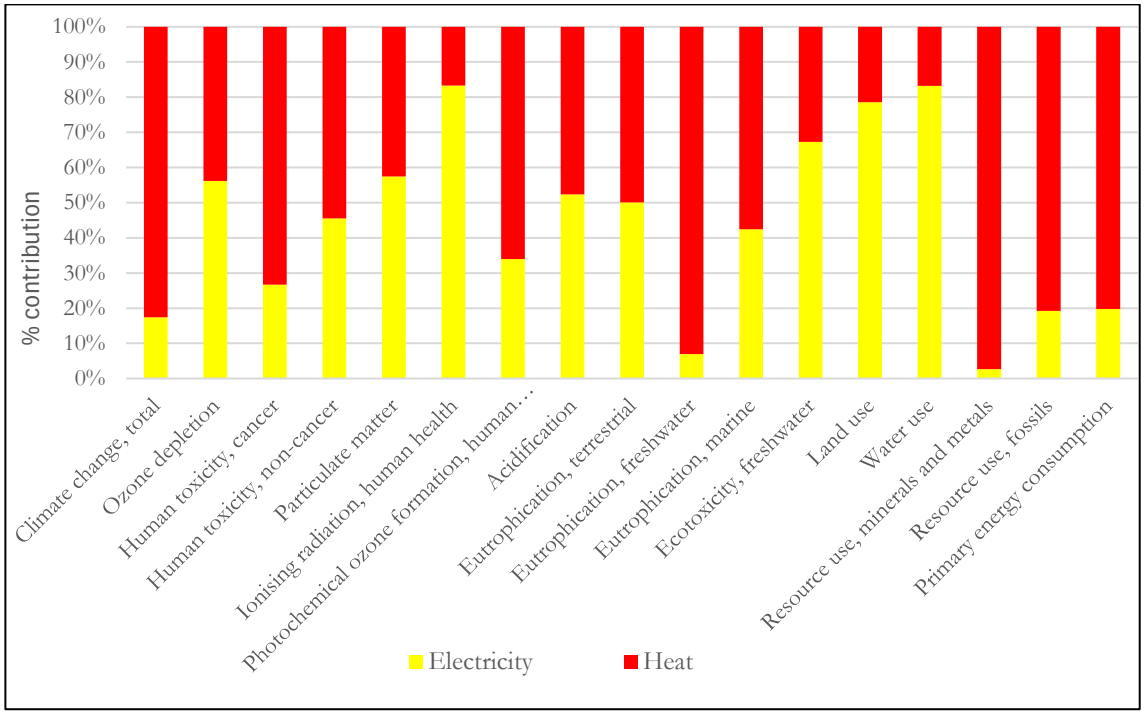

Figure 3-34: Preliminary contribution analysis – Use phase, D4.

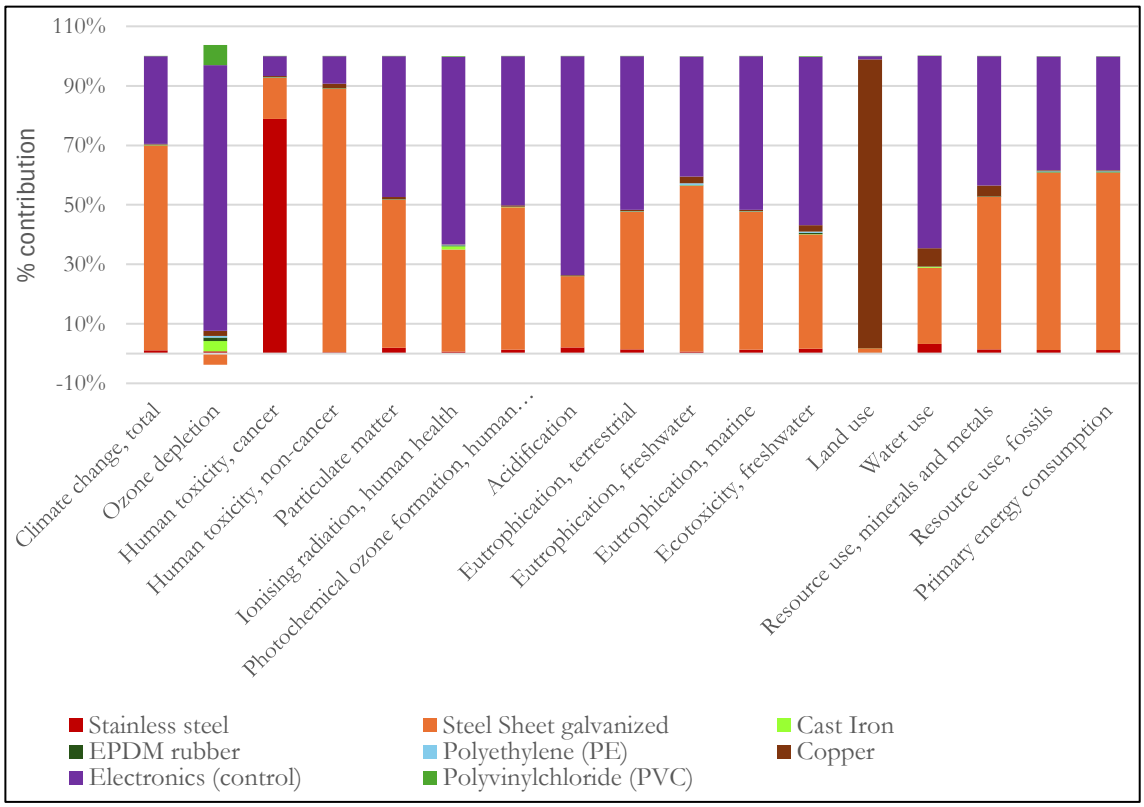

Figure 3-35: Preliminary contribution analysis – Raw materials, D4.

3.4.5. Base Case Life Cycle Costs for customers

In this section, the LCC for each BC are presented, followed by a contribution analysis per BC of the main contributors to the LCC.

3.4.5.1. Results overview Life Cycle Costs

The LCC of each BC were calculated with the purchase price, installation costs, repair & maintenance costs as well as the running costs for fuel (natural gas), electricity, water and detergent (**Table 3-94** for washing machines, **Table 3-95** for dryers; detailed and updated results per BC after sensitivity analyses (**see Section 3.4.7**) can be found in **Annex VI – Results of LCA / LCC per Base Cas.** For all BCs, the repair & maintenance costs were included as a percentage of the purchase price as indicated in MEErP Task 2, **Section 3.2.4.2** and **Section 3.2.4.4**. The total costs per year are calculated in the ERT by dividing the product price, installation costs and repair/maintenance cost by the lifetime of the machine and discounting the running costs to their net present value (based on present worth factor) to obtain the total costs per year.

It can be observed from the data that depending on the machine, EU customers are spending between € 1,300 and € 679,000 (washing machines) or € 1,200 and € 77,000 (dryers) in the purchase and operation of the product. Each time a customer makes a buying decision, the decision is not just on a purchase price but on the total LCC of the product, including running costs discounted to their net present value (between € 900 and € 622,000 for washing machines and € 930 to € 75,000 for dryers respectively).

Clearly, the LCC for BC WM5 are the highest of all BCs, which is mainly due to the size of the machine (and thereby the product price), and detergent use in the life cycle. From the dryers, D4 has the highest LCC, again due to the fact that this is the largest dryer. Also, when yearly costs are corrected for the number of washing/drying cycles per year, WM5 still shows the highest costs.

Table 3-94: Preliminary total LCC per washing machine Base Case (WM1, WM2, WM3, WM4, WM5).

Product item	Unit	WM1	WM2	WM3	WM4	WM5
Product price	EUR	2,136	34,775	12,200	57,375	585,000
Installation / acquisition costs (if any)	EUR	85	1,391	488	2,295	52,650
Fuel (natural gas)	EUR/year	33	448	0	1,023	84,432
Electricity	EUR/year	191	1,869	1,190	539	11,931
Water	EUR/year	138	1,777	122	1,296	35,707
Detergent	EUR/year	549	4,857	481	3,819	280,080
Repair & maintenance costs	EUR	64	1,043	366	14,343	146,250
Total	EUR/year	1,318	11,384	2,210	10,286	469,368

Product item	Unit	WM1	WM2	WM3	WM4	WM5
Purchase and installation costs	EUR/year	408	2,432	417	3,610	57,219
Running costs	EUR/year	910	8,952	1,793	6,676	412,149
Costs per cycle	EUR/cycle	0.73	3.16	1.26	4.68	156.46

Table 3-95: Preliminary total LCC per drying machine Base Case (D1, D2, D3, D4).

Product aspect	Unit	D1	D2	D3	D4
Product price	EUR	1,460	8,700	2,800	50,000
Installation / acquisition costs (if any)	EUR	58	348	112	4,500
Fuel (natural gas)	EUR/year	0	1,669	0	56,033
Electricity	EUR/year	929	9,988	964	18,593
Water	EUR/year	0	0	0	0
Detergent	EUR/year	0	0	0	0
Repair & maintenance costs	EUR	44	261	84	1,500
Total	EUR/year	1,208	12,088	1,035	76,866
Purchase and installation costs	EUR/year	279	431	72	2,240
Running costs	EUR/year	929	11,657	964	74,626
Costs per cycle	EUR/cycle	0.67	4.74	0.78	25.62

3.4.5.2. Contribution analysis Life Cycle Costs

A contribution analysis was performed to analyse the main contributors to the total costs per year per BC. For this, the product price, installation costs and repair/maintenance cost were divided by the lifetime to obtain the costs / year. The running costs are already provided per year in the ERT.

WM1: Light duty commercial washer extractor

For BC WM1, the main contribution to the costs per machine (on a yearly basis) are the costs for detergent (42 %), followed by the product price (29 %) (**Figure 3-36**). The running costs of energy, water and detergent together contribute to around 69 % of the total costs. Installation costs and repair & maintenance costs make up the rest of the total.

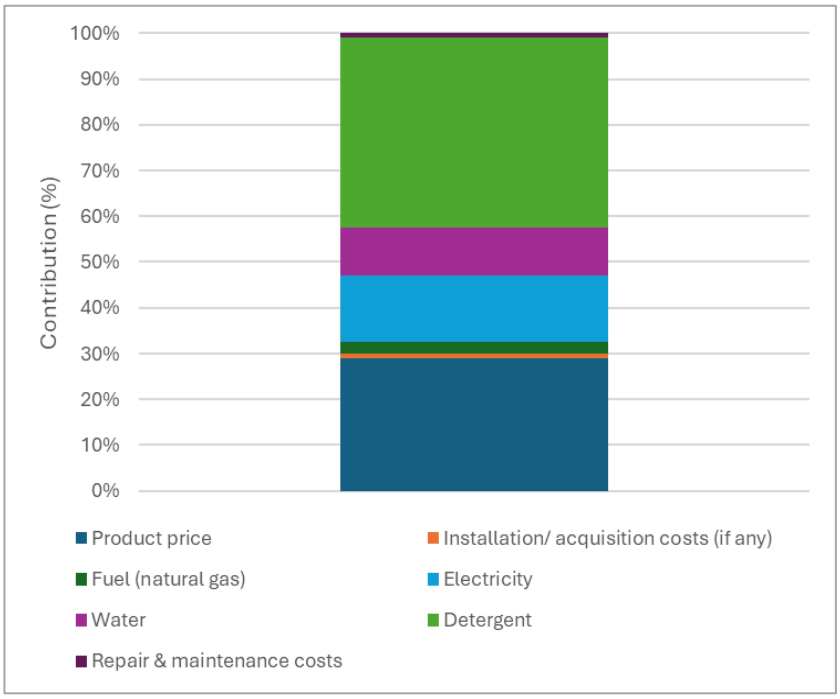

Figure 3-36: Preliminary cost contribution (per year), WM1.

WM2: Commercial washer extractor

For BC WM2, the main contribution to the costs per machine (on a yearly basis) are the costs for detergent (43 %), followed by the product price (20 %) (**Figure 3-37**). The running costs of energy, water and detergent together contribute to around 77 % of the total costs. Installation costs and repair & maintenance costs make up the rest of the total.

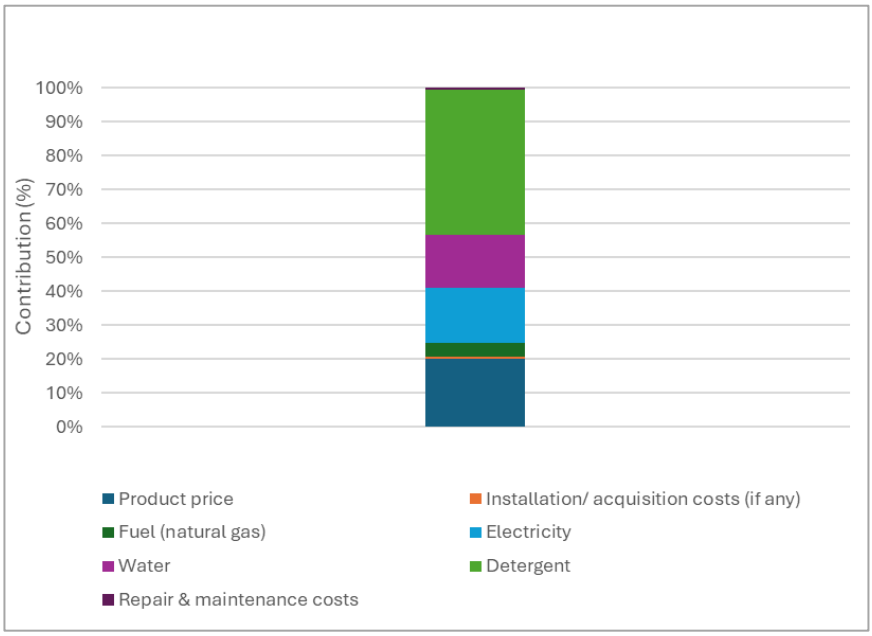

Figure 3-37: Preliminary cost contribution (per year), WM2.

WM3: Commercial washer dryer

For BC WM3, the main contribution to the costs per machine (on a yearly basis) are the costs for electricity (54 %), followed by the detergent costs (22 %) and product price (18 %) (**Figure 3-38**). The running costs of energy, water and detergent together contribute to around 81 % of the total costs. Installation costs and repair & maintenance costs make up the rest of the total.

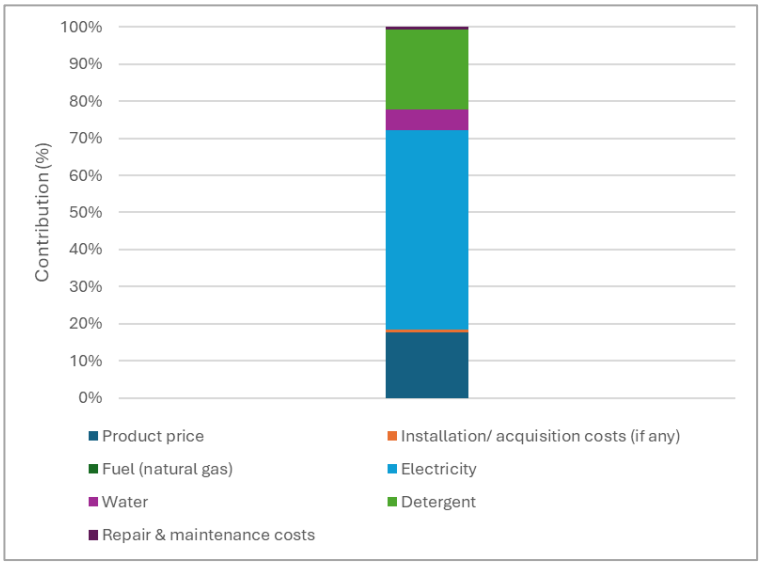

Figure 3-38: Preliminary cost contribution (per year), WM3.

WM4: Commercial barrier washer

For BC WM4, the main contribution to the costs per machine (on a yearly basis) are the costs for detergent (37 %), followed by the product price (27 %) (**Figure 3-39**). The running costs of energy, water and detergent together contribute to around 77 % of the total costs. Installation costs and repair & maintenance costs make up the rest of the total.

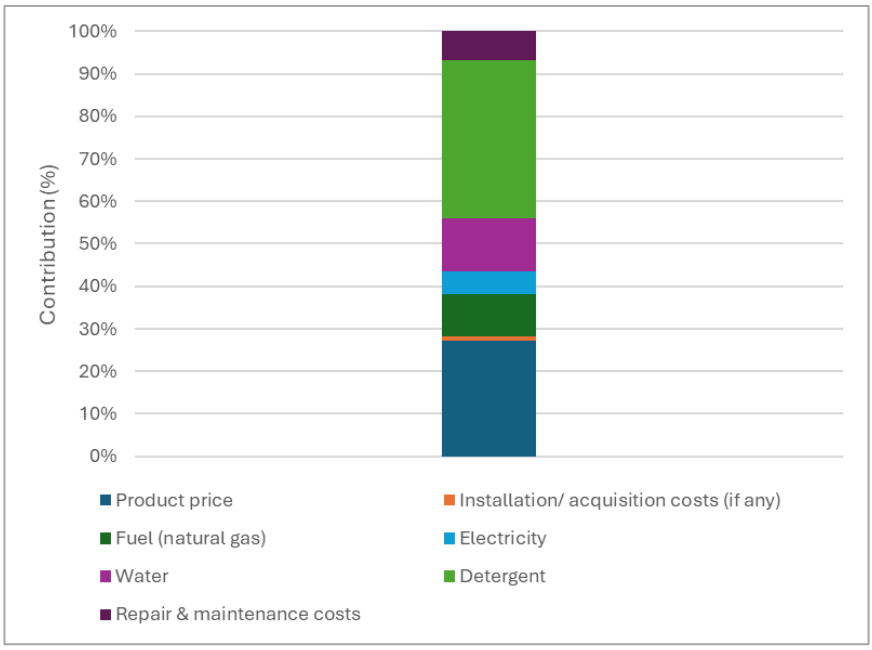

Figure 3-39: Preliminary cost contribution (per year), WM4.

WM5: Industrial continuous tunnel washers

For BC WM5, the main contribution to the costs per machine (on a yearly basis) are the costs for detergent (59 %), followed by the natural gas costs (18 %), product price (9 %) and water costs (7 %) (**Figure 3-40**). The running costs of energy, water and detergent together contribute to around 87 % of the total costs. Installation costs and repair & maintenance costs make up the rest of the total.

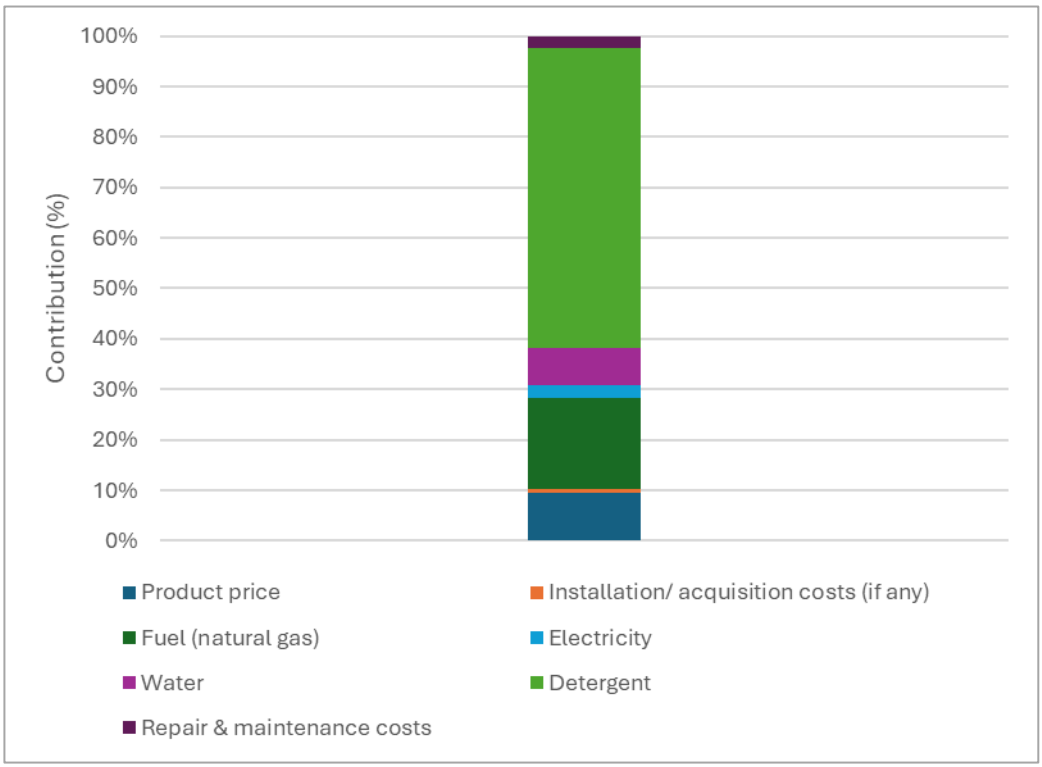

Figure 3-40: Preliminary cost contribution (per year), WM5.

D1: Light duty commercial tumble dryer

For BC D1, the main contribution to the costs per machine (on a yearly basis) are the costs for electricity (77 %), followed by the product price (22 %) (**Figure 3-41**). As the only running costs are for electricity, the remaining costs are from Installation and repair & maintenance.

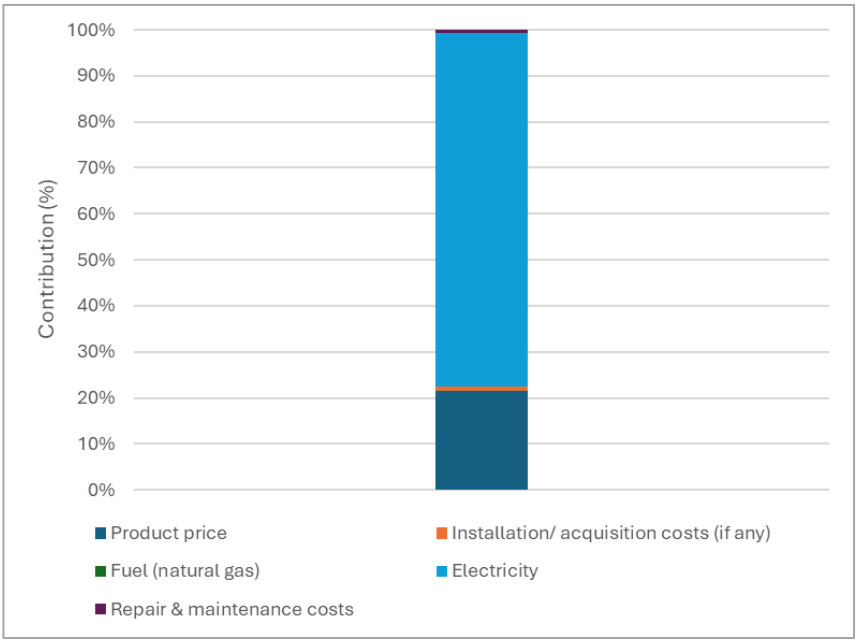

Figure 3-41: Preliminary cost contribution (per year), D1.

D2: Commercial tumble dryer

For BC D2, the main contribution to the costs per machine (on a yearly basis) are the costs for electricity (83 %), followed by natural gas costs for heating (14 %) (**Figure 3-42**). The running costs of energy, water and detergent together contribute to around 97 % of the total costs. Product price, installation costs and repair & maintenance costs make up the rest of the total.

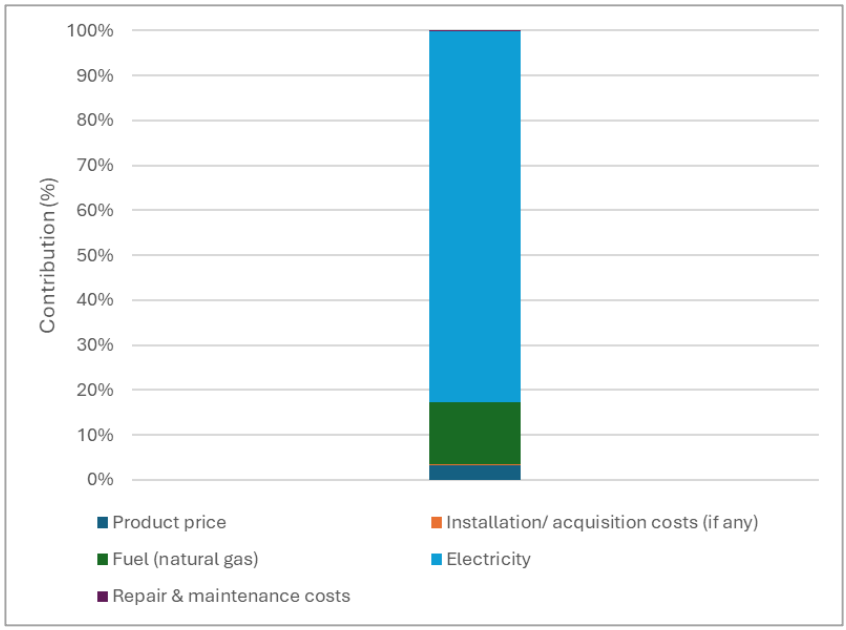

Figure 3-42: Preliminary cost contribution (per year), D2.

D3: Commercial cabinet dryer

For BC D3, the main contribution to the costs per machine (on a yearly basis) are the costs for electricity (93 %), followed by the product price (6 %) (**Figure 3-43**). Installation costs and repair & maintenance costs make up the rest of the total.

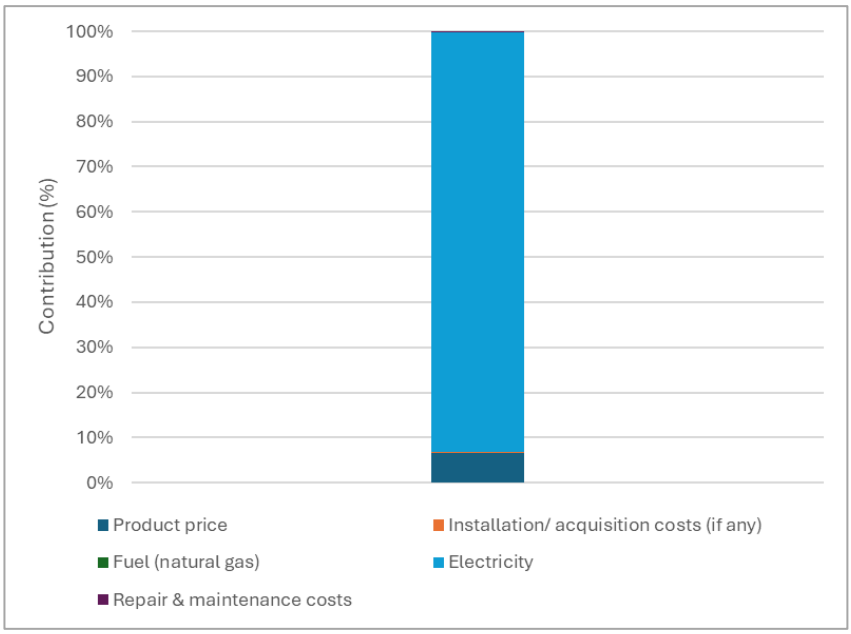

Figure 3-43: Preliminary cost contribution (per year), D3.

D4: Industrial pass-through tumble dryer

For BC D4, the main contribution to the costs per machine (on a yearly basis) are the costs for natural gas (73 %), followed by the electricity (24 %) and the product price (2.6 %) (**Figure 3-44**). The remaining costs are from installation and repairs & maintenance.

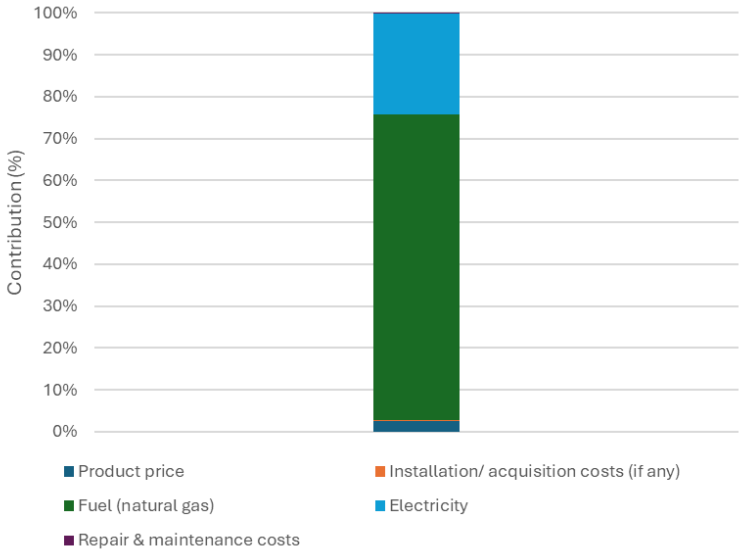

Figure 3-44: Preliminary cost contribution (per year), D4.

3.4.6. EU Totals

In this section, the initial environmental and costs impacts on EU total level are presented. For this, the per product impact are multiplied by the annual sales or the number of units in stock in the EU (**Table 3-96)** to obtain the impact of all new products of the BC in the reference year in the EU and the impact of the total stock of the BC. Detailed and updated data on EU level per BC after sensitivity analyses (see **Section 3.4.7**) are provided in the **Annex VI – Results of LCA / LCC per Base Cas**.

Table 3-96: Preliminary total EU stock numbers (as calculated in the ERT) for all Base Cases.

Base Case	Unit	EU Stock
WM1	mln. Units	0.136
WM2	mln. Units	0.257
WM3	mln. Units	0.01
WM4	mln. Units	0.024
WM5	mln. Units	0.003
D1	mln. Units	0.045
D2	mln. Units	0.156
D3	mln. Units	0.249

Base Case	Unit	EU Stock
D4	mln. Units	0.027

3.4.6.1. LCA

As summary tables, **Table 3-97** and **Table 3-98** provide an initial comparison between all BCs in their environmental impact (expressed with the PEF impact categories) and the energy consumption of the EU stock. **Detailed and updated data after sensitivity analyses (see Section 3.4.7) are provided in the Annex VI – Results of LCA / LCC per Base Cas.** From the following table it can be observed that the BCs with the highest energy consumption at an EU stock level are D2, D3, D4 and WM2. This result is explained by the high energy consumption of the dryers in comparison to the washing machines (as shown in **Table 3-90** and **Table 3-91**), as well as the large amount of annual sales of the BC WM2 product, which, consequently, leads to large stock accumulation.

Regarding the environmental impact, the BCs with the highest impact across all PEF impact categories at an EU stock level are WM2, D2, D4 and to a smaller extent WM5. This result is a combination of the high annual environmental impact of the BCs and the number of annual sales. Specifically, BCs WM2 and D2 have high annual sales numbers which contribute to the overall high environmental impact of the stock. Despite WM5 being the most impactful BC on a product level, its annual sales are by far the lowest. This leads to WM5 BC not being the most impactful product at the EU stock level.

In addition, the ERT also calculates the EU total impact in the reference year for all new product of the specific BC sold in that reference year. For this, the impact per BC is multiplied by the annual sales volume. An overview is in **Table 3-99** and **Table 3-100.** Similar to the EU stock impact, WM2, D2 and D4 have the highest impact, which is related to the higher annual sales volumes.

Table 3-97: Preliminary summary environmental impacts EU stock for washing machines (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

Main life cycle indicators	Unit	WM1	WM2	WM3	WM4	WM5
Energy consumption						
Electricity	kWh	6.58E+02	3.64E+04	2.04E+03	1.35E+03	2.69E+03
Thermal energy	MJ	1.15E+03	8.87E+04	0.00E+00	2.60E+04	1.93E+05
PEF Impact categories						
Climate change, total	kg CO_2 eq	6.62E+02	3.77E+04	1.07E+03	4.99E+03	1.79E+04
Ozone depletion	kg CFC-11 eq	1.11E-05	6.22E-04	4.21E-06	4.67E-05	1.48E-04

Main life cycle indicators	Unit	WM1	WM2	WM3	WM4	WM5
Human toxicity, cancer	CTUh	1.37E-06	4.89E-05	5.57E-07	7.58E-06	1.90E-05
Human toxicity, non-cancer	CTUh	8.84E-06	5.44E-04	7.11E-06	5.94E-05	1.32E-04
Particulate matter	disease incidence	4.26E-05	2.21E-03	5.51E-05	3.81E-04	5.42E-04
Ionising radiation, human health	kBq U235 eq	1.47E+02	8.14E+03	3.79E+02	4.67E+02	1.09E+03
Photochemical ozone formation, human health	kg NMVOC eq	1.42E+00	7.86E+01	2.16E+00	1.18E+01	2.30E+01
Acidification	mol H+ eq	2.83E+00	1.51E+02	5.09E+00	3.52E+01	3.86E+01
Eutrophication, terrestrial	mol N eq	5.90E+00	3.21E+02	8.01E+00	4.06E+01	7.84E+01
Eutrophication, freshwater	kg P eq	3.30E-02	1.98E+00	1.38E-02	1.68E-01	5.28E-01
Eutrophication, marine	Kg N eq	9.57E-01	5.32E+01	8.96E-01	5.60E+00	1.34E+01
Ecotoxicity	CTUe	5.80E+03	3.20E+05	6.09E+03	3.08E+04	7.13E+04
Land use	pt	1.77E+04	4.64E+05	1.47E+04	6.99E+04	1.37E+05
Water use	m^3 water eq. of deprived water	1.36E+03	9.16E+04	8.40E+02	8.24E+03	2.08E+04
Resource use, minerals and metals	kg Sb eq	7.86E-03	3.42E-01	1.60E-02	2.03E-01	1.31E-01
Resource use, fossils	MJ	1.04E+04	5.90E+05	1.79E+04	7.34E+04	2.73E+05

Table 3-98: Preliminary summary environmental impacts EU stock, for all dryer Base Cases (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

Main life cycle indicators	Unit	D1	D2	D3	D4
Energy consumption					
Electricity	kWh	1.04E+03	1.66E+05	6.15E+04	6.00E+04
Thermal energy	MJ	0.00E+00	2.82E+05	0.00E+00	1.84E+06
PEF Impact categories					

Main life cycle indicators	Unit	D1	D2	D3	D4
Climate change, total	kg CO_2 eq	5.33E+02	8.80E+04	2.67E+04	1.45E+05
Ozone depletion	kg CFC-11 eq	1.74E-07	2.69E-05	9.63E-06	1.66E-05
Human toxicity, cancer	CTUh	4.53E-07	1.45E-05	4.86E-06	1.59E-05
Human toxicity, non-cancer	CTUh	2.45E-06	2.51E-04	9.60E-05	1.89E-04
Particulate matter	disease incidence	2.89E-05	2.35E-03	9.63E-04	1.42E-03
Ionising radiation, human health	kBq U235 eq	1.90E+02	2.98E+04	1.10E+04	1.28E+04
Photochemical ozone formation, human health	kg NMVOC eq	1.10E+00	1.27E+02	4.59E+01	1.22E+02
Acidification	mol H+ eq	2.94E+00	2.27E+02	9.37E+01	1.48E+02
Eutrophication, terrestrial	mol N eq	3.88E+00	4.52E+02	1.69E+02	3.09E+02
Eutrophication, freshwater	kg P eq	1.12E-03	2.48E-01	5.44E-02	7.40E-01
Eutrophication, marine	Kg N eq	3.64E-01	4.34E+01	1.60E+01	3.44E+01
Ecotoxicity, freshwater	CTUe	2.56E+03	3.26E+05	1.23E+05	1.71E+05
Land use	pt	8.54E+03	3.26E+05	1.35E+05	1.48E+05
Water use	m^3 water eq. of deprived water	1.67E+02	2.40E+04	8.97E+03	1.04E+04
Resource use, minerals and metals	kg Sb eq	1.18E-02	9.10E-02	1.14E-01	2.53E-01
Resource use, fossils	MJ	8.90E+03	1.49E+06	4.61E+05	2.28E+06

Table 3-99: Preliminary summary environmental impacts EU new product for washing machines (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

Main life cycle indicators	Unit	WM1	WM2	WM3	WM4	WM5
Energy consumption						
Electricity	kWh	1.18E+02	2.39E+03	8.21E+01	6.91E+01	1.97E+02
Thermal energy	MJ	2.05E+02	5.83E+03	0.00E+00	1.33E+03	1.41E+04
PEF Impact categories						

Main life cycle indicators	Unit	WM1	WM2	WM3	WM4	WM5
Climate change, total	kg CO_2 eq	1.18E+02	2.48E+03	4.31E+01	2.56E+02	1.31E+03
Ozone depletion	kg CFC-11 eq	1.97E-06	4.10E-05	1.69E-07	2.39E-06	1.09E-05
Human toxicity, cancer	CTUh	2.45E-07	3.22E-06	2.24E-08	3.89E-07	1.39E-06
Human toxicity, non-cancer	CTUh	1.58E-06	3.58E-05	2.86E-07	3.04E-06	9.66E-06
Particulate matter	disease incidence	7.62E-06	1.46E-04	2.21E-06	1.95E-05	3.97E-05
Ionising radiation, human health	kBq U235 eq	2.63E+01	5.36E+02	1.53E+01	2.39E+01	7.99E+01
Photochemical ozone formation, human health	kg NMVOC eq	2.54E-01	5.17E+00	8.67E-02	6.03E-01	1.68E+00
Acidification	mol H+ eq	5.05E-01	9.94E+00	2.05E-01	1.80E+00	2.82E+00
Eutrophication, terrestrial	mol N eq	1.05E+00	2.11E+01	3.22E-01	2.08E+00	5.74E+00
Eutrophication, freshwater	kg P eq	5.89E-03	1.30E-01	5.57E-04	8.59E-03	3.86E-02
Eutrophication, marine	kg N eq	1.71E-01	3.50E+00	3.60E-02	2.87E-01	9.77E-01
Ecotoxicity, freshwater	CTUe	1.04E+03	2.10E+04	2.45E+02	1.58E+03	5.21E+03
Land use	pt	3.17E+03	3.06E+04	5.93E+02	3.58E+03	1.00E+04
Water use	m^3 water eq. of deprived water	2.43E+02	6.03E+03	3.38E+01	4.22E+02	1.52E+03
Resource use, minerals and metals	kg Sb eq	1.40E-03	2.25E-02	6.43E-04	1.04E-02	9.62E-03
Resource use, fossils	MJ	1.86E+03	3.89E+04	7.18E+02	3.76E+03	2.00E+04

Table 3-100: Preliminary summary environmental impacts EU new product, for all dryer Base Cases (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

Main life cycle indicators	Unit	D1	D2	D3	D4
Energy consumption					
Electricity	kWh	1.86E+02	8.17E+03	2.26E+03	2.69E+03
Thermal energy	MJ	0.00E+00	1.39E+04	0.00E+00	8.26E+04

Main life cycle indicators	Unit	D1	D2	D3	D4
PEF Impact categories					
Climate change, total	kg CO_2 eq	9.52E+01	4.34E+03	9.82E+02	6.50E+03
Ozone depletion	kg CFC-11 eq	3.10E-08	1.33E-06	3.54E-07	7.46E-07
Human toxicity, cancer	CTUh	8.08E-08	7.16E-07	1.79E-07	7.12E-07
Human toxicity, non-cancer	CTUh	4.38E-07	1.24E-05	3.53E-06	8.48E-06
Particulate matter	disease incidence	5.16E-06	1.16E-04	3.54E-05	6.38E-05
Ionising radiation, human health	kBq U235 eq	3.40E+01	1.47E+03	4.04E+02	5.77E+02
Photochemical ozone formation, human health	kg NMVOC eq	1.96E-01	6.27E+00	1.69E+00	5.46E+00
Acidification	mol H+ eq	5.25E-01	1.12E+01	3.44E+00	6.65E+00
Eutrophication, terrestrial	mol N eq	6.94E-01	2.23E+01	6.22E+00	1.39E+01
Eutrophication, freshwater	kg P eq	2.01E-04	1.22E-02	2.00E-03	3.32E-02
Eutrophication, marine	kg N eq	6.51E-02	2.14E+00	5.86E-01	1.54E+00
Ecotoxicity, freshwater	CTUeaa	4.57E+02	1.61E+04	4.53E+03	7.68E+03
Land use	pt	1.52E+03	1.61E+04	4.97E+03	6.65E+03
Water use	m^3 water eq. of deprived water	2.98E+01	1.18E+03	3.29E+02	4.65E+02
Resource use, minerals and metals	kg Sb eq	2.10E-03	4.49E-03	4.17E-03	1.13E-02
Resource use, fossils	MJ	1.59E+03	7.36E+04	1.69E+04	1.02E+05

3.4.6.2. LCC

Table 3-101 and **Table 3-102** show the initial total annual expenditure for all EU customers (EU27) in the purchase and operation of all BC products. **Detailed and updated data after sensitivity analyses (see Section 3.4.7) are provided in the Annex VI – Results of LCA / LCC per Base Cas.** In terms of annual expenditure, the EU27 running costs range from 23 to 2,663 million Euro for the washing machines and from 44 to 2,253 million Euro for the dryers. The purchase and installation costs range from 5.14 to 613 million Euro for the washing machines (**Table 3-101**) and from 12.2 to 70 million Euro for the dryers (**Table 3-102**).

In general, the running costs of all BCs are higher than their purchase and installation costs. The results are depended on the specific energy, water and detergent consumption of each product. Specifically, the running costs entail the 67 % to 93 % of the total annual EU27 expenditure for the washing machines and the 79 % to 97 % of the total annual EU27

expenditure for the dryers. On the other hand, purchase and installation costs entail the 6 % to 29 % total annual EU27 expenditure for the washing machines and the 3 % to 22 % of the total annual EU27 expenditure for the dryers.

Table 3-101: Preliminary total annual expenditure in the EU27 for washing machines.

Product item	Unit	WM1	WM2	WM3	WM4	WM5
Product price	mln. EUR/year	52	589	4.94	70	146
Installation / acquisition costs	mln. EUR/year	2	24	0.20	3	13
Fuel (natural gas)	mln. EUR/year	5	133	0.00	29	325
Electricity	mln. EUR/year	28	556	15.26	15	46
Water	mln. EUR/year	20	529	1.57	37	137
Detergent	mln. EUR/year	79	1,445	6.16	109	1,077
Repair & maintenance costs	mln. EUR/year	2	20	0.15	20	41
Total	mln. EUR/year	187	3,296	28.28	283	1,785
Running costs	mln. EUR/year	131	2,663	23	190	1,585
Purchase and installation costs	mln. EUR/year	54	613	5.14	73	159

Table 3-102: Preliminary total annual expenditure in the EU27 for dryers.

Product aspect	Unit	D1	D2	D3	D4
Product price	mln. EUR/year	11.7	67	28	60
Installation / acquisition costs	mln. EUR/year	0.5	3	1.1	5
Fuel (natural gas)	mln. EUR/year	0	300	0	1,692
Electricity	mln. EUR/year	43.5	1,794	345	561
Repair & maintenance costs	mln. EUR/year	0.4	2	0.7	2
Total	mln. EUR/year	56	2,165	375	2,320
Running costs	mln. EUR/year	44	2,094	345	2,253
Purchase and installation costs	mln. EUR/year	12.2	70	29.1	65

3.4.7. Sensitivity analyses

In **Section 3.4.7.1**, the sensitivity of the previous LCA and LCC results is checked with several sensitivity analyses, for one selected BC (WM5, the industrial continuous tunnel washer). Both sensitivity of results to the input data and sensitivity of some datasets was included.

Only after completion of the LCA and LCC assessments for the five washing machines and four dryers BCs, the study team received additional feedback and datapoints suggested by the stakeholder APPLiA after the second stakeholder meeting. To consider the effects of these

different data on the results, the study team performed a sensitivity analysis of the LCA and LCC results using the provided datapoints for BCs WM1, WM2, WM3, and WM4 (see **Section 3.4.7.2**) and D1, D2, and D3 (see **Section 3.4.7.3**); for BCs WM5 and D4, no updated data was provided.

Finally, the initial approach for selecting a certain dataset for electronics (controller board) out of those datasets that are provided by the ERT has been adjusted. Explanation and further details are provided in **Section 3.4.7.4**.

3.4.7.1. Sensitivity analysis for WM5

Stakeholders have not provided any updates on the input/output data for the industrial continuous tunnel washer (WM5) that were used in the Task 5 assessments above. To determine the sensitivity of the LCA and LCC results, for one BC WM5, several sensitivity analyses were performed, based on the assumption of possible variations in performance characteristics. However, these assumptions are not based on actual performance data; rather, they represent generic ranges of variables.

As the main impact of all BCs is derived from the Use phase followed by the Raw materials, the focus of these analyses was on these life cycle stages. In addition, sensitivity analyses for the product aspects as indicated in Article 5 of the ESPR Regulation (EU) 2024/1781 were included as well. In addition, two product specific sensitivity analysis were included (scenarios S11 and S12). An overview of the sensitivity analysis is provided in **Table 3-103.**

Table 3-103: Sensitivity analyses for WM5.

Scenario #	Product aspect	Life cycle stage	Assumptions for the modelling change
S1	Energy reduction	Use phase	10 % less energy use (same division between electricity and heat as in original data)
S2	Water reduction	Use phase	10 % less water use
S3	Detergent reduction	Use phase	10 % less detergent use
S4	Resource use and resource efficiency + Recycled content	Manufacturing + EoL	R1 at: - Stainless steel: 10 % - Electronics: 10 % *Materials that contribute >10 % for at least 2 impact categories in Raw Materials life cycle*
S5	Resource use and resource efficiency (Lighter product)	Manufacturing + EOL	10 % less weight for all BOM inputs and Manufacturing (except for electricity in assembly)
S6	Repairability	Maintenance and Repair	% of spare parts at 20 %

Scenario #	Product aspect	Life cycle stage	Assumptions for the modelling change
S7	Recyclability	EOL	R2 at: - Stainless steel: 100 % - Electronics: 65 % *Materials that contribute >10 % for at least 2 impact categories to the Raw Materials life cycle; increase by 15 % points*
S8	Dataset stainless steel recycling	EOL	Different secondary stainless steel dataset (2 options, with a different environmental impact)
S9	Dataset heat boiler	Use phase	Heat input with a condensing boiler instead of non-condensing boiler

A full overview of the results is provided in **Annex VII: Results of sensitivity analysis WM5**. A textual summary is provided below.

As the main impact of the machines is from the use phase, sensitivity of the data for energy, water and detergent use were tested (Scenarios S1-S3). A 10 % reduction of each use showed a maximum effect of around 8 % reduction for climate change for energy, with lower effect on water (-0.5 %) and detergent use (-1.6 %). Maximum reduction was around 8 % in the impact categories 'Resource use, fossils' and 'Water use' for energy and water reduction respectively. For detergent, a maximum reduction of 9 % was observed for the impact category 'Ozone depletion'. Thus, the sensitivity of the LCA results by the Use phase input data ranges from minimal to medium depending on the impact category. With regard to the costs, the reduction was relatively significant for detergent (4 %) and energy (2 %), which can be explained the majority of the LCC of this BC in water and detergent (**Figure 3-40**).

The second largest contributor to the life cycle impact was the Raw Materials phase. The sensitivity of the results by reducing the weight of input materials from the BOM (Scenario S5), a total reduction for all life cycles together was around 5 % for the impact category 'Resource use, minerals and metals', although specifically for certain life cycles separately (Raw Materials, EOL, Maintenance & Repair as well as Manufacturing & Assembly) higher reductions can be observed, ranging from 4 to 12 %. Thus, with regard to the use of resources / materials, correct BOM data is important in determining the environmental impacts; however, for other impact categories, the results are less sensitive to BOM input data.

Several sensitivities were conducted for product aspects that are considered within the ESPR regulation, (S4-S7). For changes in the recycling rate (R2, Scenario S7), the results were mainly reduced for the impact category 'Human toxicity, cancer' (-26 %), which was due to lower impact of stainless steel in this category. For all scenarios, the effect is the same for EU total data, as these are just the product impact multiplied with the yearly annual sales volume in EU27.

For two datasets used for the ERT, a sensitivity analysis was performed, as indicated as S8 and S9 in **Table 3-103.** For steel recycling, two datasets were available in the ERT: '*126-Secondary steel slab electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel*' and '*128-Steel cast part alloyed electric arc furnace route, from*

steel scrap, secondary production single route, at plant carbon steel'. Dataset #126 was tested as sensitivity showing a high reduction for the EOL stage (between 71 % to 97 %) due to a lower impact for recycling with this process, although on the total impact across all life cycle stages, the effect was negligible (maximum -0.95 % for the impact category 'Ionising radiation, human health'), thus not altering the overall results of the product impact.

In Scenario S9, a more energy-efficient dataset for a heat boiler was tested: '*253-10 kW central heating (ch) boiler production, fuelled by natural gas, condensing boiler 10 kW Capacity lifespan 20 y production mix 1 MJ of thermal energy'* was compared with a dataset representing a boiler without condensing capacity '*252-10 kW central heating (ch) boiler production, fuelled by natural gas 10 kW Capacity lifespan 20 y production mix 1 MJ of thermal energy'*). The heat impact was reduced by up to 24 % depending on the impact category. However, when considering the total life cycle impact, the reduction was limited to a maximum of 7 %, notably in the categories 'Photochemical ozone formation, human health' and 'Climate change'. Consequently, a conservative assumption was applied in the current LCA results, using the non-condensing boiler dataset.

In conclusion, although the initial input data for the LCA and LCC analyses for category WM5 was of medium quality (mainly extrapolations from 2011 study), the sensitivity analyses showed that it depends on the data point and the impact category whether the results are hardly or highly affected. Nevertheless, more accurate input data from more recent years would enhance the reliability of this LCA and LCC study.

3.4.7.2. Sensitivity analysis for washing machines WM1-WM4 based on updated stakeholder data

A sensitivity analysis on several data input parameters was conducted for BCs WM1-4 and D1-3 according to feedback received by the stakeholder APPLiA after the second stakeholder meeting of the project. This section contains the parameters and results of the sensitivity analysis. The updated values are interpreted as representing the technical state of the art of commercial washing machines.

Sensitivity analysis for WM1

The revised input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 3-104.** Regarding the detergent consumption, a middle value of the provided range was used.

Table 3-104: Sensitivity analysis parameters for WM1.

Parameter	Unit	Reference: Base Case Task 5	Sensitivity: APPLiA update 2025
Nominal rated capacity	kg	7	8
Lifetime	years	6	10
Lifetime	cycles	10,080	11,250

Parameter	Unit	Reference: Base Case Task 5	Sensitivity: APPLiA update 2025
Energy consumption [(a)]	kWh/kg	0.10	0.16
Water consumption [(a)]	L/kg	5.7	9.3
Detergent consumption [(b) (c)]	g/kg load	11	3 - 26
Duration	min/cycle	45	79
Cycles per year		1,800	1,125
Units sales/year in EU of the product category	units/year	24,300	24,300
Customer price indication in EU	euro	2,136	2,000

Comments: (a): Cycle measured is full load; ECO 60 for commercial, Cotton 60 for light duty commercial; (b): Depending on if there is a pre-wash and how heavily soiled the load is and also the water hardness. (c): Values given: 3 min - 26 max, 11 g/kg used in model; (Source: APPLiA 2025)

The consumption data and environmental impact results (

Table 3-105**)**, and the Life Cycle Costing impact results (**Table 3-106**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference BC (original results). The updated APPLiA data result in higher impacts in all PEF impact categories compared to the reference BC. This is due to higher reported energy and water consumption values and a longer lifetime or higher number of cycles over the lifetime, respectively.

Table 3-105: Sensitivity analysis consumption data and life cycle environmental impact compared to original results for WM1.

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Total electricity consumption (use phase)	kWh	4,838	9,868	+104 %
Total thermal energy (use phase)	MJ	8,451	17,244	+104 %
Water (use phase)	m^3	429	837	+95 %
Detergent (use phase)	kg	795	990	+25 %
PEF Impact categories	**Unit**	**Reference: Base Case**	**Sensitivity (APPLiA update 2025)**	**% difference**
Climate change, total	kg CO_2 eq.	4.9E+03	8.3E+03	+70 %
Ozone depletion	kg CFC-11 eq.	8.1E-05	1.1E-04	+30 %
Human toxicity, cancer	CTUh	1.0E-05	1.3E-05	+33 %
Human toxicity, non-cancer	CTUh	6.5E-05	1.1E-04	+65 %
Particulate matter	disease incidence	3.1E-04	4.5E-04	+42 %
Ionising radiation, human health	kBq U235 eq.	1.1E+03	2.1E+03	+91 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.0E+01	1.6E+01	+58 %
Acidification	mol H+ eq.	2.1E+01	3.1E+01	+49 %
Eutrophication, terrestrial	mol N eq.	4.3E+01	6.5E+01	+51 %
Eutrophication, freshwater	kg P eq.	2.4E-01	3.6E-01	+47 %
Eutrophication, marine	kg N eq.	7.0E+00	1.0E+01	+43 %
Ecotoxicity, freshwater	CTUe	4.3E+04	6.3E+04	+48 %
Land use	pt	1.3E+05	1.5E+05	+15 %
Water use	m^3 water eq. of deprived water	1.0E+04	1.8E+04	+80 %
Resource use, minerals and metals	kg Sb eq.	5.8E-02	6.6E-02	+14 %
Resource use, fossils	MJ	7.7E+04	1.3E+05	+72 %

Table 3-106: Sensitivity analysis Life Cycle Costing impact compared to original results for WM1.

Cost categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Lifetime expectancy	years	6	10
Product price	EUR	2,136	2,000
	EUR/year	356	200
Installation/ acquisition costs	EUR/year	85	80
Natural gas (for heat)	EUR/year	33	36

Electricity	EUR/year	191	209
Water	EUR/year	138	145
Detergent costs	EUR/year	549	368
Repair & maintenance costs	EUR	64	60
Repair & maintenance costs	EUR/year	11	6.0
Total	**EUR/year**	**1,318**	**973**

Sensitivity analysis for WM2

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 3-107.** Regarding the detergent consumption, a middle value of the provided range was used.

Table 3-107: Sensitivity analysis parameters for WM2.

Parameter	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Nominal rated capacity	kg	24	29
Lifetime	years	15	10
Lifetime	cycles	54,000	30,000
Energy consumption [(a)]	kWh/kg	0.18	0.25
Water consumption [(a)]	L/kg	12.5	9
Detergent consumption [(b) (c)]	g/kg load	17	3-26
Duration	min/cycle	45	47
Cycles per year		3,600	3,000
Units sales/year in EU of the product category	units/year	16,935	53,000
Customer price indication in EU	Euro	34,775	9,000

(a): Cycle measured is full load; ECO 60 for commercial, Cotton 60 for light duty commercial; (b): Depending on if there is a pre-wash and how heavily soiled the load is and also the water hardness. (c): Values given: 3 min - 26 max, 11 g/kg used in model

The consumption data and environmental impact results (**Table 3-108**), and the Life Cycle Costing impact results (**Table 3-109**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference BC (original results).

Table 3-108: Sensitivity analysis consumption data and environmental impact compared to original results for WM2.

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Total electricity consumption (use phase)	kWh	141,349	132,358	-6 %
Total thermal energy (use phase)	MJ	344,551	322,638	-6 %
Water (use phase)	m^3	16,140	7,830	-51 %
Detergent (use phase)	kg	22,770	9,570	-58 %

PEF Impact categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Climate change, total	kg CO_2 eq.	1.5E+05	1.1E+05	-27 %
Ozone depletion	kg CFC-11 eq.	2.4E-03	1.0E-03	-58 %
Human toxicity, cancer	CTUh	1.9E-04	9.8E-05	-48 %
Human toxicity, non-cancer	CTUh	2.1E-03	1.1E-03	-49 %
Particulate matter	disease incidence	8.6E-03	5.1E-03	-41 %
Ionising radiation, human health	kBq U235 eq.	3.2E+04	2.7E+04	-16 %
Photochemical ozone formation, human health	kg NMVOC eq.	3.1E+02	2.0E+02	-35 %
Acidification	mol H+ eq.	5.9E+02	3.9E+02	-33 %
Eutrophication, terrestrial	mol N eq.	1.3E+03	7.6E+02	-39 %
Eutrophication, freshwater	kg P eq.	7.7E+00	3.5E+00	-55 %
Eutrophication, marine	kg N eq.	2.1E+02	1.1E+02	-47 %
Ecotoxicity, freshwater	CTUe	1.2E+06	6.9E+05	-45 %
Land use	pt	1.8E+06	1.0E+06	-45 %
Water use	m^3 water eq. of deprived water	3.6E+05	1.8E+05	-51.0 %
Resource use, minerals and metals	kg Sb eq.	1.3E+00	9.2E-01	-31 %
Resource use, fossils	MJ	2.3E+06	1.7E+06	-25 %

Table 3-109: Sensitivity analysis Life Cycle Costing impact compared to original results for WM2.

Cost category	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Product price	EUR	34,775	9,000
	EUR/year	2,318	900
Installation/ acquisition costs	EUR	1,391	360
Natural gas (for heat)	EUR/year	448	660
Electricity	EUR/year	1,869	2,755
Water	EUR/year	1,777	1,330
Detergent costs	EUR/year	4,857	3,175
Repair & maintenance costs	EUR	1,043	270
	EUR/year	70	27
Total	**EUR/year**	**11,384**	**8,882**

It can be observed from the LCA results that there is a significant impact reduction for all impact categories ranging between 16 to 58 %. Given that detergent and water consumption are the highest contributors across most of the impact categories (see **Section 03.4.4.2**), this observation can be attributed mainly to the lower data for water and detergent use of the APPLiA update compared to the reference BC. The LCC results indicate 23 % lower costs per year mainly due to lower estimated data for the product price, the lifetime and the consumption of water and detergent. However, an increase is observed in the costs related to energy due to the increase in energy consumption in the input data.

Sensitivity analysis for WM3

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 3-110.** Regarding the detergent consumption, a middle value of the provided range was used.

Table 3-110: Sensitivity analysis parameters for WM3.

Parameter	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Nominal rated capacity	kg	6	18
Lifetime	years	31	10
Lifetime	cycles	54,560	30,000
Energy consumption [(a)]	kWh/kg	0.62	0.62
Water consumption [(a)]	L/kg	8.3	10
Detergent consumption [(b) (c)]	g/kg load	12	3 - 26
Duration	min/cycle	75	75
Cycles per year		1,760	3,000
Units sales/year in EU of the product category	units/year	405	405
Customer price indication in EU	Euro	12,200	13,000

Comments: (a): Cycle measured is full load; ECO 60 for commercial, Cotton 60 for light duty commercial; (b): Depending on if there is a pre-wash and how heavily soiled the load is and also the water hardness. (c): Values given: 3 min - 26 max, 11 g/kg used in model

Source: APPLiA 2025

The consumption data and environmental impact results (**Table 3-111**), and the Life Cycle Costing impact results (**Table 3-112**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference BC (original results).

Table 3-111: Sensitivity analysis consumption data and environmental life cycle impact compared to original results for WM3.

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Total electricity consumption (use phase)	kWh	202,689	334,807	+65 %
Total thermal energy (use phase)	MJ	--	--	--
Water (use phase)	m^3	2,523	5,400	+114 %
Detergent (use phase)	kg	3,720	5,940	+60 %
PEF Impact categories	**Unit**	**Reference: Base Case**	**Sensitivity (APPLiA update 2025)**	**% difference**
Climate change, total	kg CO_2 eq.	1.1E+05	1.7E+05	+58 %
Ozone depletion	kg CFC-11 eq.	4.2E-04	6.8E-04	+63 %

Human toxicity, cancer	CTUh	5.5E-05	8.7E-05	+58 %
Human toxicity, non-cancer	CTUh	7.1E-04	1.2E-03	+64 %
Particulate matter	disease incidence	5.5E-03	7.8E-03	+44 %
Ionising radiation, human health	kBq U235 eq.	3.8E+04	6.2E+04	+64 %
Photochemical ozone formation, human health	kg NMVOC eq.	2.1E+02	3.2E+02	+52 %
Acidification	mol H+ eq.	5.1E+02	7.1E+02	+40 %
Eutrophication, terrestrial	mol N eq.	8.0E+02	1.2E+03	+53 %
Eutrophication, freshwater	kg P eq.	1.4E+00	2.4E+00	+75 %
Eutrophication, marine	kg N eq.	8.9E+01	1.4E+02	+55 %
Ecotoxicity, freshwater	CTUe	6.0E+05	9.6E+05	+59 %
Land use	pt	1.5E+06	1.8E+06	+25 %
Water use	m^3 water eq. of deprived water	8.3E+04	1.6E+05	+87 %
Resource use, minerals and metals	kg Sb eq.	1.6E+00	1.7E+00	+5 %
Resource use, fossils	MJ	1.8E+06	2.8E+06	+60 %

Table 3-112: Sensitivity analysis Life Cycle Costing impact compared to original results for WM3.

Cost categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Lifetime expectancy	years	31 [(a)]	10
Product price	EUR	12,200	13,000
	EUR/year	394	1,300
Installation/ acquisition costs	EUR	488	520
Natural gas (for heat)	EUR/year	0	0
Electricity	EUR/year	1,190	7,199
Water	EUR/year	122	948
Detergent costs	EUR/year	481	2,748
Repair & maintenance costs	EUR	366	390
Repair & maintenance costs	EUR/year	12	39
Total	**EUR/year**	**2,210**	**12,322**

Notes: (a) The original estimate of a lifetime expectancy of 31 years was adopted from a previous study. Stakeholders have deemed this far too high. It has thus been adjusted.

Sensitivity analysis for WM4

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 3-113.** Regarding the detergent consumption, the middle value of the provided range was used.

Table 3-113: Sensitivity analysis parameters for WM4.

Parameter	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Nominal rated capacity	kg	32	32
Lifetime	years	21	10
Lifetime	cycles	46,200	30,000
Energy consumption [(a)]	kWh/kg	0.24	0.15
Water consumption [(a)]	L/kg	12.5	13.3
Detergent consumption [(b) (c)]	g/kg load	13	3-26
Duration	min/cycle	60	53
Cycles per year		2,200	3,000
Units sales/year in EU of the product category	units/year	1,215	1,215
Customer price indication in EU	euro	57,375	35,000

Comments: (a): Cycle measured is full load; ECO 60 for commercial, Cotton 60 for light duty commercial; (b): Depending on if there is a pre-wash and how heavily soiled the load is and also the water hardness. (c): Values given: 3 min - 26 max, 11 g/kg used in model.

Source: APPLiA 2025

The consumption data and environmental impact results (**Table 3-114**), and the Life Cycle Costing impact results (**Table 3-115**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference BC (original results).

Table 3-114: Sensitivity analysis consumption data and environmental impact compared to original results for WM4.

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Total electricity consumption (use phase)	kWh	56,781	23,610	-58 %
Total thermal energy (use phase)	MJ	1,096,870	456,213	-58 %
Water (use phase)	m^3	16,735	12,768	-24 %
Detergent (use phase)	kg	18,471	10,560	-43 %
PEF Impact categories	**Unit**	**Reference: Base Case**	**Sensitivity (APPLiA update 2025)**	**% difference**
Climate change, total	kg CO_2 eq.	2.1E+05	1.4E+05	-35 %
Ozone depletion	kg CFC-11 eq.	2.0E-03	1.2E-03	-41 %
Human toxicity, cancer	CTUh	3.2E-04	2.7E-04	-17 %
Human toxicity, non-cancer	CTUh	2.5E-03	1.9E-03	-24 %
Particulate matter	disease incidence	1.6E-02	1.4E-02	-16 %
Ionising radiation, human health	kBq U235 eq.	2.0E+04	1.1E+04	-43 %

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Photochemical ozone formation, human health	kg NMVOC eq.	5.0E+02	3.9E+02	-21 %
Acidification	mol H+ eq.	1.5E+03	1.3E+03	-11 %
Eutrophication, terrestrial	mol N eq.	1.7E+03	1.3E+03	-23 %
Eutrophication, freshwater	kg P eq.	7.1E+00	4.5E+00	-36 %
Eutrophication, marine	kg N eq.	2.4E+02	1.7E+02	-29 %
Ecotoxicity, freshwater	CTUe	1.3E+06	9.2E+05	-29 %
Land use	pt	2.9E+06	2.4E+06	-18 %
Water use	m^3 water eq. of deprived water	3.5E+05	2.6E+05	-26 %
Resource use, minerals and metals	kg Sb eq.	8.6E+00	8.3E+00	-4 %
Resource use, fossils	MJ	3.1E+06	1.9E+06	-37 %

Table 3-115: Sensitivity analysis Life Cycle Costing impact compared to original results for WM4.

Cost categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Lifetime expectancy	years	21 (a)	10
Product price	EUR	57,375	35,000
	EUR/year	2,732	3,500
Installation/ acquisition costs	EUR	2,295	1,400
Natural gas (for heat)	EUR/year	1,023	953
Electricity	EUR/year	539	502
Water	EUR/year	1,296	2,215
Detergent costs	EUR/year	3,819	4,892
Repair & maintenance costs	EUR	14,343	8,750
Repair & maintenance costs	EUR/year	683	875
Total	**EUR/year**	**10,286**	**13,076**

Note: (a) The original estimate of a lifetime expectancy of 21 years was adopted from a previous study. Stakeholders have deemed this far too high. It has thus been adjusted.

3.4.7.3. Sensitivity analysis for dryers D1-D3 based on updated stakeholder data

Sensitivity analysis for D1

Several input parameters suggested by APPLiA (2025) have been used in the sensitivity analysis as shown in **Table 3-116.** The updated values are interpreted as representing the technical state of the art of commercial dryers.

Table 3-116: Sensitivity analysis parameters for D1.

Parameter	Unit	Reference: Base Case	Sensitivity: (APPLiA update 2025)
Product weight	kg	60	57
Nominal rated capacity	kg	6	9
Lifetime	years	5.6	10
Lifetime	cycles	10,080	7,500
Energy consumption	kWh/kg	0.38	0.24
Duration	min/cycle	40	165
Cycles per year		1,800	750
Units sales/year in EU of the product category	units/year	8,000	16,000
Customer price indication in EU	euro	1,460	1,600

The consumption data and environmental impact results (**Table 3-117**), and the Life Cycle Costing impact results (**Table 3-118**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference BC (original results).

Table 3-117: Sensitivity analysis consumption data and environmental impact compared to original results for D1.

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Total electricity consumption (use phase)	kWh	23,239	16,227	-30 %
Total thermal energy (use phase)	MJ	--	--	--
PEF Impact categories	**Unit**	**Reference: Base Case**	**Sensitivity (APPLiA update 2025)**	**% difference**
Climate change, total	kg CO_2 eq.	1.2E+04	9.0E+03	-25 %
Ozone depletion	kg CFC-11 eq.	3.9E-06	2.8E-06	-28 %
Human toxicity, cancer	CTUh	1.0E-05	9.6E-06	-5 %
Human toxicity, non-cancer	CTUh	5.5E-05	4.5E-05	-18 %
Particulate matter	disease incidence	6.4E-04	5.5E-04	-15 %
Ionising radiation, human health	kBq U235 eq.	4.3E+03	3.0E+03	-29 %
Photochemical ozone formation, human health	kg NMVOC eq.	2.5E+01	2.0E+01	-20 %
Acidification	mol H+ eq.	6.6E+01	5.7E+01	-14 %
Eutrophication, terrestrial	mol N eq.	8.7E+01	6.9E+01	-21 %
Eutrophication, freshwater	kg P eq.	2.5E-02	1.9E-02	-24 %
Eutrophication, marine	kg N eq.	8.1E+00	6.4E+00	-21 %
Ecotoxicity, freshwater	CTUe	5.7E+04	4.4E+04	-23 %

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Land use	pt	1.9E+05	1.8E+05	-7 %
Water use	m^3 water eq. of deprived water	3.7E+03	2.7E+03	-27 %
Resource use, minerals and metals	kg Sb eq.	2.6E-01	2.6E-01	0 %
Resource use, fossils	MJ	2.0E+05	1.5E+05	-26 %

Table 3-118: Sensitivity analysis Life Cycle Costing impact compared to original results for D1.

Cost categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Lifetime expectancy	years	5.6	10
Product price	EUR	1,460	1,600
	EUR/year	261	160
Installation/ acquisition costs	EUR	58	64
Natural gas (for heat)	EUR/year	0	0
Electricity	EUR/year	929	353
Repair & maintenance costs	EUR	44	48
Repair & maintenance costs	EUR/year	7.9	4.8
Total	**EUR/year**	**1,208**	**524**

Sensitivity analysis for D2

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 3-119**. The updated values are interpreted as representing the technical state of the art of commercial dryers.

Table 3-119: Sensitivity analysis parameters for D2.

Parameter	Unit	Reference: Base Case	Sensitivity: (APPLiA update 2025)
Product weight	kg	57	290
Nominal rated capacity	kg	32	37
Lifetime	years	22	15
Lifetime	cycles	55,102	35,000
Energy consumption	kWh/kg	0.87	0.63
Duration	min/cycle	40	35
Cycles per year		2,551	2,333
Units sales/year in EU of the product category	units/year	7,700	51,000

Parameter	Unit	Reference: Base Case	Sensitivity: (APPLiA update 2025)
Customer price indication in EU	Euro	8,700	6,000

The consumption data and environmental impact results (**Table 3-120**), and the Life Cycle Costing impact results (**Table 3-121**) for the sensitivity analysis are presented below, including the difference (%) between the reference case (original results).

Table 3-120: Sensitivity analysis consumption data and environmental impact compared to original results for D2.

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Total electricity consumption (use phase)	kWh	1,060,926	563,060	-47 %
Total thermal energy (use phase)	MJ	1,804,120	957,499	-47 %
Consumption	**Unit**	**Reference: Base Case**	**Sensitivity (APPLiA update 2025)**	**% difference**
Climate change, total	kg CO_2 eq.	5.64E+05	3.00E+05	-47 %
Ozone depletion	kg CFC-11 eq.	1.72E-04	9.16E-05	-47 %
Human toxicity, cancer	CTUh	9.30E-05	5.32E-05	-43 %
Human toxicity, non-cancer	CTUh	1.61E-03	8.63E-04	-46 %
Particulate matter	disease incidence	1.51E-02	8.14E-03	-46 %
Ionising radiation, human health	kBq U235 eq.	1.91E+05	1.01E+05	-47 %
Photochemical ozone formation, human health	kg NMVOC eq.	8.14E+02	4.36E+02	-46 %
Acidification	mol H+ eq.	1.45E+03	7.88E+02	-46 %
Eutrophication, terrestrial	mol N eq.	2.89E+03	1.55E+03	-47 %
Eutrophication, freshwater	kg P eq.	1.59E+00	8.44E-01	-47 %
Eutrophication, marine	kg N eq.	2.78E+02	1.49E+02	-47 %
Ecotoxicity, freshwater	CTUe	2.09E+06	1.12E+06	-47 %
Land use	pt	2.09E+06	1.18E+06	-44 %
Water use	m^3 water eq. of deprived water	1.54E+05	8.18E+04	-47 %
Resource use, minerals and metals	kg Sb eq.	5.83E-01	4.24E-01	-27 %
Resource use, fossils	MJ	9.56E+06	5.09E+06	-47 %

Table 3-121: Sensitivity analysis Life Cycle Costing impact compared to original results for D2.

Cost category	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Lifetime expectancy	years	22 (a)	15
Product price	EUR	8,700	6,000

	EUR/year	403	400
Installation/ acquisition costs	EUR	348	240
Natural gas (for heat)	EUR/year	1,669	1,328
Electricity	EUR/year	9,988	7,947
Repair & maintenance costs	EUR	261	180
	EUR/year	12.1	12.0
Total	**EUR/year**	**12,088**	**9,703**

Note: (a) The original estimate of a lifetime expectancy of 22 years was adopted from a previous study. Stakeholders have deemed this too high. It has thus been adjusted.

It can be observed from the LCA results that there is significantly less impact for all impact categories with the difference ranging between 27 to 47 %. Given that energy consumption is the highest contributor across most of the impact categories (see **Section 03.4.4.2**), this observation can be attributed mainly to the lower data for energy use of the APPLiA update compared to the reference BC. The LCC results indicate 20 % lower costs per year mainly due to lower estimated data for the product price, a reduced lifetime and the consumption of energy.

Sensitivity analysis for D3

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 3-122**. The updated values are interpreted as representing the technical state of the art of commercial dryers.

Table 3-122: Sensitivity analysis parameters for D3.

Parameter	Unit	Reference: Base Case	Sensitivity: (APPLiA update 2025)
Product weight	kg	145	128
Nominal rated capacity	kg	8	7
Lifetime	years	41.7	10
Lifetime	cycles	55,044	30,000
Energy consumption	kWh/kg	0.51	0.6
Duration	min/cycle	130	105
Cycles per year		1,320	3,000
Units sales/year in EU of the product category	units/year	10,000	10,000
Customer price indication in EU	Euro	2,800	2,000

The consumption data and environmental impact results (**Table 3-123**), and the Life Cycle Costing impact results (**Table 3-124**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference BC (original results).

Table 3-123: Sensitivity analysis consumption data and environmental impact compared to original results for D3.

Consumption	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)	% difference
Total electricity consumption (use phase)	kWh	226,038	126,020	-44 %
Total thermal energy (use phase)	MJ	--	--	--
PEF Impact categories	**Unit**	**Reference: Base Case**	**Sensitivity (APPLiA update 2025)**	**% difference**
Climate change, total	kg CO_2 eq.	9.8E+04	5.6E+04	-43 %
Ozone depletion	kg CFC-11 eq.	3.5E-05	2.0E-05	-44 %
Human toxicity, cancer	CTUh	1.8E-05	1.1E-05	-39 %
Human toxicity, non-cancer	CTUh	3.5E-04	2.1E-04	-40 %
Particulate matter	disease incidence	3.5E-03	2.2E-03	-38 %
Ionising radiation, human health	kBq U235 eq.	4.0E+04	2.3E+04	-41 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.7E+02	1.0E+02	-41 %
Acidification	mol H+ eq.	3.4E+02	2.2E+02	-37 %
Eutrophication, terrestrial	mol N eq.	6.2E+02	3.7E+02	-41 %
Eutrophication, freshwater	kg P eq.	2.0E-01	1.1E-01	-43 %
Eutrophication, marine	kg N eq.	5.9E+01	3.4E+01	-41 %
Ecotoxicity, freshwater	CTUe	4.5E+05	2.6E+05	-42 %
Land use	pt	5.0E+05	3.2E+05	-36 %
Water use	m^3 water eq. of deprived water	3.3E+04	1.9E+04	-43 %
Resource use, minerals and metals	kg Sb eq.	4.2E-01	4.1E-01	-3 %
Resource use, fossils	MJ	1.7E+06	9.7E+05	-43 %

Table 3-124: Sensitivity analysis Life Cycle Costing impact compared to original results for D3.

Cost categories	Unit	Reference: Base Case	Sensitivity (BAT 2025)
Lifetime expectancy	years	41.7 [(a)]	10
Product price	EUR	2,800	2,000
	EUR/year	68	200
Installation/ acquisition costs	EUR	112	80
Natural gas (for heat)	EUR/year	0	0
Electricity	EUR/year	964 [(b)]	3,225 [(c)]
Repair & maintenance costs	EUR	84	60
Repair & maintenance costs	EUR/year	2.0	6.0
Total	**EUR/year**	**1,035**	**3,489**

Notes: (a) The original estimate of a lifetime expectancy of 41 years was adopted from a previous study. Stakeholders have deemed this far too high. It has thus been adjusted. (b) The present value factor is used over a 41-year period in this LCC, which results in low result of annual electricity costs. Present costs are 1,245 €/year. (c) 2.27 times higher cycle count per year compared to the BC.

3.4.7.4. Adjusted ERT dataset on electronics

Due to the lack of more specific data and stakeholder input regarding the weight of electronics in the BoM (see MEErP Task 4), this study used the percentage share of electronics in the total product weight as considered in the previous preparatory study from 2011. The previous calculations using the ERT (as presented in **Section 3.4.4**, **Section 3.4.5, Section 3.4.6 and Section 3.4.7**) were performed with the electronics dataset 'Controller board' of the ERT, which was initially considered a representative dataset for modelling an electronics component of the machines.

Upon closer examination of the quantities of electronics used, it became apparent that the electronics cannot solely consist of a controller board. Instead, the reported quantities rather cover all electronic components within the devices, including parts whose emission factors in the impact categories are significantly lower than those of a controller board. For this reason, the study team decided that the ERT dataset 'Controller Board' is not representative of the total amount of electronics used. Since the ERT does not provide more specific datasets and the level of detail for electronics in the BOM available for these product categories is not sufficient enough, instead the ERT's dataset '164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg' was considered a more suitable proxy in terms of impact categories, more adequately covering a mix of electronic components like a controller board, printed wiring board and further electronic parts that are less complex to manufacture.

The updated results of LCA and LCC per BC as presented in Annex VI – Results of LCA / LCC per Base Cas include the revised electronics dataset.

3.4.8. Final updated LCA and LCC results available in the Annexes

A detailed breakdown of the revised input data and revised results of MEErP Task 5 that consider all updated input data according to stakeholders' feedback (see sensitivity analyses in **Section 3.4.7.2** and **Section 3.4.7.3**) and the revised dataset for electronics (see sensitivity analysis in **Section 3.4.7.4**) is provided in **Annex V: Inputs for LCA / LCC per Base Case** and **Annex VI – Results of LCA / LCC per Base Case**

3.4.9. Conclusions on the LCA and LCC assessment

The environmental LCA and LCC assessment conducted in this study, and the results interpretation, has resulted in key conclusions.

The LCA indicates that the majority of the environmental impact across all BCs originates from the life cycle stages 'use phase' and 'raw material acquisition'. This observation directly correlates product utility consumption and product weight with environmental impact. Thus, the heaviest products and those with the largest nominal capacity are the ones with the highest impact. On an EU stock level, however, sales volume influences stock accumulation, meaning that the products with the highest impact are those with the highest sales.

The contribution analysis identified the most impactful contributors highlighting potential opportunities for impact reduction. Specifically, in the use phase, energy consumption and detergent consumption are the largest contributors across most impact categories. Both aspects belong to the use phase but their environmental impacts stem largely from the production stages (i.e. electricity generation and detergent manufacturing). Stainless steel is identified as a major contributor across various impact categories, followed by polypropylene and copper.

The LCC assessment has identified detergents and energy use as the highest contributors for all BCs. For dryers, energy consumption, whether electricity or fuels (used to heat up air for the drying process), is the dominant contributor depending on the type of usage. In general, it is observed that the running costs for all BCs surpass the initial purchase and installation costs. This trend applies also at the EU stock level, reinforcing the importance of considering operational expenses. These insights can inform the development of impact reduction design options in the following tasks.

Only after the second stakeholder meeting of the project, updated input data by the stakeholder APPLiA was received. Although the sensitivity analysis conducted for BCs WM1-4 and D1-3 shows some considerable changes in the specific results due to different assumptions on rated capacities, lifetimes and consumption parameters, the above conclusions (use phase as largest contributor to environmental impacts, raw material contributions to the impacts and overall contribution of the specific product categories) still apply to the revised data. Considering the broad range of products within the categories and the data quality scoring approach (see **Table 3-71:** Data quality scoring.), which ranks stakeholder input as higher quality than the initial BC data based on the 2011 preparatory study results, expert judgement and literature information, the study will use revised inputs (APPLiA 2025 updated data) as the revised BC information for subsequent tasks.

3.4.10. Substances of Concern assessment

This section of the report describes the Substances of Concern (SoCs) identification Task, which is a new task beyond the methodological approach of the MEErP running parallel with the life cycle environmental impact and LCC assessment. It covered a stakeholder consultation process, and the resulting assessment of information and performance requirements.

The Substances of Concern identification task, guided by ESPR Art. 2(27)'s criteria, examined stakeholder consultation input and existing EU regulations (REACH[72], CLP[73], POP[74], WFD/SCIP[75], WEEE[76], RoHS[77]) to determine which substances in commercial and industrial laundry appliances warrant additional scrutiny. When such substances are present, information requirements may be imposed to report substance identity, location, concentration, safe-use instructions, and end-of-life guidance. For substances meeting criterion ESPR Art. 2(27)(d), performance requirements (such as maximum concentration limits or bans) may also be needed to safeguard circularity.

The stakeholder consultation provided insights on the complexity of data collection, the overlap with the aforementioned regulations. Additionally, recyclers expressed concerns on the time-lag between design and recycling, the challenges of using a DPP in fast-paced waste treatment operations, and the need for harmonised methodologies for testing for the presence of SoC. During the consultation, no specific Substances of Concern were identified or reported. Nevertheless, the ESPR requires manufacturers to adhere to information requirements (Article 7 of the ESPR) for all Substances of Concern present in their products, resulting in tracking obligations concerning their identity, location, concentration, safe-use instructions, and end-of-life treatment. To meet these obligations with minimal duplication and maximum alignment, the following thresholds (based on draft JRC guidance) are recommended:

- A 0.1 % w/w threshold for Substances of Very High Concern (SVHC) (Art. 2(27)(a)) and POPs (Art. 2(27)(c)) in line with REACH Art. 33(1),
- UN Globally Harmonised System (GHS) generic concentration limits (or, where absent, the lowest CLP Annex I generic concentration limits) for hazard-classed substances under Art. 2(27)(b), supplemented by the latest endocrine-disruptor and *Persistent, Mobile, and Toxic* (PMT)/ *Persistent, Bioaccumulative, and Toxic* (PBT) criteria from the CLP amendment (Delegated Regulation (EU) 2023/707), and
- A uniform 0.1 % w/w cutoff for Substance of Concern affecting circularity (Art. 2(27)(d)), pending more granular data obtained by implementing information requirements.

72 Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).
73 EU Commission CLP, 2008.
74 Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants.
75 SCIP is the database for information on Substances of Concern in articles as such or in complex objects (Products) established under the Waste Framework Directive (WFD) 2008/98/EC.
76 European Parliament and Council, 2012.
77 European Parliament and Council, 2011.

Because full-lifecycle Intentionally Added Substances and Non-Intentionally Added Substances data collection is time- and resource-intensive, the scope has been limited to product-specific Intentionally Added Substances present in the final product, including its components and spare parts. Three implementation scenarios are proposed to implement the information requirements in this product group:

- Ambitious: covering all Art. 2(27) Substances of Concern without exemptions,
- Intermediate: covering all Art. 2(27) Substances of Concern, with case-by-case exemptions for substances based on solid justification, and
- Limited: tracking only Art. 2(27)(a–c) Substances of Concern would be tracked, but companies could justify broader exemptions for groups of substances, hazard classes or categories, etc, within the flexibilities offered by the legal text, coupled with a targeted study to identify additional Art. 2(27)(d) candidates for selected regulation trough amending the delegate act.

A five-year roll-out is recommended across all scenarios to allow for supplier engagement, data gathering, and DPP integration. An assessment of feasibility and administrative burden should be undertaken as part of the impact assessment.

Finally, performance requirements under article 6 of the ESPR need not be imposed at this stage as there is currently no clear indication that the WEEE/RoHS recycling framework has issues with SoC, and stakeholder feedback has not identified any specific performance gaps. As new research or recyclability insights emerge, revisiting performance criteria should be considered. Further information can be found in **Annex VIII: Substances of Concern.**

3.5. MEErP Task 6 – Design Options for Ecodesign requirements

3.5.1. Objectives of MEErP Task 6

The aim of Task 6 in the MEErP is to identify and evaluate Design Options (DOs) for commercial and industrial laundry appliances. The assessment of the DOs builds on the results of MEErP Task 5, in particular the identification of the relevant environmental impact and improving potentials identified during the LCA. It also takes into account the monetary consequences in terms of LCC to the customer, their environmental costs and benefits, and the search for the Least Life Cycle Cost (LLCC) solution and DOs reflecting Best Available Technology (BAT) as identified in MEErP Task 4.

The ecodesign option(s) refer to the respective categories of commercial and industrial laundry appliances as defined in MEErP Task 1 (scope). These categories are used for analytical purposes, as they group together ranges of laundry appliances considered to be reasonably functionally equivalent. The categories exhibit different design features, components and/or material composition. They are technically specified in the form of BCs, which serves the attribution of quantified parameters as an input for the environmental and cost assessment (MEErP Task 5) as well as the evaluation of DOs. The DOs are aligned with:

- DOs being horizontally applicable to all products in scope;
- Product (BC) specific DOs.

The objective of evaluating DOs is to identify possible environmental improvement potentials in the context of the hotspots of environmental impacts identified in MEErP Task 5. Possible approaches to redesigning laundry appliances should be considered based on information gathered from manufacturers and operators of such machinery during the stakeholder consultation conducted throughout the preparatory study. The DOs refer to technological and operational innovations that aim to improve specific performance aspects influencing the overall sustainability of commercial and industrial laundry appliances, compared to the current BAT. The DOs considered in MEErP Task 6 are evaluated from the perspective of their possible environmental impact rather than their technical and economic feasibility. This means that only such DOs are considered that are deemed plausible by stakeholders or have been identified in literature, patents and communications of companies that manufacture laundry machines or components thereof. The DOs listed by Graulich et al. (2011) in their preparatory study of this product category were used as a starting point for researching the currently available DOs.

It is worth noting that the evaluation of DOs is an analytical tool that identifies technical approaches that are most impactful for achieving environmental improvements. This analysis intends to inform the formulation of recommendations in the form of policy options (MEErP Task 7) rather than to predetermine future legal requirements.

Introduction to the evaluation of Design Options using the MEErP

The MEErP provides a structured and comprehensive framework for assessing the environmental, economic, and technical performance of product DOs. At its core, the MEErP

facilitates a life-cycle-based evaluation that integrates environmental impact assessments with techno-economic analysis to identify the LLCC and BAT. This ensures that design decisions not only meet regulatory requirements but also promote sustainability and cost-effectiveness.

The evaluation of DOs within MEErP is prepared by several tasks, including the definition of product scope (MEErP Task 1), market analysis (MEErP Task 2), use-stage and technical analysis of existing products (MEErP Task 3 and Task 4), as well as the LCA and LCC in the succeeding (MEErP Task 5). The revised MEErP (2024) introduces refinements to better align with the EU's Green Deal objectives, emphasising aspects related to climate neutrality, circularity, and SoCs related to the product group under study. The work process for developing DOs remains structured around seven core tasks, with MEErP Task 6 playing a pivotal role in identifying and evaluating improvement potentials.

DOs are first mapped and evaluated, taking stakeholder input into account, and then assessed using the ERT. The latter helps to quantify the improvement potential of environmental impact against the BCs. This structured approach enables policymakers and stakeholders to compare alternatives objectively and select the most sustainable and economically viable solutions. Thus, the MEErP ensures that product innovations are aligned with broader environmental goals, such as reducing greenhouse gas emissions and improving energy efficiency and the adoption of a circular economy.

According to the MEErP, Task 6 of the preparatory study encompasses in principle the following sections:

- Introduction and Objectives.
- **Identification DOs:** Based on findings of the Lot 24 study (2011) and the insights from MEErP Tasks 1–5 of this study, DOs that could help improving resource consumption, material use, reparability, recyclability, or durability are mapped. Additionally, information collected during the stakeholder consultation is taken into account.
- Feasibility assessment of selected DOs.
- **Quantification of environmental impact and comparison of design option against BCs:** The updated ERT is used to model the environmental performance of each design option.
  An LCA of DOs is performed relative to the BC LCA established in Task 5 to determine:
  - Environmental benefits,
  - Cost savings or increases,
  - Feasibility and market readiness.
- Analysis of LLCC and BAT:
  - LLCC: The option with the lowest total cost over the product's life.
  - BAT: The most environmentally beneficial option that is technically and economically viable in the medium term.
  - Best Not (yet) Available Technologies (BNAT): Promising long-term innovations not yet market ready.

- **Discussions on DOs:** not assessed using the ERT and documentation of trade-offs: any trade-offs between environmental and economic performance.
- **Conclusions:** The chapter provides a summary of relevant findings which will then be used to define policy options and scenarios in MEErP Task 7.

The present study on Ecodesign Options focuses on commercial and industrial washing machines, washers/extractors and dryers.

3.5.2. Overview of Design Options

The following sections provide an overview of DOs for commercial and industrial laundry machines. As a starting point, the DOs consider the BAT, and BNAT presented in the former preparatory study (Graulich et al., 2011). The DOs from 2011 have been reviewed and commented by stakeholders in the course of the current stakeholder consultation process. The results of this review helped in prioritising and deprioritising some of the DOs and in reassessing their feasibility and improvement potential in light of the results of MEErP Task 5 of the present preparatory study. For assessing the market availability of BAT and BNAT, the concept of Technology Readiness Level (TRL) has been adopted according to the Commission (European Commission 2017).

Furthermore, a survey of emerging technologies, components and processes that could deliver measurable environmental improvements was conducted to identify new technological innovations or approaches that could be used to design more eco-efficient appliances. Also in this survey, stakeholders (including manufacturers, associations and representatives of the cleaning industry (users) etc.) have been asked to provide concrete information of new innovative solutions, both BAT and BNAT. However, the amount and content of information provided during the consultation process was limited and difficult to quantify. Consequently, the initial analysis was primarily based on literature data, supplemented by data extrapolated from technical performance parameters or assumptions on their functional feasibility. After publication of the draft MEErP Task 6 report, stakeholders provided further feedback on the initially proposed DOs and improvement potentials which is considered in the current finalised MEErP Task 6 report.

3.5.2.1. Design Options for commercial and industrial washing machines

During the stakeholder consultation conducted in the course of this preparatory study, various stakeholders stressed that commercial and industrial laundry appliances have undergone significant development over the past century, reaching a high level of technological maturity. Today, the focus is on refining washing and tumble-drying processes to enhance efficiency and sustainability. One major advancement is the dramatic reduction in water consumption and improved water extraction over the past years, which significantly cuts down the energy use for heating the water, and drying time. Key sub-technologies such as heat pump systems, frequency-controlled motors, and advanced control systems with user-friendly interfaces have been integrated once they proved capable of delivering customer value and return on investment.

The use of digital tools for analysis and simulation has further optimised designs in terms of strength, weight, and energy efficiency. Alongside these technical improvements, there is a growing emphasis on maximising appliance uage and reliability through smart sensors, connectivity, and predictive maintenance. These innovations not only enhance operational safety and serviceability but also help to prevent costly downtime. Altogether, these advancements contribute to longer-lasting appliances that align with sustainability goals and deliver tangible benefits to customers.

Best Available Technologies for commercial and industrial washing machines

The list of DOs presented in the former preparatory study (Graulich et al. 2011), encompassed eight BAT, referring to the state of the art in 2011, as well as BNAT, which were not yet market ready in 2011**. Table 3-125** shows the 2011-BAT for washing machines and **Table 3-126** shows one BNAT that was considered a possible DO in 2011. For each DO, a brief description is provided (for more detailed explanation, see Graulich et al. (2011). Moreover, the present state of adoption (ca. 13 years later) is indicated, based on information provided by stakeholders.

Table 3-125: Review of in 2011 Best Available Technologies (BAT) for commercial and industrial washing machines, based on the former preparatory study (Graulich et al., 2011).

2011-BAT (review of 2012 study)*	Index Nr. (2011)	Description	State of adoption as of 2025 according to stakeholder information
Increased motor efficiency	M 1.1	Process flexibility, better motor efficiency	Motors have been upgraded according to and comply with the motor regulations TRL: 9 Conclusion: no longer considered BAT
Heat exchanger	M 1.2	Reduces energy consumption for freshwater heating by recovering heat from wastewater	Unchanged, TRL: 9 (mature technology but not so common in commercial & industrial washing machines) Conclusion: **Initially still to be considered BAT**
Water recovery systems	M 1.3	Saves water and energy	Hygiene bio accumulations risk still exists TRL: 9 (mature technology mostly applied in WM5 but not so common in WM1) Conclusion: no longer considered BAT
Load control	M 1.4	Optimises energy, water and detergent use based on load size, type, and cycle	Have been continuously developed and most valuable in coin-operated appliances TRL: 9 Conclusion: **still to be considered BAT**
Further control systems	M 1.5	Better dosing, selection of right programme depending on the actual cleaning job, helps avoiding unnecessary consumption	Continuously developed TRL: 9 Conclusion: **still to be considered BAT**

2011-BAT (review of 2012 study)*	Index Nr. (2011)	Description	State of adoption as of 2025 according to stakeholder information
Ozone technology	M 1.6	Reduced energy, water, detergent consumption	The same drawbacks are still valid TRL: 9 Conclusion: **Initially still to be considered BAT**
Drum construction	M 1.7	Better clemency of the textile fibres helps to reduce wear and tear of textiles during laundry --> prolongation of service life of textiles.	Finetuning always ongoing TRL: 9 Conclusion: **Initially still to be considered BAT**
Wash process with lower temperature	M 1.8	Reduced energy consumption, requires either more or better detergents or longer cycle duration	Awareness of the drawbacks about hygiene risk and contamination risk have grown TRL: 9 Conclusion: no longer considered BAT

Source: Graulich et al. (2011)

Table 3-126: Review of in 2011 Best Not Yet Available Technologies (BNAT) for commercial and industrial washing machines in 2011, based on Lot 24 study (2011).

2011-BNAT (review of 2012 study)*	Index Nr.	Description	State of adoption as of 2025 according to stakeholder provided information
Polymer beads	--	Beads, made from special polymers attract and absorb dirt from clothes when agitated in water while no detergent is needed	Approx. TRL 8 or 9 as the technology has been demonstrated in operational environments. However, stakeholders indicate that it is not actually used in commercial laundry, due to concerns regarding micro-plastic releases (beads tend to get trapped in pockets and seams) Conclusion: No longer considered BNAT / not considered as a Design Option

Source: Graulich et al. (2011)

Based on the above and additional information reviewed by the consultant**, Table 3-127** specifies the DOs considered as BAT in the present study.

Table 3-127: Selection of PRESENT Best Available Technologies as Design Options for commercial and industrial washing machines

2025-BAT	Index Nr.	Description of new innovations since 2011	State of adoption as of 2025 according to stakeholder information
Heat recovery from waste water	WM-DO1	Use of additive manufacturing (3D printing) to create heat exchangers with complex geometries (e.g., gyroid lattices) that maximise surface area while minimising pressure drop. This allows lightweight and compact designs that are customisable for specific laundry machine configurations.	adopted and updated from 2011 study* Source: (Raja et al. 2020) **Initially considered as a Design Option**
Load control	WM-DO2	Use of machine learning / artificial intelligence to analyse load size, fabric type, and soil level to automatically adjust wash cycles.	adopted and updated from 2011 study* **Considered as a Design Option**
Smart detergent dosing	WM-DO3	Use of machine learning / artificial intelligence to analyse load size, fabric type, and soil level to automatically adjust detergent dosing	adopted and updated from 2011 study* Source: (FMB Laundry 2024) **Considered as a Design Option**
Ozone technology	WM-DO4	Integration with IoT and AI allows real-time monitoring of ozone levels, cycle optimisation, and minimises ozone overuse or underperformance. New-generation corona discharge and UV-based ozone generators are more compact, efficient, and durable.	adopted and updated from 2011 study* Sources: (ClearWater Tech LLC.; Coin-O-Matic 2024); **Initially considered as a Design Option**

2025-BAT	Index Nr.	Description of new innovations since 2011	State of adoption as of 2025 according to stakeholder information
Drum construction	WM-DO5	Optimisation of perforation patterns aims at improving washing efficiency, fabric care, and energy savings. - Variable hole sizes and shapes - Asymmetric and zoned patterns - 3D-formed baffles with integrated perforations	adopted and updated from 2012 study* https://patents.google.com/patent/EP0848099A1/en – Drum for a Laundry Treatment Machine EP1974083A1 – Laundry Drum **Initially considered as a Design Option**
Extended time of spare part availability and repair support	WM-DO6	Some manufacturers guarantee the availability of spare parts for repair for at least 10 years after sales have stopped for a respective appliance model. Moreover, maintenance services and access to repair manuals is offered to extend the service life of washing machines	Best Practice rather than BAT. TRL: 9 Problematic integration within the scope of ESPR: the measure consists of marketing claims and features of sales contract, rather than a design feature. Nevertheless **considered as a Design Option**
Solar Thermal Integration	--	Preheating of feed water by integration of solar thermal collectors with wastewater heat recovery units from dryers and washers.	New emergent BAT. TRL: 9 (Solar Thermal Heating is a mature technology but not yet widely integrated in commercial and industrial laundry - mostly in experimental or custom-built systems). Source: (Ahmed et al. 2022) Problematic integration within the scope of ESPR: requires separate infrastructure outside the body of a washing machine -> not considered as a Design Option

For a technical description, please see Graulich et al. (2011)

With regard to **heat recovery (WM-DO1)**, stakeholders of commercial washing machines stated in their latest feedback to the report that heat recovery is commonly used where outgoing heat from the effluent is used in real time to heat incoming water for the next filling. In laundries, typically the heated bath is the main wash, whereas rinses are cold. Heating the rinses which have no need to be heated will not save any energy. If the heated water is instead to be saved to use it later, insulated tanks that save the heat for the next main wash will be needed, being too large to fit into a washing machine. For WM1, that are used infrequently, the heat will need to be kept until the next day or several days after, which will pose microbiological problems. According to stakeholder feedback, heat recovery from waste water is a typical design that is too costly for investing in each single appliance. Adding heat recovery will be at the drain, at the bottom of the washer which means the machine has to be higher. Since the cabinet and legs need to be able to support the whole machine, it will weigh

considerably more according to stakeholder feedback. Further, stakeholders argued that the laundry waste water is dirty with particles and contains a lot of dirt including textile fibres that will clog the heat exchanger fast, if not instantly. It would require a full wastewater treatment plant between the washer and the gyroid lattice which will surely be enough to cool the wastewater, and it seems impossible to clean gyroid lattices.

Using heat recovery systems might be a good alternative for commercial laundries, however, not one heat recovery system built into each washer, but one system for the whole laundry, enabling heat from one washer to be used by the first washer to start a wash cycle. Since the system is built outside of the washing machines, stakeholders deem it out of scope for this product related study but rather to be applied for building regulations, i.e. covered by Regulation 2024/1275 on the energy performance of buildings. Stakeholders pointed out that double regulation or in worst case contradicting regulations have to be avoided.

On **WM-DO2 (load control)** and **WM-DO3 (smart detergent dosing)**, stakeholders of commercial washing machines stated that the load control itself cannot lower the detergent consumption, but this design option has to be paired with WM-DO3 (smart detergent dosing). Further, it does not automatically mean that WM-DO3 is also implemented, as the dosing system is usually a separate device outside the washing machine.

With regard to **ozone technology (WM-DO4)**, stakeholders of commercial washing machines state that ozone technology faces many challenges: Ozone is not very soluble in water and will outgas into the air, which is a safety risk as it is toxic to humans and un-dissolved ozone can cause respiratory irritation. Further, there could be potential damage to washing machines and garments; ozone degrades machine parts and weakens fabric fibres over time which would be in contradiction to sustainability expectations. Ozone generators are not feasible to incorporate into washers, they are separate, freestanding units requiring separate infrastructure outside the body of a washing machine. On top of that, this would require significant initial investments. Finally, according to stakeholder feedback, internal tests of manufacturers have not shown any proof that ozone reduces energy, water or detergent consumption in wash programmes with optimised water consumption, but only when excessive water is used. Ozone technology is therefore not considered by stakeholders to be a reasonable DO and will not be further considered by the study team for the further analysis.

With regard to **drum construction (WM-DO5)** however, in their latest feedback to this report,, stakeholders of commercial washing machines state that it is not economically possible to make a drum with variable hole sizes, as drums are hardware and variable perforation zones or changing the hole patterns are not possible in hardware. Once the metal is perforated it cannot be changed with any type of means that is economically feasible. To make a drum with variable hole size, such as an aperture on a camera, would be very costly and cleaning them would not work. On the other hand, drums with different hole sizes/patterns for different applications are already being used, according to stakeholder feedback. Drum construction has been finetuned for many years, and different manufacturers make variants already today for adopting to different load to clean. The assumption of the preparatory study that further design optimisation would improve performance significantly is not likely from a stakeholder perspective. Especially the initial assumptions of the preparatory study, stating that an improved drum construction could possibly save 40 to 80 % water is not considered realistic,

as this would not enough water would remain to fully wet the load, leading to wet load not being cleaned properly, meaning the whole purpose of washing will not be accomplished.

Description of best practices for commercial and industrial washing machines

Extended time of spare parts availability and repair support

It is considered a best practice for manufacturers of commercial and industrial washing machines to extend the availability of spare parts and provide long-term repair support for their customers. This approach plays a crucial role in preventing premature obsolescence, ensuring that machines remain functional and serviceable well beyond their initial warranty period. By maintaining access to essential components and offering technical assistance, manufacturers not only support sustainability and reduce environmental impact, but also build trust and loyalty among professional users who rely on these machines for daily operations. This commitment to longevity aligns with circular economy principles and helps customers to maximise their investment over the product's full lifecycle.

An example of a well-established and comprehensive repair support programme for commercial washing machines is Miele (Miele & Cie. KG 2025). The manufacturer`s commitment to product longevity is reflected by the following elements of its repair programme:

- Long-term availability of original spare parts for supported machines well beyond their warranty period (**10 years or more)**.
- Factory-trained technicians get certified as service professionals and thus equipped with the correct tools and original spare parts to ensure efficient repairs - often on the first visit.
- Remote diagnostics in form of an online available remote assist service allows technical experts to diagnose and help resolve issues without an on-site visit, reducing downtime and service costs.
- Customers can easily access online self-help tools or troubleshoot instructions and also schedule repair services via online booking using a corporate digital platform.

Industrial laundry appliances are another example of very long-term maintenance support, here it is best practice for manufacturers to offer customer support (including repair and maintenance; spare parts) over a time span of 30 years and beyond. At the 2nd stakeholder meeting, representatives of industrial manufacturers explained that in their branch the standard practice is to conclude maintenance contracts with clients. In this manner, an installation will be checked for faults on a routine basis as part of preventive maintenance rather than waiting for a malfunction. The aim is that any necessary repairs can then be identified and performed on a timely basis, before this leads to off-time and thus to more significant economic losses for the facility operator. Some manufacturers refer in their promotional information to the availability of spare parts and to 'aftermarket' maintenance and

services in this respect however not specifying the timelines of spare part availability or maintenance contracts[78].

According to latest stakeholder feedback, the initial assumed the overall appliances' lifetime extension by five years (WM1 to WM4, D1 to D4) and by ten years (WM5) due to extended spare parts availability and repair support was questioned as most manufacturers of commercial and industrial appliances seem to have integrated this option already in their business models. Therefore, only a small share of the market might still benefit from such an option. To consider this best practice of the commercial and industrial business context, the study team revised the initial input data to +2 years extended lifetime for WM1 to WM4 and D1 to D3, and to +5 years for the categories WM5 and D4.

Availability of motors and fans as spare parts

Availability of motors and fans as spare parts in commercial and industrial washing machines is particularly important due to the critical role these components play in the machine's performance and longevity. The motor is the heart of the washing machine, responsible for driving the drum and enabling various wash cycles. Over time, it is subject to mechanical wear and electrical stress, making it one of the most commonly replaced parts. If these components fail and replacements are not readily available, the entire machine may become inoperable, leading to costly downtime and potential early replacement. Ensuring long-term availability of these key parts helps to prevent obsolescence, supports sustainable maintenance practices, and extends the useful life of the equipment, which is especially valuable in commercial and industrial settings where reliability is paramount. However, some stakeholders have warned during the stakeholder consultation and meetings that the availability of some induction motors – as spare parts - is being undermined by the requirements set out by the EU Motor Regulation 2019/1781 Article 1(2):

> "(2) The requirements in section 1, and points (1), (2), (5) to (11), and (13) of section 2 of Annex I shall not apply to the following motors:
> (m) motors placed on the market before 1 July 2029 as substitutes for identical motors integrated in products placed on the market before 1 July 2022, and specifically marketed as such."

Some induction motors used in commercial and industrial laundry machines are in scope of EU Motor Regulation 2019/1781, meaning that according to Article 4 of the Regulation, they must comply with the ecodesign requirements set out in annex I of that Regulation. Article 1(2)(m) lists the above exclusion from compliance with the ecodesign energy efficiency requirements for motors (Annex I section 1) and with some of the ecodesign product information requirements (Annex I section 2 (1), (2), (5) to (11), and (13)). However, in the case of spare parts, this exclusion is only relevant for motors that have or will be placed on the market before July 2029 as substitutes for motors that were placed on the market before 2022. This means that, in particular, in laundry machines that were placed on the market shortly before 2022, if a motor is to malfunction to a degree that it would need to be replaced,

[78] See for example here: https://www.jensen-group.com/de/dienstleistungen/aftermarket-produkte-dienstleistungen and here: https://www.kannegiesser.com/de/de/service/informationen/service-worldwide.html, both last viewed on 11.8.2025

the complete machine would need to be scrapped as of July 2029 if the efficiency of the earlier motor model cannot be improved to comply with the Annex I ecodesign requirements.

Stakeholders warn that due to this regulation, appliances may only be repaired for 7 years (no longer) as the required efficiency of motors cannot be met by spare parts for identical motors integrated in products placed on the market before 1 July 2022. It was emphasised that it is not feasible to redesign legacy appliances in a way that would allow them to host new motor classes that comply with Annex II of the Regulation (EU) 2019/1781. To avoid legal obsolescence, stakeholders suggest excluding components such as motors or fans from the spare parts requirements in the component-specific regulations.

Though the need for an exclusion may be relevant, the consultants assume that ESPR cannot exclude certain parts from another regulation. Furthermore, should ESPR develop requirements on the availability of certain spare parts for repair, this aspect would need to be taken into consideration in future ESPR requirements for laundry machines.

Present Best Not Yet Available Technologies for commercial and industrial washing machines

Table 3-128: Overview of present BNAT for commercial washing machines in 2025.

2025 BNAT	Index Nr.	Description	Technology readiness level
Ultrasonic cleaning technology	WM-DO7	Ultrasonic waves (typically 20–400 kHz) are injected in the washing water to create small bubbles that quickly collapse and cause cavitation. This creates tiny shockwaves that dislodge dirt from textile surfaces.	Emerging technology in textile care but established in other industry sectors. TRL in laundry: 6 - 7 (technology demonstrated and some prototypes used in real-world commercial settings). Not yet widely adopted. **Initially considered as a Design Option**
Nano-Fibre Filtration Systems	WM-DO8	Filters made with nanofibres to capture microplastics and fine particles from wastewater.	New emerging BAT. TRL: 7 to 8 **Initially considered as a Design Option**
Phase-Change Materials (PCMs) for Heat Storage	--	PCMs that store and release heat during phase transitions (e.g., solid to liquid) can be used for load shifting: heat stored during off-peak hours helps reducing energy demand during peak hours.	TRL: 6 to 7 (PCM-based systems have been successfully tested in controlled pilot environments) Problematic integration within the scope of ESPR: requires separate infrastructure outside the body of a washing machine. Not considered as a Design Option

2025 BNAT	Index Nr.	Description	Technology readiness level
Biochemical Detergents with Enzyme Boosters	--	Novel enzymatic detergents that work effectively at lower temperatures. Reduced need for hot water without compromising cleanliness.	TRL 7 (System Prototype Demonstration in Operational Environment) Problematic integration within the scope of ESPR: addresses detergent industry (consumables) rather than laundry machine manufacturers. Not considered as a Design Option.

Description of new emerging BNAT as design option for commercial and industrial washing machines

Ultrasonic cleaning in commercial laundry

Ultrasonic cleaning technology is an innovation in commercial laundry systems that enhances fabric cleaning by using high-frequency sound waves, see for example analysis from (Sethi 2021) and (Choi et al.). These ultrasonic waves, typically in the range of 20–40 kHz, generate microscopic cavitation bubbles in water. When these bubbles collapse, they release intense localised energy that dislodges dirt, oils, and contaminants from fabric fibres without the need for harsh chemicals or high temperatures. In commercial laundry applications, ultrasonic systems are integrated into washing machines or pre-treatment units to improve stain removal, reduce water and detergent usage, and extend fabric life. This technology is considered especially valuable in healthcare, hospitality, and industrial settings where hygiene and textile preservation are critical.

According to recent developments, ultrasonic systems can reduce energy consumption by up to 50 % compared to conventional washers. In terms of detergent savings, ultrasonic cleaning can reduce chemical usage by 30 to 50 %, as the mechanical action of cavitation enhances the effectiveness of smaller amounts of detergent. Savings in water use are estimated at 30 % due to more efficient cleaning action (Sethi 2021).

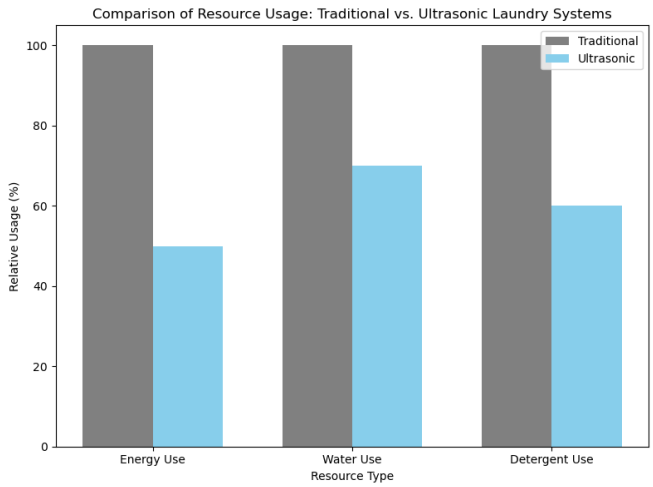

Figure 3-45: Comparison between ultrasonic cleaning and traditional washing methods in commercial laundry.

Source: (Sethi 2021)

Latest stakeholder feedback from the commercial sector on this technology, however, states that ultrasonic cleaning is not an option in front loaded washers where the water use has been optimised. Ultrasonic cleaning technology is not relevant due to the absorption for ultrasonic energy by fabrics and the need for full immersion in water, meaning it would require more water and energy compared to what frontloaded washers currently use. It is possible that it would work with a single small piece of fabric completely immersed in water which is, however, not how the commercial washers are designed. According to stakeholders of the commercial sector, ultrasonic is not a sustainable solution and would not be competitive from cost point of view.

Nano-Fibre Filtration Systems

Nano-fibre filtration is an emerging technology in commercial laundry systems designed to enhance water treatment and reduce the discharge of microplastics from broken synthetic textile fibres into wastewater. These systems use ultra-fine fibres – often less than 100 nanometres in diameter – to create dense, high-surface-area membranes capable of capturing microplastics, lint, and other fine particles that pass through conventional filters. In a laundry context, nano-fibre filters are typically integrated into the wastewater discharge line, where they trap contaminants before the water is either discharged or recycled. Some advanced systems also incorporate self-cleaning mechanisms and Internet of things (IoT) sensors to monitor the filter performance and predict maintenance needs, making them both efficient and low maintenance. Despite their fine structure, these filters maintain high flow rates with low pressure drops, ensuring energy-efficient operation (Kaya, Y., Dayanir, S. 2020).

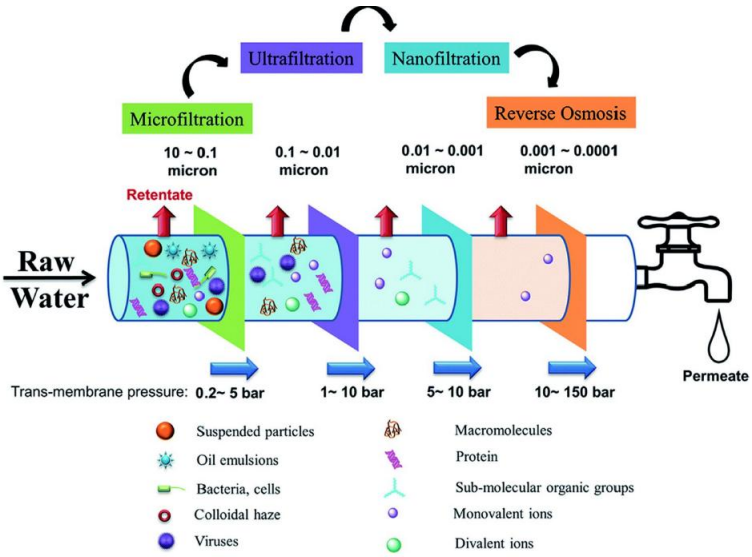

Figure 3-46: Nanofiltration technology in commercial laundry.

Source: (Namla et al. 2025)

This BNAT will not only help laundry facilities to comply in future with increasingly strict environmental regulations but also supports water reuse strategies by improving the quality of

recycled water. The high level of filtration supports effective water reuse, enabling facilities to recycle water safely and reduce overall consumption. Additionally, nano-fibre systems help commercial laundries to comply with emerging environmental regulations (particularly limit values regarding microplastic pollution) that is likely to be enacted on Member State law in line with the intention set out in the Urban Wastewater Treatment Directive 2024/3019 (recitals (28) and (37).

Latest stakeholder feedback points out that with regard to microplastics, it has not yet been determined what type of filters will be required. They emphasise that filters at the individual machine level do not make sense in professional settings, as machines must drain process water quickly and refill with fresh water - a process that is incompatible with filters installed on single machines.

Stakeholders also report that nano-fibre filtration systems have been investigated for capturing microplastics and fine particles from laundry wastewater. However, they note that laundry effluent contains a high load of dirt particles and loose fibres, which would cause nano-scale filters to clog rapidly, making it impossible to filter even a decilitre of effluent without prior treatment in a wastewater plant. According to the above referenced study, effective nano-filtration would require multiple filters with progressively smaller pores and individual pressure regulators between each stage. Stakeholders agree that such a setup might be feasible at the building or facility level, but it is not possible to integrate it into a single washing machine, especially those processing a high load of water in real time.

One stakeholder further highlights that although a standard for microplastic filtration is being developed by the working group WG17 at the CENELEC level, that even filters as large as 50 microns cannot be practically fitted into a single washer. They report that nano-fibre filtration systems have so far shown poor performance and are not a commercially realistic solution. Even if future technological advances make such systems commercially available, stakeholders argue it would still not be justified to integrate them into individual machines; at best, building-level wastewater treatment might be realistic. Therefore, they conclude that such technologies are out of scope for potential ESPR requirements for commercial and industrial Laundry.

3.5.2.2. Design Options for commercial and industrial dryers

Best Available Technologies (BAT) for commercial and industrial dryers

The list of DOs presented in the Lot 24 study (Graulich et al. 2011), encompassed seven BAT, referring to the state of the art in 2011, as well as BNAT, which were not yet market ready in 2011. **Table 3-129** shows the 2011-BAT for dryers and **Table 3-130** shows three BNAT that were considered possible DOs in 2011. For each design option, a brief description is provided (for more detailed explanation, see Graulich et al. (2011)). Moreover, the present state of adoption (ca. 13 years later) is indicated, based on information provided by stakeholders.

Table 3-129: Review of in 2011 Best Available Technologies for commercial and industrial dryers, based on the former preparatory study (2011).

Design Option	Index Nr. (2011)	Description	State of adoption as of 2025 according to stakeholder provided information
Increased motor efficiency	M 2.1	Slightly better energy performance	Motors have been upgraded according to and are following the motor regulations TRL: 9 Conclusion: No longer considered BAT
Heat pump	M 2.2	Saves a lot of energy	Slowly growing for smaller machines, not so common due to longer drying time. Heat pumps increasingly use hydrocarbon refrigerants, in particular in smaller machines with capacities below 12 kW, due to their energy efficiency and restrictions on fluorinated gases. Updated safety rules allow for larger charges of flammable refrigerants including hydrocarbons. TRL: 9 Conclusion: **still to be considered BAT**
Heat recovery systems	M 2.3	exhaust gas recirculation, recuperation, and adsorption-based thermal energy storage	Not so common TRL: 9 Conclusion: No longer considered BAT as they have long been part of generic industrial systems and can be adopted. Instead, active heat recovery by using heat pumps (M2.2) bears more innovation potential in the laundry sector.
Improved air flow systems	M 2.4	Saves energy Optimisation for different loads	Continuously developed, but no step changes. Existing fan regulations leads to improvements. See also specific comments below about Motors and Fans TRL: 9 Conclusion: No longer considered BAT
Load control	M 2.5	Can detect part loads and adjust input flows of energy (in practice only relevant for D1)	Not so common and very complex TRL: 9 Conclusion: **still to be considered BAT**
Residual moisture control – RMC	M 2.6	Less energy consumption Better laundry economy.	RMC is very common. Continuously developed, but no step changes TRL: 9 Conclusion: No longer considered BAT
Improved insulation	M 2.7	Saves energy by avoiding heat dissipation through machine casing	Have not been implemented since it´s too costly. Also, a safety risk. Limited applicability in categories D2,3,4 TRL: 9 Conclusion: No longer considered BAT

* For a technical description, please see Graulich et al. (2011)

Table 3-130: Review of in 2011 Best NOT yet Available Technologies for non-domestic dryers in 2011, based on the former preparatory study (2011).

2011-BNAT (review of 2012 study)*	Index Nr.	Description	State of adoption as of 2025 according to stakeholder provided information
Modulating Gas Dryers	--	Modulating natural gas burners adjust the flame intensity based on real-time drying needs so that the heat input rate to the drying drum is modulated to the moisture level of the load. Thus, the dryer requires less heat towards the end of the cycle.	TRL: 8 – 9 (The technology is commercially available and in regular use, indicating a high level of maturity. However, the level of adoption in commercial and industrial dryers is uncertain.) Conclusion: No longer considered BNAT **Now considered BAT -> considered as a Design Option**
Microwave dryer	--	Microwaves could be used to directly heat the moisture in the textiles -> improved heat distribution in the load and reduced heating time.	TRL: 6 -7 (While microwave drying technology is industrialised in other industry sectors, it is currently not widely used in commercial laundry dryers (Lee and Grassi). In addition to the technical challenges associated with the uniform distribution of microwave energy within mixed fabric loads, the high initial cost and the integration complexity with existing laundry systems are identified as factors hindering the adoption of this technology.) Conclusion: Still considered an emerging technology in the field of laundry dryers -> not considered a viable design option.
Vacuum condensation technology	--	Under reduced air pressure, water evaporates at lower temperature. Less energy is needed to create a vacuum than to heat the laundry.	TRL: 5 – 6 (Vacuum drying has been prototyped and tested in Lab or semi-operational environments but it has not yet been commercialised for laundry applications due to high equipment cost and technical complexity). Conclusion: Still considered an emerging technology in the field of laundry dryers -> not considered a viable Design Option.

Source: Graulich et al. (2011)

Based on the above and additional information reviewed by the consultant**, Table 3-131** specifies the DOs considered as BAT in the present study.

Table 3-131: PRESENT Best AVAILABLE Technologies for commercial and industrial dryers.

2025-BAT	Index Nr.	Description	State of adoption as of 2025 according to stakeholder information
Heat pump	D-DO1	See Table 3-129	adopted and updated from 2011 study* **considered as a Design Option**
Load control	D-DO2	See Table 3-129	adopted and updated from 2011 study* **considered as a Design Option**
Modulating Gas Dryers	D-DO3	See Table 3-130	TRL: 8 – 9 **considered as a Design Option**
Drum construction	D-DO4	Optimising the drum construction in commercial laundry dryers can significantly enhance airflow and moisture extraction. This improves energy efficiency, drying performance, fabric care, and machine longevity. - Optimised hole size/pattern - Variable perforation zones - Internal baffles or lifters - Spiral or helical airflow guides	TRL: 9 **Initially considered as a Design Option** US8042282B2 – Drum for Clothes Dryer (LG Electronics): https://patents.google.com/patent/US8042282B2/en

Source: Graulich et al. (2011)

Description of new emerging BAT for commercial and industrial dryers

Modulating Gas Dryers

Modulating gas dryers are increasingly used in commercial laundry operations due to their efficiency benefits. These dryers consume significantly less energy per load (2.2 kWh vs. 3.5 kWh) as compared to uncontrolled gas heating technology. Technically, they are based on advanced burner technology that adjusts the flame intensity based on real-time drying needs, rather than operating at a constant high heat. This modulation significantly reduces energy consumption: Approx. 37 % lower monthly energy usage. Modulating gas dryers moreover prevent overheating and help shortening drying cycles. Environmentally, this leads to lower greenhouse gas emissions and reduced fuel usage, contributing to a smaller carbon footprint. Additionally, the precise temperature control helps extend the lifespan of textiles, reducing waste and the need for frequent replacements. Overall, modulating gas dryers offer a sustainable solution for commercial and industrial laundry facilities, where substantial annual cost savings are possible (see e.g. (Scott 2023a)).

Drum construction

Innovations in drum construction for commercial laundry dryers have led to significant improvements in both performance and environmental impact. Modern drums are now designed with perforated stainless-steel surfaces, optimised airflow patterns, and reduced friction coatings, which enhance heat distribution and drying efficiency. The perforated stainless-steel surface in commercial laundry dryer drums is a key innovation that significantly enhances drying efficiency. These drums feature numerous small, evenly spaced holes that allow hot air to circulate more effectively through the fabric load, promoting faster and more uniform moisture evaporation. Some advanced models incorporate reversible drum rotation and sensor-driven moisture detection, ensuring even drying and preventing over-drying. These innovations reduce energy consumption by shortening cycle times and minimising heat loss. Environmentally, this translates to lower greenhouse gas emissions. Additionally, the smooth stainless steel and the pattern and shape of the perforations help to protect textiles from snags and wear, thus extending their usable life.

With regard to **drum construction (D-DO4)**, in their latest feedback to this report, however, stakeholders of commercial dryers state that it is not economically possible to make a drum with variable hole sizes, as drums are hardware and variable perforation zones or changing the hole patterns are not possible in hardware. Once the metal is perforated it cannot be changed with any type of means that are economically feasible. To make a drum with variable hole size, such as an aperture on a camera, would be very costly and cleaning them would not work. On the other hand, using drums with different hole sizes/patterns for different applications, that is already used according to stakeholder feedback. Drum construction has been finetuned for many years, and different manufacturers make variants already today. The assumption of the preparatory study that further design optimisation would improve performance significantly is not likely from a stakeholder perspective. According to stakeholder feedback, some design improvements considering the complete airflow system might be possible, however, the feedback did not include any further details of the underlying technical measures or suggested improvement potential.

Present Best NOT Yet Available Technologies (BNAT) for commercial and industrial dryers

Table 3-132 details DOs that have not yet matured and that are thus considered as BNAT. These DOs will not be analysed further.

Table 3-132: Overview of BNAT Design Options for commercial and industrial washing machines in 2025.

Design Option	Index Nr.	Description	Technology readiness level
Desiccant-Assisted Drying	--	Uses materials that absorb moisture (like silica gel) to pull water from clothes without heat. Desiccants would need to be regenerated by using heat, could perhaps be done with solar heat. Yet appears to be impractical for laundry drying.	TRL: 4 (only relevant at laboratory scale) Conclusion: Not considered a viable Design Option.
Electroosmotic Drying	--	Applies an electric field to move water molecules out of fabric.	TRL: 3 - 4 (Experimental proof of concept, only relevant at laboratory scale) Conclusion: Not considered a viable Design Option.

3.5.2.3. Summary of the selection of Design Options for commercial and industrial laundry appliances

A summary of the selected DOs in MEErP Task 6 is specified in **Table 3-133** below for commercial and industrial washing machines and in **Table 3-134** for commercial and industrial dryers.

Table 3-133: Summary of selected Design Options for commercial and industrial washing machines in 2025.

Design Option	Index Nr.	Description	Applicable to WM-categories
Heat recovery	WM-DO1	See Table 3-127	WM5
Load control	WM-DO2	See Table 3-127	WM1-5
Smart detergent dosing	WM-DO3	See Table 3-127	WM1-5
Extended time of spare part availability and repair support	WM-DO6	See Table 3-127	WM1-5
Discarded Design Option: Ozone technology	WM-DO4	See Table 3-127	---
Discarded Design Option: Drum construction / perforation design	WM-DO5	See Table 3-127	---
Discarded Design Option: Ultrasonic cleaning technology	WM-DO7	See Table 3-128	---

Design Option	Index Nr.	Description	Applicable to WM-categories
Discarded Design Option: Nano-Fibre Filtration Systems	WM-DO8	See Table 3-128	---

* For technical reasons, WM-DO8 cannot be parameterised for LCA because the main purpose of this design feature is the removal of microplastic from wastewater at the source. This environmental aspect is not adequately addressed in LCA on the one hand and on the other hand, there is currently no data available regarding the performance of such filters in practice.

Table 3-134: Summary of selected Design Options for commercial and industrial dryers in 2025.

Design Option	Index Nr.	Description	Applicable for dryer-categories
Heat pump	D-DO1	See Table 3-130	D1, smaller sizes of D2, D3, (D4); WM3 (drying function of the washer-dryer)
Smart load control	D-DO2	See Table 3-130	D1, D3
Modulating Gas Dryers	D-DO3	See Table 3-131	D1, D2, D4; WM3 (drying function of the washer-dryer)
Extended time of spare part availability and repair support	D--DO5	See Table 3-127	D1-4
Discarded Design Option: Drum construction/ perforation design	D-DO4	See Table 3-131	---

3.5.2.4. Stakeholder consultation process

Several online consultations as well as two stakeholder meetings were conducted during the preparatory study to collect information and input from stakeholders. The consultation phases included:

1) 17 May 2024 - 21 June 2024: questions addressed the scope and differentiation of commercial and industrial (at the time referred to as ‘professional’) laundry appliances.
2) 12 July 2024 and 30 August 2024: questions addressed MEErP Tasks 2, 3, and 4 including technical and user aspects.
3) 30 September 2024: First stakeholder meeting: presentation of interim results on MEErP Tasks 1, 2, 3, and 4 with focus on the definition of scope and technical / environmental improvement potentials of commercial and industrial (at the time referred to as “professional”) laundry appliances.
4) 12 October 2024 and 30 December 2024: Additional online consultation of meeting participants to collect written feedback on the MEErP Tasks 1, 2, 3, and 4 as well as further data for MEErP Tasks 5 and 6. The data requested included corresponding BOM, energy demand during the use phase, purchase price and initial lifetime.

5) 10 April 2025: Second stakeholder meeting: presentation of interim results on MEErP Task 5 as well as discussion on revised scope and differentiation of commercial and industrial laundry appliances MEErP Task 1 and discussion on DOs MEErP Task 6.
6) 1 May 2025 – 30 May 2025: Additional online consultation of meeting participants to collect information on SoCs as well as feedback on BAT/BNAT and DOs.
7) 15 September 2025: Stakeholder interaction on preparatory study report MEErP Task 6 and Task 7; online presentation of the Task 6 and Task 7 reports followed by a period for receiving written stakeholder input and further bilateral exchanges with members from APPLiA, ETCT, and ETSA.

The information received through the stakeholder consultations was limited. Generally, stakeholders did not provide concrete feedback on performance characteristics. It appears this is related to the lack of a suitable body of results from performance testing. Though the prior preparatory study (Graulich et al. 2011) recommended the development of performance standards to ensure the harmonisation of future performance data, it took over six years to develop such standards, and as their application is at present still voluntary, they are still not widely applied to this purpose. Against this background, the data that has been used to develop the BCs and that should have been used to analyse the DOs is considered uncertain.

The analysis of DOs presented in the next sections is thus based on values found in the literature, which have, however, often not been elicited in the context of the commercial and industrial laundry appliances. The initial parameters used in the analysis thus did not represent the actual expected environmental improvement but rather a hypothetical range of potential improvement. Stakeholder feedback received after the publication of the first draft of MEErP Task 6 on the selection of DOs and their improvement potential has been considered to revise the input parameters and LCA/LCC calculations. Concrete calculations could only be performed once data is available from performance test results that follow the available standards.

No information was provided regarding the implications of DOs for the BoM of the respective appliance categories. Given that the BOM vary widely even within each category (due to differences in size and weight), it was assumed that changes to the BoM are based on technical assumptions rather than measured data. Neither was data provided regarding costs of DOs (besides on D-DO1, a heat pump for dryers); thus, LCC calculations could not be undertaken on the basis of primary data.

3.5.3. Base Cases for the assessment of Design Options

The following section is dedicated to the presentation of the key input parameters for the nine BCs of commercial and industrial laundry appliances, and in addition their DOs.

MEErP Task 6 reflects the definition of categories as set out in MEErP Task 1 and builds on the BCs as defined in the previous MEErP Task 5. They do not represent individual real-world products but are instead an amalgamation of commercial and industrial laundry appliances that roughly fall in the same range of size or application characteristics. The types of BCs have been formulated and refined based on stakeholder input and expert judgement. This study has identified 5 BCs for the washing machines and 4 BCs for the dryers (**Table 3-135**). This number results from the high diversity of laundry appliances in the commercial and industrial

sectors, where individual appliances range from light duty ones, whose size and use patterns resemble household laundry appliances, to industrial sized but custom-built large-scale installations.

The main sources of the data used in the definition of BCs are the following two reports:

- Tasks 1-4 of this Preparatory Study,
- Preparatory studies for Ecodesign Requirements of Energy-using products – Lot 24: Professional Washing Machines, Dryers and Dishwashers – Part: Washing machines and dryers (Graulich et al. 2011).

Table 3-135: Overview of Base Cases for commercial and industrial washing machines and dryers.

Washing machines	Dryers
WM1: Light duty commercial washer extractor	D1: Light duty commercial tumble dryer
WM2: Commercial washer extractor	D2: Commercial tumble dryer
WM3: Commercial washer dryer	D3: Commercial cabinet dryer
WM4: Commercial barrier washer	D4: Industrial pass-through (transfer) tumble dryer
WM5: Industrial continuous tunnel washers	

3.5.3.1. Input parameters for Design Options of commercial and industrial washing machines

The following sub-sections summarise the initial performance parameters of the reference BC for each washing machine appliance category as presented and analysed in detail in MEErP Task 5, together with the revised performance parameters of the updated BCs which are based on data provided by the stakeholder APPLiA in June 2025. It was decided in MEErP Task 5 to use these revised inputs as the revised BC information for the subsequent tasks. Therefore, here in Task 6 the presumed changes of parameters due to implemented DOs refer to the updated BCs based on APPLiA's 2025 input.

Table 3-133 above specifies the details of the DOs and the washing machine categories to which they are applicable. On this basis, the following tables show the performance parameters used to analyse the DO for each appliance category.

WM1: Input parameters Design Options

Table 3-136 shows the initial performance parameters for light duty commercial washer extractors (WM1) alongside parameters that have been revised following input provided by APPLiA in June and October 2025 and the assumed changes in performance that the application of the various DOs is expected to result in. The average price is estimated to remain unchanged in consideration of the latest data provided by APPLiA based on the applicable DOs. For washing machine category WM1, the design option WM-DO6 (extended time of spare part availability and repair support) is expected to increase the appliance lifetime

by an average of 2 years, DO WM-DO2 (load control), is expected to affect the energy consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 20 % as found in literature, see following table. The accumulative effect is estimated to account for a 8 % reduction of energy consumption. Design option WM-DO2 (load control) is also expected to reduce the water consumption by up to 50 %. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 10 % (as stakeholders indicated that the overall reduction potential for water is technically limited). The accumulative effect is estimated to account for a 6 % reduction of water consumption. Design options WM-DO2 (load control) and WM-DO3 (smart detergent dosing) are both expected to affect the detergent consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 20 % as found in literature, see following table. The accumulative effect is estimated to account for a 8 % reduction of the detergent consumption.

Table 3-136: Design option parameters for WM1: Light duty commercial washer extractor.

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Data source	Base Case Task 5	Stakeholder Input by APPLiA (June 2025)	See table notes below
Nominal rated capacity (kg)	7	8	unchanged
Product weight (kg)	73.86	95; due to absence of more detailed data, the initial parameters of the reference BC were taken	unchanged; estimation: electronics doubled
Lifetime (years)	5.6	10	WM-DO6: +2 = 12 [(a)]
Average price (€)	2,136	2,000	unchanged [(d)]
Cycles per year	1,800	1,125	unchanged
Annual sales (mln units per year)	0.0243	unchanged	0.0202
Energy consumption wash (kWh/cycle)	0.7	1.28	= 1.178 non-cumulative average of -8 %[(a)] due to: WM-DO2: -14 % to -25 % [(b)]

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Water consumption (m^3/cycle)	0.04	0.07	= 0.067 non-cumulative average of -6 %[(a)] due to: WM-DO2: up to -50 % [(c)]
Detergent consumption (kg per cycle)	0.079	0.088	= 0.081 non-cumulative average of -8 %[(a)] due to: WM-DO2: -20 % to -30 % [(c)] WM-DO3: up to -20 % [(a)]
Cycle time (minutes)	45	79	unchanged

Sources: (a) estimate/assumption based on stakeholder feedback; (b) (Hangxing Washing Machinery 2025; Miele & Cie. KG 2015); (c) (Miele & Cie. KG, 2015; (Laundry and Cleaning News International 2016); (d) stakeholder feedback

WM2: Input parameters Design Options

Table 3-137 shows the initial performance parameters for commercial washer extractors (WM2) alongside parameters that have been revised following input provided by APPLiA in June and October 2025 and the assumed changes in performance that the application of the various DOs is expected to result in. WM-DO6 (extended time of spare part availability and repair support) is expected to increase the appliance lifetime by an average of 2 years. The average price including DOs is estimated to remain unchanged in consideration of the latest data provided by APPLiA based on the applicable DOs. DO WM-DO2 (load control)is expected to affect the energy consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 20 % as found in literature, see following table. WM-DO2 (load control) is also expected to reduce the water consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 10 % (as stakeholders indicated that the overall reduction potential for water is technically limited). The accumulative effect is estimated to account for a 6 % reduction of water consumption. Design options WM-DO2 (load control) and WM-DO3 (smart detergent dosing) are both expected to affect the detergent consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 20 % as found in literature, see following table. The accumulative effect is estimated to account for a 8 % reduction of the detergent consumption.

Table 3-137: Design option parameters for WM2: Commercial washer extractor.

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Data source	Base Case Task 5	Stakeholder Input by APPLiA (June 2025)	See table notes below
Nominal rated capacity (kg)	24	29	unchanged
Product weight (kg)	211	523; due to absence of more detailed data, the initial parameters of the reference BC were taken	unchanged; estimation: electronics doubled
Lifetime (years)	15.3	10	WM-DO6: +2 = 12 [a]
Average price (€)	34,775	9,000	unchanged[e]
Cycles per year	3,600	3,000	unchanged
Annual sales (mln units per year)	0.02	0.05	0.044
Energy consumption wash (kWh/cycle)	4.2	7.25	= 6.67 non-cumulative average of -8 %[a] due to: WM-DO2: -14 % to -25 % [c]
Water consumption (m^3/cycle)	0.30	0.26	= 0.244 non-cumulative average of -6 %[a] due to: WM-DO2: up to -50 % [c]
Detergent consumption (kg per cycle)	0.422	0.319	= 0.293 non-cumulative average of -8 %[a] due to: WM-DO2: -20 % [a] WM-DO3: -20 % to -40 % [d]
Cycle time (hours)	0.75	0.78	unchanged

Sources: (a) estimate/assumption based on stakeholder feedback; (b) (Cardis et al.; Hangxing Washing Machinery 2025; Miele & Cie. KG 2015) Click or tap here to enter text.; (c) (Hasek 2014; Miele & Cie. KG 2015; Pacific Gas and Electric Company 2009) (d) (Jay 2025; PSG Hydro n.d.) ; (e) stakeholder feedback

WM3: Input parameters Design Options

Table 3-138 shows the initial performance parameters for commercial washer dryers (WM3) alongside parameters that have been revised following input provided by APPLiA in June and October 2025 and the assumed changes in performance that the application of the various DOs is expected to achieve. For WM3, Design Option WM-DO6 (extended availability of spare parts and repair support) is expected to increase the appliance lifetime by an average of 2 years. The average price is estimated to increase by 1,500 Euro due to the installation of either a heat pump or a modulating gas dryer. Due to the double function of this machine, the energy consumption is affected both by the DOs developed for washing machines and by those for dryers at different levels. Design Option WM-DO2 (load control) is expected to lead

to an energy consumption reduction with decreasing consumption of the washing cycle by up to -5 % of the energy consumption. For the drying function, either D-DO1 (heat pump) is estimated to reduce the gas consumption of the drying function between -10 % to -20 %, or D-DO3 (modulating gas dryer) to reduce it by -14 %. The accumulative effect is estimated to account for a 20 % reduction of energy/gas consumption or a total of 8.9 kWh/cycle. WM-DO2 (load control) is also expected to reduce the water consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 10 % (as stakeholders indicated that the overall reduction potential for water is technically limited). The accumulative effect is estimated to account for a 6 % reduction of water consumption. Design options WM-DO2 (load control) and WM-DO3 (smart detergent dosing) are both expected to affect the detergent consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 20 % as found in literature, see following table. The accumulative effect is estimated to account for a 8 % reduction of the detergent consumption.

Table 3-138: Design option parameters for WM3: Commercial washer dryer.

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Data source	Base Case Task 5	Stakeholder Input by APPLiA (June 2025)	See table notes below
Nominal rated capacity (kg)	6	18	unchanged
Product weight (kg)	382	475	D-DO1: +10 kg stainless steel; estimation: electronics doubled [(a)]
Lifetime (years)	31.25	10	WM-DO6: +2 = 12 [(a)]
Average price (€)	12,200	13,000	14,500 [(a)]
Cycles per year	1,760	3,000	Unchanged
Annual sales (mln units per year)	0.000405	unchanged	0.00034
Energy consumption wash (kWh/cycle or MJ/cycle)	3.68	11.16	= 8.9 non-cumulative average of -20 % due to: WM-DO2: -14 % to -25 % [(b)] only for drying: D-DO1: -10 % to -20 % [(c),(d)] D-DO3: 14 % average gas savings [(e)]

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Water consumption (m^3/cycle)	0.05	0.18	= 0.169 non-cumulative average of -6 % due to: WM-DO2: -30 % to -50 % [f]
Detergent consumption (kg per cycle)	0.07	0.198	= 0.182 non-cumulative average of -8 % due to: WM-DO2 / WM-DO3: -20 % to -30 % [g]
Cycle time (hours)	1.25	**1.25**	unchanged

Sources: (a) estimate/assumption; (b) (Miele & Cie. KG 2015) (c) (El Fil and Garimella 2022); (d) (Goetzler et al. 2016); (e) (Scott 2023b); (f) (Laundrylux Inc. 2025); (g) (PSG Hydro n.d.);

WM4: Input parameters Design Options

Table 3-139 shows the initial performance parameters for commercial barrier washers (WM4) alongside parameters that have been revised following input provided by APPLiA in June 2025 and the assumed changes in performance that the application of the various DOs is expected to result in. WM-DO6 (extended availability of spare parts and repair support) is expected to increase the appliance lifetime by an average of 2 years. The average price is estimated to remain unchanged in consideration of the latest data provided by APPLiA based on the applicable DOs. DO WM-DO2 (load control) is expected to affect the energy consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 20 %. WM-DO2 (load control) is also expected to reduce the water consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 10 % (as stakeholders indicated that the overall reduction potential for water is technically limited). The accumulative effect is estimated to account for a 6 % reduction of water consumption. Design options WM-DO2 (load control) and WM-DO3 (smart detergent dosing) are both expected to affect the detergent consumption. Whereas latest stakeholder feedback indicated an improvement potential of 5 % for the market represented by APPLiA members (about 80 % of the market), the study consultants assumed that for the remaining 20 % of the market the improvement potential might be higher and considered an average improvement potential of 20 %. The accumulative effect is estimated to account for a 8 % reduction of the detergent consumption.

Table 3-139: Design option parameters for WM4: Commercial barrier washer.

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Data source	Base Case Task 5	Stakeholder Input by APPLiA (June 2025)	See table notes below
Nominal rated capacity (kg)	32	32	unchanged
Product weight (kg)	1,003	850	Unchanged
Lifetime (years)	20.5	10	WM-DO6: +2 = 12 [(a)]
Average price (€)	57,375	35,000	unchanged [(b)]
Cycles per year	2,200	3,000	unchanged
Annual sales (mln units per year)	0.001215	unchanged	0.00083
Energy consumption wash (kWh/cycle)	7.68	4.8	= 4.416 non-cumulative average of -8 % due to: WM-DO2: -5 % to -20 % [(a)]
Water consumption (m^3/cycle)	0.37	0.43	= 0.404 non-cumulative average of -6 % due to: WM-DO2: -5 % to -10 % [(a)]
Detergent consumption (kg per cycle)	0.41	0.352	= 0.324 non-cumulative average of -8 % due to: WM-DO2: -10 % to -20 % [(a)] WM-DO3: -20 % to -30 % [(a)]
Cycle time (hours)	1	0.88	unchanged

Sources: (a) estimate/assumption based on stakeholder feedback; (b) stakeholder feedback

WM5: Input parameters Design Options

Table 3-140 shows the initial performance parameters for industrial continuous tunnel washers (WM5) and the assumed changes in performance that the application of the various DOs is expected to result in. Stakeholders of the industry sector pointed out that the questionnaires of this preparatory study on machine sizes, end customers, and usage patterns were not applicable to the industrial sector and as a result of this limitation, no industrial data were collected. Therefore, the following parameters are based on assumptions of the study team. For WM5, DO WM-DO1 (heat recovery) is expected to affect the weight and composition of the appliance, adding 35 kg of stainless steel and 5 kg copper to the composition. WM-DO6 (extended availability of spare parts and repair service) is expected to increase the appliance lifetime by an average of 5 years. The average price is estimated at 590,000, assuming a small increase in relation to the 2011 study assumptions. The DO WM-DO1 (heat recovery) can affect the energy consumption by -50 % to -65 %; as industrial continuous tunnel washers are customised systems targeted at cost efficiency, the study team considers a rather

conservative total reduction potential of 5 % of the energy consumption or 363 kWh/cycle. The water consumption is estimated to decrease by DOs like load control (WM-DO2) or by installing water recycling systems that can recover and treat wastewater from laundry operations for reuse in subsequent washing cycles, see for example (Girbau 2024). As stakeholders indicated that the overall reduction potential for water within the washing machines is technically rather limited, the study team estimates a remaining reduction potential by 5 % or a combined 6.8 m^3/cycle. Detergent consumption of this category is affected by WM-DO3 (-10 % to -25 %), considering a decrease of 10 % or 9.2 kg/cycle for the further calculations.

Table 3-140: Design option parameters for WM5: Industrial continuous tunnel washer.

Description	Initial parameters: MEErP Task 5 reference Base Case	Parameters: Change due to DO
Data source	Base Case Task 5	See table notes below
Nominal rated capacity (kg/h)	1,500	unchanged
Product weight (kg)	12,120	WM-DO1: +35 kg stainless steel and +5 kg copper [(a)]
Lifetime (years)	13.7	WM-DO6: +5 = 18.7 [(a)]
Average price (€)	585,000	590,000 [(a)]
Cycles per year	3,000	unchanged
Annual sales (mln units per year)	0.00025	0.00015
Energy consumption wash (kWh/cycle)	382.5 (19.125 kWh/hour)	= 363.4 non-cumulative average of -5 % due to: WM-DO1: -50 % to -65 % [(b) (c)]
Water consumption (m^3/cycle)	7.0	= 6.7 non-cumulative average of -5 % due to: WM-DO2: up to -5 % [(a)]
Detergent consumption (kg per cycle)	10.20	= 9.18 non-cumulative average of -10 % due to: WM-DO3: -10 % to -25 % [(d)]
Cycle time (hours)	0.75	unchanged

Sources: (a) estimate/assumption; (b) (Imgon Business Marketing Agency 2020); (c) (CWS Workwear 2024); (d) (U.S. Department of Energy 2015; Vartex 2025)

3.5.3.2. Input parameters for Design Options of commercial and industrial dryers

The following sub-sections specify the assumed changes to the performance parameters for each drying appliance category, representing the current state of the art in comparison to the BCs analysed in MEErP Task 5. These changes are based on data provided by APPLiA in

June 2025, as well as on the presumed changes to the parameters when DOs are implemented.

Table 3-134 specifies the DO details and the dryer categories for which they are applicable. On its basis, the following tables show the performance parameters used to analyse the DO for each appliance category (BCs).

D1: Input parameters Design Options

Table 3-141 below shows the initial performance parameters for BC D1 (light duty commercial tumble dryers) alongside parameters that have been revised following input provided by APPLiA in June 2025 and the assumed changes in performance that the application of the various DOs is expected to result in. DO D-DO1 (heat pump) is expected to affect the weight and composition of the appliance, adding 5 kg of steel and 1 kg of copper to the composition. According to stakeholder feedback, the heat pump will add 50 % to the initial price. DO D-DO5 (extended spare part availability and repair service) is expected to increase the appliance lifetime by an average of 2 years. DOs D-DO1 (heat pump, -40 % to -60 %), D-DO2 (load control, -10 % to -30 %) and D-DO3 (modulating gas dryers, 14 % average gas savings) are all expected to affect the energy consumption at different levels. The combined effect is estimated to account for a 20 % reduction of energy consumption or a total of 1.73 kWh/cycle.

Table 3-141: Design option parameters for D1: Light duty commercial tumble dryer.

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Data source	Base Case Task 5	Stakeholder Input by APPLiA (June 2025)	See table notes below
Nominal rated capacity (kg)	6	9	unchanged
Product weight (kg)	60	57	D-DO1: +5 kg stainless steel +1 kg Cu [(a)]
Lifetime (years)	5.6	10	D-DO5: +2 = 12 [(a)]
Average price (€)	1,460	1,600	2,400 [(d)]
Cycles per year	1,800	750	unchanged
Annual sales (mln units per year)	0.008	0.016	0.0133
Energy consumption drying (kWh/cycle)	2.28	2.16	= 1.73 non-cumulative average of -20 % due to: D-DO1: -40 % to -65 % [(b)] D-DO2: -10 % to -30 % [(a)] D-DO3: 14 % average gas savings [(c)]

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Cycle time (hours)	0.67	2.75	might increase up to 200 minutes (3.3 h) with heat pump; it is assumed that the number of cycles per year will not be affected

Sources: (a) estimate/assumption; (b) (Electrolux Group 2024; Electrolux Professional 2023); (c) (Scott 2023a); (d) stakeholder feedback

D2: Input parameters Design Options

Table 3-142 shows the initial performance parameters for BC D2 (commercial tumble dryers) alongside parameters that have been revised following input provided by APPLiA in June and October 2025 and the assumed changes in performance that the application of the various DOs is expected to result in. The average price has initially been revised to 6,500 due to the new APPLiA data, based on DOs D-DO3 and D-DO4. According to latest stakeholder feedback, D-DO1 (heat pump) is also applicable to the smaller sizes of commercial tumble dryers; however, as the cycle time will increase significantly up to 200 minutes when changing to a heat pump, a heat pump is not suitable for larger machines with high throughput that rely on short cycle duration. For commercial tumble dryers a heat pump will add 50 % to the initial price according to stakeholder feedback. The study team estimates that a heat pump might be applicable to 50 % of this product category (small sizes); therefore, the changes in price (+3,000 Euro), the additional product weight (+5 kg stainless steel, +1 kg Cu) and energy savings potential due to a heat pump (-40 % to -60 %) will be set at half each. DO D-DO3 (modulating gas dryers, 14 % average gas savings) is also expected to affect the energy consumption. It is assumed that for BC D2 (commercial tumble dryers) either a heat pump (for the smaller machine sizes) or modulating gas dryers could be applied. The overall effect for this BC is estimated to account for a 10 % reduction of energy consumption. DO D-DO5 (extended spare part availability and repair service) is expected to increase the appliance lifetime by an average of 2 years.

Table 3-142: Design option parameters for D2: Commercial tumble dryer.

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Data source	Base Case Task 5	Stakeholder Input by APPLiA (June 2025)	See table notes below
Nominal rated capacity (kg)	32	37	unchanged
Product weight (kg)	57.2	290	D-DO1: +2.5 kg stainless steel +0.5 kg Cu [(a)]

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Lifetime (years)	21.6	15	D-DO5: +2 = 17 [a]
Average price (€)	8,700	6,000	7,500 [d]
Cycles per year	2,551	2,333	unchanged
Annual sales (mln units per year)	0.0077	0.051	0.045
Energy consumption drying (kWh/cycle)	27.9	23.3	= 20.97 non-cumulative average of -10 % due to: D-DO1: -20 % to -30 % [b] D-DO3: 14 % average gas savings [c]
Cycle time (hours)	0.67	0.5	might increase up to 200 minutes (3.3 h) with heat pump; it is assumed that the number of cycles per year will not be affected

Sources: (a) estimate/assumption; (b) (Electrolux Professional 2023); (c) (Scott 2023a); (d) stakeholder feedback

D3: Input parameters Design Options

Table 3-143 shows the initial performance parameters for BC D3 (commercial cabinet dryers) alongside parameters that have been revised following input provided by APPLiA in June and October 2025 and the assumed changes in performance that the application of the various DOs is expected to result in. For D3, the product weight is assumed to be affected by D-DO1 (heat pump), leading to an increase in weight of 5 kg stainless steel and 1 kg copper on average. D-DO5 (extended spare part availability and repair service) is expected to increase the appliance lifetime by an average of 2 years. The average price has been revised to 2,500 due to the APPLiA data. DOs D-DO1 (heat pump, -30 % to -50 %) and D-DO2 (load control, -10 % to -30 %) are both expected to affect the energy consumption with the combined effect estimated to account for a 10 % reduction of energy consumption or a total of 3.8 kWh/cycle. Stakeholders commented that no standard exists to measure the energy consumption of commercial cabinet dryers so that the estimates and calculations are not possible to be verified by them.

Table 3-143: Design option parameters for D3: Commercial cabinet dryer.

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Data source	Base Case Task 5	Stakeholder Input by APPLiA (June 2025)	See table notes below

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Nominal rated capacity (kg)	8	7	unchanged
Product weight (kg)	145	128	D-DO1: +5 kg stainless steel and +1 kg copper [(a)]
Lifetime (years)	31.25	10	D-DO5: +2 = 12 [(a)]
Average price (€)	2,800	2,000	2,500 [(a)]
Cycles per year	1,760	3,000	unchanged
Annual sales (mln units per year)	0.01	unchanged	0.0083
Energy consumption drying (kWh/cycle)	3.1	4.2	= 3.8 non-cumulative average of -10 % due to: D-DO1: -30 % to -50 % [(b)] D-DO2: -10 % to -30 % [(a)]
Cycle time (hours)	2.16	1.75	might increase up to 200 minutes (3.3 h) with heat pump; it is assumed that the number of cycles per year will not be affected

Sources: (a) estimate/assumption; (b) (Electrolux Professional 2023);

D4: Input parameters Design Options

Table 3-144 shows the initial performance parameters for Base Case D4 (industrial pass-through tumble dryers) and the assumed changes in performance that the application of DOs is expected to result in. Stakeholders of the industry sector pointed out that the questionnaires of this preparatory study on machine sizes, end customers, and usage patterns were not applicable to the industrial sector and as a result of this limitation, no industrial data were collected. Therefore, the following parameters are based on assumptions of the study team. As the product category is designed customised for the specific applications, there is no 'the one' design option. It is therefore assumed that improvement potential might be gained by either heat pumps, or heat recovery in case of a system approach (D-DO1) or modulating gas dryers (D-DO3, see for example (CLM Consolidated Laundry Machinery n.d.)). In a simple approach, the product weight is assumed to be affected by these DOs, leading to an increase in weight of 35 kg stainless steel and 5 kg copper on average. For commercial dryers, DO D-DO3 (modulating gas dryers) is expected to lead to an average reduction in gas consumption of -14 %, assuming that this technology and savings potential is also applicable to industrial pass-through tumble dryers. A more conservative reduction potential of 7 % of the gas consumption has been assumed by the study team for the calculations. DO D-DO5 (extended spare part availability and repair service) is expected to increase the appliance lifetime by an average of 5 years. The average price has been revised to 55,000 €, an assumed increase of +10 % due to the DOs.

Table 3-144: Design option parameters for D4: Industrial pass-through tumble dryer.

Description	Initial parameters: MEErP Task 5 reference Base Case	Parameters: Change due to DO
Data source	Base Case Task 5	See table notes below
Nominal rated capacity (kg/h)	400	unchanged
Product weight (kg)	2,871	D-DO3: +35 kg stainless steel and +5 kg copper [(a)]
Lifetime (years)	25	D-DO5: +5 = 30 [(a)]
Average price (€)	50,000	55,000 [(a)]
Cycles per year	3,000	unchanged
Annual sales (mln units per year)	0.0012	0,0011
Energy consumption drying (kWh/cycle)	272	= 253 average of -7 % due to: D-DO3: 14 % average gas savings [(b)]
Cycle time (hours)	0.33	unchanged

Sources: (a) estimate/assumption; (b) (Scott 2023a), related to commercial dryers

3.5.4. Environmental impact of Design Options and comparison to the respective Base Cases

This section covers the calculated environmental benefits and impact of the previously identified DOs for each BC. All relevant changes to input parameters per option are examined using the ERT to assess how each option affects the output values across all PEF impact categories. The updated ERT is used to model the environmental performance of each DO. The LCA of the DOs is assessed relative to the BC LCA established in Task 5. In the cases of WM1-4 and D1-3, the results of the sensitivity analysis are used for comparison, as these are considered to represent the cumulative effect of Best Available Technology (BAT) in 2025. All LCA results are set in relation to the total amount of dry textiles processed throughout the whole service life duration of the respective appliances, and values are normalised per 1 kg of dry textiles processed.

It is noteworthy that the results displayed below show the combined implementation of DOs per appliance category rather than individual impact of DOs. The DO identified in this study can only be meaningfully assessed in combination, as the technical feasibility of implementing individual DOs within the respective categories of laundry appliances could not be verified in detail. Stakeholders for example confirmed that WM-DO2 (load control) has to be paired with WM-DO3 (smart detergent dosing). The DO derived from literature exhibit a wide range of potential improvements in environmental performances. For the purpose of this study, rather conservative assumptions were applied when estimating their potential, as stakeholders repeatedly claimed that there is little room left for ecological optimisation, arguing that

commercial and industrial appliances are already operating at the technical/physical limits of their performance and are already optimised in this respect.

3.5.4.1. WM1: Environmental impact of Design Options

Table 3-145: Results for WM1: Environmental impact of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh	988	909	-8 %
Thermal energy (use phase)	MJ	1,724	1,586	-8 %
Water (use phase)	m^3	83.7	78.7	-6 %
Detergent (use phase)	kg	99	91	-8%
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	8.1E+02	7.5E+02	-8 %
Ozone depletion	kg CFC-11 eq.	1.1E-05	9.8E-06	-8 %
Human toxicity, cancer	CTUh	1.3E-06	1.2E-06	-10 %
Human toxicity, non-cancer	CTUh	1.1E-05	9.8E-06	-7 %
Particulate matter	disease incidence	4.2E-05	3.9E-05	-8 %
Ionising radiation, human health	kBq U235 eq.	2.1E+02	1.9E+02	-8 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.6E+00	1.5E+00	-8 %
Acidification	mol H+ eq.	2.8E+00	2.6E+00	-8 %
Eutrophication, terrestrial	mol N eq.	6.3E+00	5.8E+00	-8 %
Eutrophication, freshwater	kg P eq.	3.6E-02	3.3E-02	-7 %
Eutrophication, marine	kg N eq.	9.9E-01	9.1E-01	-8 %
Ecotoxicity, freshwater	CTUe	6.2E+03	5.7E+03	-8 %
Land use	pt	1.5E+04	1.3E+04	-12 %
Water use	m^3 water eq. of deprived water	1.8E+03	1.7E+03	-6 %
Resource use, minerals and metals	kg Sb eq.	4.7E-03	4.3E-03	-9 %
Resource use, fossils	MJ	1.3E+04	1.2E+04	-8 %

3.5.4.2. WM2: Environmental impact of Design Options

Table 3-146: Results for WM2: Environmental impact. of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh	13,237	12,177	-8 %
Thermal energy (use phase)	MJ	32,264	29,686	-8 %
Water (use phase)	m^3	783	736	-6 %
Detergent (use phase)	kg	957	880	-8 %
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options adopted in combination**	**% difference**
Climate change, total	kg CO_2 eq.	1.0E+04	9.5E+03	-8 %
Ozone depletion	kg CFC-11 eq.	1.0E-04	9.4E-05	-8 %
Human toxicity, cancer	CTUh	9.7E-06	8.9E-06	-8 %
Human toxicity, non-cancer	CTUh	1.1E-04	9.8E-05	-7 %
Particulate matter	disease incidence	4.4E-04	4.1E-04	-8 %
Ionising radiation, human health	kBq U235 eq.	2.7E+03	2.4E+03	-8 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.8E+01	1.7E+01	-8 %
Acidification	mol H+ eq.	3.2E+01	2.9E+01	-8 %
Eutrophication, terrestrial	mol N eq.	7.1E+01	6.5E+01	-8 %
Eutrophication, freshwater	kg P eq.	3.5E-01	3.2E-01	-7 %
Eutrophication, marine	kg N eq.	1.0E+01	9.7E+00	-8 %
Ecotoxicity, freshwater	CTUe	6.6E+04	6.1E+04	-8 %
Land use	pt	1.0E+05	9.0E+04	-10 %
Water use	m^3 water eq. of deprived water	1.7E+04	1.6E+04	-6 %
Resource use, minerals and metals	kg Sb eq.	4.0E-02	3.8E-02	-6 %
Resource use, fossils	MJ	1.7E+05	1.5E+05	-8 %

3.5.4.3. WM3: Environmental impact of Design Options

Table 3-147: Results for WM3: Environmental impact of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh	33,480	26,789	-20 %
Thermal energy (use phase)	MJ	--	--	--
Water (use phase)	m^3	540	508	-6 %
Detergent (use phase)	kg	594	546	-8 %
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	1.6E+04	1.3E+04	-18 %
Ozone depletion	kg CFC-11 eq.	6.8E-05	6.2E-05	-9 %
Human toxicity, cancer	CTUh	8.4E-06	7.6E-06	-9 %
Human toxicity, non-cancer	CTUh	1.1E-04	9.4E-05	-12 %
Particulate matter	disease incidence	6.2E-04	5.1E-04	-16 %
Ionising radiation, human health	kBq U235 eq.	6.1E+03	4.9E+03	-20 %
Photochemical ozone formation, human health	kg NMVOC eq.	2.8E+01	2.3E+01	-17 %
Acidification	mol H+ eq.	5.2E+01	4.3E+01	-18 %
Eutrophication, terrestrial	mol N eq.	1.1E+02	8.9E+01	-17 %
Eutrophication, freshwater	kg P eq.	2.4E-01	2.2E-01	-9 %
Eutrophication, marine	kg N eq.	1.3E+01	1.1E+01	-15 %
Ecotoxicity, freshwater	CTUe	9.0E+04	7.5E+04	-16 %
Land use	pt	1.8E+05	1.5E+05	-16 %
Water use	m^3 water eq. of deprived water	1.5E+04	1.4E+04	-11 %
Resource use, minerals and metals	kg Sb eq.	3.8E-02	3.7E-02	-5 %
Resource use, fossils	MJ	2.7E+05	2.2E+05	-19 %

3.5.4.4. WM4: Environmental impact of Design Options

Table 3-148: Results for WM4: Environmental impact of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh	2,361	2,173	-8 %
Thermal energy (use phase)	MJ	45,621	41,970	-8 %
Water (use phase)	m^3	1,277	1,212	-6 %
Detergent (use phase)	kg	1,056	972	-8 %
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	7.7E+03	7.1E+03	-8 %
Ozone depletion	kg CFC-11 eq.	1.2E-04	1.1E-04	-8 %
Human toxicity, cancer	CTUh	2.5E-05	2.2E-05	-12 %
Human toxicity, non-cancer	CTUh	1.4E-04	1.3E-04	-7 %
Particulate matter	disease incidence	4.0E-04	3.6E-04	-9 %
Ionising radiation, human health	kBq U235 eq.	8.5E+02	7.8E+02	-8 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.5E+01	1.3E+01	-8 %
Acidification	mol H+ eq.	2.4E+01	2.2E+01	-9 %
Eutrophication, terrestrial	mol N eq.	5.5E+01	5.0E+01	-8 %
Eutrophication, freshwater	kg P eq.	4.5E-01	4.2E-01	-7 %
Eutrophication, marine	kg N eq.	9.7E+00	8.9E+00	-8 %
Ecotoxicity, freshwater	CTUe	5.8E+04	5.3E+04	-8 %
Land use	pt	2.4E+05	2.1E+05	-14 %
Water use	m^3 water eq. of deprived water	2.5E+04	2.3E+04	-5 %
Resource use, minerals and metals	kg Sb eq.	1.0E-01	8.7E-02	-13 %
Resource use, fossils	MJ	1.1E+05	1.1E+05	-8 %

3.5.4.5. WM5: Environmental impact of Design Options

Table 3-149: Results for WM5: Environmental impact of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (Task 5)	Results with Design Options adopted	% difference
Total electricity consumption (use phase)	kWh	57,375	54,507	-5 %
Thermal energy (use phase)	MJ	4,131,000	3,924,447	-5 %
Water (use phase)	m^3	21,038	19,986	-5 %
Detergent (use phase)	kg	30,600	27,540	-10 %
PEF Impact categories	**Unit**	**Base Case (Task 5)**	**Results with Design Options adopted**	**% difference**
Climate change, total	kg CO_2 eq.	3.7E+05	3.5E+05	-6 %
Ozone depletion	kg CFC-11 eq.	3.2E-03	2.9E-03	-10 %
Human toxicity, cancer	CTUh	4.0E-04	3.4E-04	-15 %
Human toxicity, non-cancer	CTUh	2.7E-03	2.6E-03	-7 %
Particulate matter	disease incidence	1.0E-02	9.3E-03	-9 %
Ionising radiation, human health	kBq U235 eq.	2.3E+04	2.1E+04	-6 %
Photochemical ozone formation, human health	kg NMVOC eq.	4.6E+02	4.2E+02	-7 %
Acidification	mol H+ eq.	6.7E+02	6.1E+02	-9 %
Eutrophication, terrestrial	mol N eq.	1.6E+03	1.4E+03	-8 %
Eutrophication, freshwater	kg P eq.	1.1E+01	1.0E+01	-8 %
Eutrophication, marine	kg N eq.	2.7E+02	2.5E+02	-9 %
Ecotoxicity, freshwater	CTUe	1.5E+06	1.3E+06	-9 %
Land use	pt	2.9E+06	2.5E+06	-15 %
Water use	m^3 water eq. of deprived water	4.4E+05	4.2E+05	-6 %
Resource use, minerals and metals	kg Sb eq.	1.8E+00	1.6E+00	-11 %
Resource use, fossils	MJ	5.7E+06	5.4E+06	-6 %

3.5.4.6. D1: Environmental impact of Design Options

Table 3-150: Results for D1: Environmental impact of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (APPLiA update 2025)	Results with Design Options adopted	% difference
Total electricity consumption (use phase)	kWh	1,623	1,299	-20 %
Thermal energy (use phase)	MJ	--	--	--
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options adopted**	**% difference**
Climate change, total	kg CO_2 eq.	7.1E+02	5.7E+02	-20 %
Ozone depletion	kg CFC-11 eq.	2.8E-07	2.2E-07	-20 %
Human toxicity, cancer	CTUh	9.1E-07	8.5E-07	-7 %
Human toxicity, non-cancer	CTUh	3.0E-06	2.5E-06	-16 %
Particulate matter	disease incidence	2.5E-05	2.0E-05	-18 %
Ionising radiation, human health	kBq U235 eq.	2.9E+02	2.3E+02	-20 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.2E+00	9.6E-01	-19 %
Acidification	mol H+ eq.	2.3E+00	1.8E+00	-19 %
Eutrophication, terrestrial	mol N eq.	4.4E+00	3.6E+00	-19 %
Eutrophication, freshwater	kg P eq.	1.7E-03	1.4E-03	-19 %
Eutrophication, marine	kg N eq.	4.2E-01	3.4E-01	-19 %
Ecotoxicity, freshwater	CTUe	3.3E+03	2.7E+03	-19 %
Land use	pt	1.8E+04	1.9E+04	9 %
Water use	m^3 water eq. of deprived water	2.4E+02	1.9E+02	-19 %
Resource use, minerals and metals	kg Sb eq.	3.2E-03	3.2E-03	1 %
Resource use, fossils	MJ	1.2E+04	9.8E+03	-20 %

3.5.4.7. D2: Environmental impact of Design Options

Table 3-151: Results for D2: Environmental impact of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh	37,537	33,785	-10 %
Thermal energy (use phase)	MJ	63,833	57,451	-10 %
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	2.0E+04	1.8E+04	-10 %
Ozone depletion	kg CFC-11 eq.	6.1E-06	5.5E-06	-10 %
Human toxicity, cancer	CTUh	3.5E-06	3.2E-06	-9 %
Human toxicity, non-cancer	CTUh	5.7E-05	5.1E-05	-10 %
Particulate matter	disease incidence	5.2E-04	4.7E-04	-10 %
Ionising radiation, human health	kBq U235 eq.	6.8E+03	6.1E+03	-10 %
Photochemical ozone formation, human health	kg NMVOC eq.	2.9E+01	2.6E+01	-10 %
Acidification	mol H+ eq.	5.0E+01	4.5E+01	-10 %
Eutrophication, terrestrial	mol N eq.	1.0E+02	9.2E+01	-10 %
Eutrophication, freshwater	kg P eq.	5.6E-02	5.1E-02	-10 %
Eutrophication, marine	kg N eq.	9.8E+00	8.8E+00	-10 %
Ecotoxicity, freshwater	CTUe	7.4E+04	6.6E+04	-10 %
Land use	pt	7.9E+04	7.6E+04	-4 %
Water use	m^3 water eq. of deprived water	5.4E+03	4.9E+03	-10 %
Resource use, minerals and metals	kg Sb eq.	1.4E-02	1.3E-02	-7 %
Resource use, fossils	MJ	3.4E+05	3.0E+05	-10 %

3.5.4.8. D3: Environmental impact of Design Options

Table 3-152: Results for D3: Environmental impact of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh	12,602	11,342	-10 %
Thermal energy (use phase)	MJ	--	--	--
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	5.3E+03	4.8E+03	-10 %
Ozone depletion	kg CFC-11 eq.	2.0E-06	1.8E-06	-10 %
Human toxicity, cancer	CTUh	1.0E-06	9.9E-07	-1 %
Human toxicity, non-cancer	CTUh	1.9E-05	1.7E-05	-10 %
Particulate matter	disease incidence	1.7E-04	1.5E-04	-10 %
Ionising radiation, human health	kBq U235 eq.	2.3E+03	2.0E+03	-10 %
Photochemical ozone formation, human health	kg NMVOC eq.	8.8E+00	7.9E+00	-10 %
Acidification	mol H+ eq.	1.6E+01	1.5E+01	-10 %
Eutrophication, terrestrial	mol N eq.	3.3E+01	2.9E+01	-10 %
Eutrophication, freshwater	kg P eq.	1.1E-02	1.0E-02	-10 %
Eutrophication, marine	kg N eq.	3.1E+00	2.8E+00	-10 %
Ecotoxicity, freshwater	CTUe	2.5E+04	2.2E+04	-10 %
Land use	pt	3.2E+04	3.3E+04	3 %
Water use	m^3 water eq. of deprived water	1.8E+03	1.6E+03	-10 %
Resource use, minerals and metals	kg Sb eq.	3.9E-03	3.9E-03	0 %
Resource use, fossils	MJ	9.3E+04	8.3E+04	-10 %

3.5.4.9. D4: Environmental impact of Design Options

Table 3-153: Results for D4: Environmental impact of Design Options compared to Base Case per product per year of use.

Consumption	Unit	Base Case (Task 5)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh / kg	89,760	83,490	-7 %
Thermal energy (use phase)	MJ	2,752,067	2,559,422	-7 %
PEF Impact categories	**Unit**	**Base Case (Task 5)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	2.2E+05	2.0E+05	-7 %
Ozone depletion	kg CFC-11 eq.	2.5E-05	2.3E-05	-7 %
Human toxicity, cancer	CTUh	2.4E-05	2.2E-05	-6 %
Human toxicity, non-cancer	CTUh	2.8E-04	2.6E-04	-7 %
Particulate matter	disease incidence	2.1E-03	2.0E-03	-7 %
Ionising radiation, human health	kBq U235 eq.	1.9E+04	1.8E+04	-7 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.8E+02	1.7E+02	-7 %
Acidification	mol H+ eq.	2.2E+02	2.0E+02	-7 %
Eutrophication, terrestrial	mol N eq.	4.6E+02	4.3E+02	-7 %
Eutrophication, freshwater	kg P eq.	1.1E+00	1.0E+00	-7 %
Eutrophication, marine	kg N eq.	5.1E+01	4.8E+01	-7 %
Ecotoxicity, freshwater	CTUe	2.6E+05	2.4E+05	-7 %
Land use	pt	2.2E+05	2.1E+05	-3 %
Water use	m^3 water eq. of deprived water	1.5E+04	1.4E+04	-7 %
Resource use, minerals and metals	kg Sb eq.	3.6E-01	3.4E-01	-7 %
Resource use, fossils	MJ	3.4E+06	3.2E+06	-7 %

3.5.4.10. Further discussion on Design Options not assessed by means of LCA

Concerning the environmental impact of the majority of the considered DOs, quantification is generally impeded by the absence of primary data with regard to the performance parameters of the respective BCs, in addition to the uncertainty of the improvement potentials of each DO in the context of each appliance categories. Literature data on BAT and emerging technologies are seldom sufficiently specific to distinguish between the results of their implementation in different appliance categories. Some DOs show different improvement potentials depending on the appliance category they are used in. For instance, the implementation of smart load control is rather effective within the context of scenarios where mixed laundry and/or partial

loads are the norm, as evidenced by the utilisation of the WM1 and D1 use cases. In other commercial and industrial contexts, it can be assumed that partial loads are more seldom the case

Regarding smart load control, introducing AI-based functions in laundry appliances—such as load detection, fabric recognition, or predictive maintenance—are increasingly being powered by machine learning models that rely on cloud computing. These models often require substantial computational resources, which exceed the processing capacity of the appliance's control unit and are therefore typically provided by remote data centres connected via the Internet. Although the outsourcing of AI processing can improve the performance, convenience and energy efficiency of laundry appliances, it creates a systemic trade-off between potential energy savings at the level of laundry appliances and the growing energy consumption of cloud infrastructure. As cloud data centres that process AI tasks consume a lot of energy, this may merely shift energy consumption rather than reducing it overall. Consequently, the total energy saving potential of using AI may be lower than expected. However, data centres and their energy consumption are beyond the scope of this study even if they serve the function of modern laundry appliances. Nevertheless, before adopting AI-powered laundry control as a DO, it is recommendable to assess these aspects in better detail, taking into account primary data on the energy consumption in both domains (laundry appliance and AI-data centres).

3.5.5. Impact on Life Cycle Costs of selected Design Options

There was an insufficient body of publicly available data on the costs and market prices of the individual design options for commercial and industrial laundry appliances. Therefore, the evaluation of the financial implications of specific design alternatives with the objective of enhancing environmental quality was conducted based on estimated data which were partly adjusted according to stakeholder feedback.

3.5.5.1. WM1: LCC impact of Design Options

Table 3-154: Results for WM1: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Lifetime expectancy	years	10	12	+20 %
Product price	EUR	2,000	2,000	0 %
	EUR/year	200	167	-16.7 %
Installation/acquisition costs	EUR	80	80	0 %
Natural gas (for heat)	EUR/year	36	33	-9.6 %
Electricity	EUR/year	209	189	-9.6 %
Water	EUR/year	145	134	-7.6 %
Detergent costs	EUR/year	368	333	-9.6 %

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Repair & maintenance costs	EUR	60	60	0 %
	EUR/year	6.0	5.0	-12.5 %
Total	**EUR/year**	**973**	**868**	**-10.8 %**

3.5.5.2. WM2: LCC impact of Design Options

Table 3-155: Results for WM2: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Lifetime expectancy	years	10	12	+20 %
Product price	EUR	9,000	9,000	0 %
	EUR/year	900	750	-16.7 %
Installation/ acquisition costs	EUR	360	360	0 %
Natural gas (for heat)	EUR/year	676	602	-11 %
Electricity	EUR/year	2,824	2,513	-11 %
Water	EUR/year	1,363	1,240	-9.1 %
Detergent costs	EUR/year	3,254	2,896	-11 %
Repair & maintenance costs	EUR	270	270	0 %
	EUR/year	27	22.5	-16.7 %
Total	**EUR/year**	**9,081**	**7,964**	**-11.3 %**

3.5.5.3. WM3: LCC impact of Design Options

Table 3-156: Results for WM3: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Lifetime expectancy	years	10	12	+20 %
Product price	EUR	13,000	14,500	+11.5 %
	EUR/year	1,300	1,208	-7 %
Installation/ acquisition costs	EUR	520	580	+11.5 %
Natural gas (for heat)	EUR/year	0	0	0 %
Electricity	EUR/year	7,191	5,655	-21 %
Water	EUR/year	947	875	-7.6 %

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Detergent costs	EUR/year	2,781	2,515	-9.6 %
Repair & maintenance costs	EUR	390	435	+11.5 %
	EUR/year	39	36	-7.7 %
Total	**EUR/year**	**12,309**	**10,338**	**-16 %**

3.5.5.4. WM4: LCC impact of Design Options

Table 3-157: Results for WM4: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Lifetime expectancy	years	10	12	+20 %
Product price	EUR	35,000	35,000	0 %
	EUR/year	3,500	2,917	-17 %
Installation/ acquisition costs	EUR	1,400	1,400	0 %
Natural gas (for heat)	EUR/year	947	855	-9.70 %
Electricity	EUR/year	499	451	-9.6 %
Water	EUR/year	2,201	2,052	-6.7 %
Detergent costs	EUR/year	4,861	4,391	-9.7 %
Repair & maintenance costs	EUR	8,750	8,750	0 %
	EUR/year	875	729	-17 %
Total	**EUR/year**	**13,023**	**11,512**	**-11.6 %**

3.5.5.5. WM5: LCC impact of Design Options

Table 3-158: Results for WM5: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (Task 5)	Results with Design Options	% difference
Lifetime expectancy	years	13.7	18.7	+36 %
Product price	EUR	585,000	590,000	+0.9 %
	EUR/year	42,700	31,551	-26 %

Cost category	Unit	Base Case (Task 5)	Results with Design Options	% difference
Installation/ acquisition costs	EUR	52,650	53,100	+0.9 %
Natural gas (for heat)	EUR/year	84,420	77,137	-8.6 %
Electricity	EUR/year	11,929	10,900	-8.6 %
Water	EUR/year	35,702	32,622	-8.6 %
Detergent costs	EUR/year	280,042	242,415	-13.4 %
Repair & maintenance costs	EUR	146,250	147,500	+0.9 %
	EUR/year	10,675	7,888	-26 %
Total	**EUR/year**	**469,312**	**405,352**	**-13.6 %**

3.5.5.6. D1: LCC impact of Design Options

Table 3-159: Results for D1: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Lifetime expectancy	years	10	12	+20 %
Product price	EUR	1,600	2,400	+50 %
	EUR/year	160	200	+25 %
Installation/ acquisition costs	EUR	64	96	+50 %
Natural gas (for heat)	EUR/year	0	0	0 %
Electricity	EUR/year	353	279	-21 %
Repair & maintenance costs	EUR	48	72	+50 %
	EUR/year	4.8	6.0	+25 %
Total	**EUR/year**	**524**	**493**	**-6 %**

3.5.5.7. D2: LCC impact of Design Options

Table 3-160: Results for D2: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Lifetime expectancy	years	15	17	+13 %
Product price	EUR	6,000	7,500	+25 %
	EUR/year	400	441	+10 %
Installation/ acquisition costs	EUR	240	300	+25 %
Natural gas (for heat)	EUR/year	1,328	1,181	-11 %
Electricity	EUR/year	7,947	7,065	-11 %
Repair & maintenance costs	EUR	180	225	+25 %
	EUR/year	12.0	13.0	+8 %
Total	**EUR/year**	**9,703**	**8,718**	**-10 %**

3.5.5.8. D3: LCC impact of Design Options

Table 3-161: Results for D3: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Lifetime expectancy	years	10	12	+20 %
Product price	EUR	2,000	2,500	+25 %
	EUR/year	200	208	+4 %
Installation/ acquisition costs	EUR	80	100	+25 %
Natural gas (for heat)	EUR/year	0	0	0 %
Electricity	EUR/year	3,225	2,951	-8 %
Repair & maintenance costs	EUR	60	75	+25 %
	EUR/year	6.0	6.0	0 %
Total	**EUR/year**	**3,439**	**3,174**	**-7.7 %**

3.5.5.9. D4: LCC impact of Design Options

Table 3-162: Results for D4: Life Cycle Costing impact of Design Options compared to Base Case.

Cost category	Unit	Base Case (Task 5)	Results with Design Options	% difference
Lifetime expectancy	years	25	30	+20 %
Product price	EUR	50,000	55,000	+10 %
	EUR/year	2,000	1,833	-8 %
Installation/ acquisition costs	EUR	4,500	4,950	+10 %
Natural gas (for heat)	EUR/year	56,033	50,933	-9 %
Electricity	EUR/year	18,593	16,901	-9 %
Repair & maintenance costs	EUR	9,000	9,900	+10 %
	EUR/year	360	330	-8 %
Total	**EUR/year**	**77,166**	**70,163**	**-9 %**

3.5.6. Summary of results – Impact of Design Options

This section contains an overview of both the environmental effects and LCC outcomes of the selected DOs to identify potential policy recommendations.

Further, the annualised LCC are summarised from the data previously presented in this report. This is because discount rates and present-worth calculations are applied internally by the ERT. The total yearly costs are presented for the selected DOs per BC, enabling a like-for-like comparison of annualised LCC. Discounting and present-worth conversion are both conducted within the ERT, thus resulting in the reporting of solely the total annual cost figures. This is due to the fact that they offer the most accurate representation of life-cycle cost at present.

3.5.6.1. Overview of environmental and economic impact of Design Options per washing machine Base Case

The following tables contain an overview of the effect the DOs have on the original BCs of commercial and industrial washing machines in terms of environmental impact expressed in energy/water/detergent consumption and the 16 PEF impact categories (**Table 3-163**) and the total yearly LCC (

Table 3-164). The effect is expressed in percentage difference, where a negative value indicates a reduction in the environmental impact and resources consumption or LCC respectively.

Table 3-163: Percentage change in environmental impact for washing machine Design Options compared to the original Base Cases.

PEF Impact category / Consumption	WM1 - DO	WM2 - DO	WM3 - DO	WM4 - DO	WM5 - DO
Total electricity consumption / thermal energy (use phase)	-8 %	-8 %	-20 %	-8 %	-5 %
Water (use phase)	-6 %	-6 %	-6 %	-6 %	-5 %
Detergent (use phase)	-8 %	-8 %	-8 %	-8 %	-10 %
Climate change, total	-8 %	-9 %	-18 %	-8 %	-6 %
Ozone depletion	-8 %	-8 %	-9 %	-8 %	-10 %
Human toxicity, cancer	-10 %	-8 %	-9 %	-12 %	-15 %
Human toxicity, non-cancer	-7 %	-8 %	-12 %	-7 %	-7 %
Particulate matter	-8 %	-7 %	-16 %	-9 %	-9 %
Ionising radiation, human health	-8 %	-8 %	-20 %	-8 %	-6 %
Photochemical ozone formation, human health	-8 %	-8 %	-17 %	-8 %	-7 %
Acidification	-8 %	-8 %	-18 %	-9 %	-9 %
Eutrophication, terrestrial	-8 %	-8 %	-17 %	-8 %	-8 %
Eutrophication, freshwater	-7 %	-8 %	-9 %	-7 %	-8 %
Eutrophication, marine	-8 %	-7 %	-15 %	-8 %	-9 %
Ecotoxicity, freshwater	-8 %	-8 %	-16 %	-8 %	-9 %
Land use	-12 %	-8 %	-16 %	-14 %	-15 %
Water use	-6 %	-10 %	-11 %	-5 %	-6 %
Resource use, minerals and metals	-9 %	-6 %	-5 %	-13 %	-11 %
Resource use, fossils	-8 %	-6 %	-19 %	-8 %	-6 %

Table 3-164: Total yearly costs of Design Options in EUR per washing machine Base Case.

BC		Total costs (EUR/year)	Difference (%)
WM1	Reference	973	0 %
	DO	868	-10.8 %
WM2	Reference	9,081	0 %
	DO	8,053	-11.3 %
WM3	Reference	12,309	0 %
	DO	10,338	-16.0 %
WM4	Reference	13,023	0 %
	DO	11,512	-11.6 %
WM5	Reference	469,312	0 %
	DO	405,352	-13.6 %

The following tables contain an overview of the effect the DOs have on the original BCs of commercial and industrial dryers in terms of environmental impact expressed in energy/water/detergent consumption and the 16 PEF impact categories (**Table 3-165**) and the total yearly LCC (**Table 3-166**). The effect is expressed in percentage difference, where a negative value indicates a reduction in the environmental impact and resources consumption or LCC respectively.

Table 3-165: Percentage change in environmental impact for dryer Design Options compared to the original Base Cases.

PEF Impact category / Consumption	D1 - DO	D2 - DO	D3 - DO	D4 - DO
Total energy consumption	-20 %	-10 %	-10 %	-7 %
Climate change, total	-20 %	-10 %	-10 %	-7 %
Ozone depletion	-7 %	-10 %	-10 %	-7 %
Human toxicity, cancer	-16 %	-9 %	-1 %	-6 %
Human toxicity, non-cancer	-18 %	-10 %	-10 %	-7 %
Particulate matter	-20 %	-10 %	-10 %	-7 %
Ionising radiation, human health	-19 %	-10 %	-10 %	-7 %

PEF Impact category / Consumption	D1 - DO	D2 - DO	D3 - DO	D4 - DO
Photochemical ozone formation, human health	-19 %	-10 %	-10 %	-7 %
Acidification	-19 %	-10 %	-10 %	-7 %
Eutrophication, terrestrial	-19 %	-10 %	-10 %	-7 %
Eutrophication, freshwater	-19 %	-10 %	-10 %	-7 %
Eutrophication, marine	-19 %	-10 %	-10 %	-7 %
Ecotoxicity, freshwater	9 %	-10 %	-10 %	-7 %
Land use	-19 %	-4 %	3 %	-3 %
Water use	1 %	-10 %	-10 %	-7 %
Resource use, minerals and metals	-20 %	-7 %	0 %	-7 %
Resource use, fossils	-20 %	-10 %	-10 %	-7 %

Table 3-166: Total yearly costs of Design Options in EUR per dryer Base Case.

BC		Total costs (EUR/year)	Difference (%)
D1	Reference	524	0 %
	DO	493	-6.0 %
D2	Reference	9,703	0 %
	DO	8,718	-10.2 %
D3	Reference	3,439	0 %
	DO	3,174	-7.7 %
D4	Reference	77,166	0 %
	DO	70,163	-9.1 %

3.5.6.2. Overview of PEF single score and LCC results

Calculation method PEF single score

In this section, both environmental impacts and LCC results are analysed in combination to determine if there is a savings potential of the proposed design options that allows the

conclusion to follow-up with policy measures on these product categories (see following Task 7). Since the design options address the product aspects outlined in Article 5(1) of the ESPR, the full range of environmental impacts must be evaluated to ensure a balanced assessment. Incorporation of multiple aspects into the framework makes it possible for a design option to perform significantly better in one impact category while underperforming in others. A narrow focus on one or two categories, such as GHG emissions only, would introduce bias into the comparison and overlook trade-offs across the remaining impact categories.

To address this, the Product Environmental Footprint (PEF) single-score methodology is applied, transforming the impact category results (as previously shown) into a single, normalised, weighted indicator. By aggregating climate change, toxicity, eutrophication, land use, and other life cycle impacts into one score, design alternatives can be ranked according to their overall environmental performance.

When these PEF single scores are plotted alongside their corresponding LCC, a clear comparison against the BC is revealed. If the selected DOs have lower PEF single scores and cost profiles compared to the BC, they may then be prioritised for inclusion in the new ESPR Ecodesign requirements. Prior to presenting the analysis, the single-score method will be explained and the scores for the BC and DOs will be reported.

The PEF single score is calculated as follows:

$$PEF\ single\ score = \sum_{i=1}^{16} Ii * \frac{WFi}{NFi}$$

With: I = calculated impact for PEF impact category (e.g. climate change, acidification, etc).

Wf = Weighting factor for PEF impact category

Nf = Normalisation factor PEF impact category

The weighting factor reflects the relative importance of the impact category, and the normalisation factor anchors each impact to a per-capita baseline. The most recent set of weighting and normalisation factors was released in 2023 by the Joint Research Centre (Andreasi Bassi et al. 2023), which builds on the original factors in Annex I of the Commission Recommendation (EU) 2021/2279 (European Commission 2021). The factors used for calculating the single score is included in **Table 3-167**.

Table 3-167: PEF Single score normalisation factors and weighting factors per PEF impact category.

Impact categories	Unit	Nf	Wf
Climate change	kg CO_2 eq./person	7.55E+03	21.06 %
Ozone depletion	kg CFC-11 eq./person	5.23E-02	6.31 %
Human toxicity, cancer	CTUh/person	1.73E-05	2.13 %
Human toxicity, non-cancer	CTUh/person	1.29E-04	1.84 %

Particulate matter	disease incidences/person	5.95E-04	8.96 %
Ionising radiation	kBq U-235 eq./person	4.22E+03	5.01 %
Photochemical ozone formation	kg NMVOC eq./person	4.09E+01	4.78 %
Acidification	mol H^+ eq./person	5.56E+01	6.20 %
Eutrophication, terrestrial	mol N eq./person	1.77E+02	3.71 %
Eutrophication, freshwater	kg P eq./person	1.61E+00	2.80 %
Eutrophication, marine	kg N eq./person	1.95E+01	2.96 %
Ecotoxicity, freshwater	CTUe/person	5.67E+04	1.92 %
Land use	pt/person	8.19E+05	7.94 %
Water use	m^3 water eq. of deprived water/person	1.15E+04	8.51 %
Resource use, minerals and metals	kg Sb eq./person	6.36E-02	7.55 %
Resource use, fossils	MJ/person	6.50E+04	8.32 %

PEF single score per Base Case and Design Options

The purpose of PEF single scores is to provide comparable weighted values across all 16 PEF impact categories, where a higher single score indicates a greater environmental impact (**Table 3-168**). Therefore, PEF single scores were calculated for each of the BCs, aggregating impacts across all life-cycle stages over the product's entire lifetime and per year of use. The same scoring system was then applied to the selected DOs within each BC, enabling a like-for-like comparison of overall environmental performance.

Although the ERT already calculates all sixteen PEF impact categories and provides the necessary inputs for single-score calculation, it doesn't perform a full, PEF-aligned LCA study. Therefore, scores derived from the tool should be treated as an indicative guidance rather than as a comprehensive PEF assessment when comparing results. Finally, the PEF single score approach has been developed to potentially compare the impact of products to standard benchmark values for specific product categories, calculated following product specific PEF Category Rules. However, there is no current standard scale for broader comparison outside this study for the product category of commercial and industrial washing machines and dryers.

Table 3-168: PEF Single score of selected Design options for each Base Case per year of use.

BC	PEF Single Score Reference Base Case	PEF Single Score Base Case with Design Options	% Difference
WM1 Light duty commercial washer extractor	0.082	0.076	-8.0 %
WM2 Commercial washer extractor	0.927	0.857	-7.5 %
WM3 Commercial washer dryer	1.32	1.10	-16.9 %

BC	PEF Single Score Reference Base Case	PEF Single Score Base Case with Design Options	% Difference
WM4 Commercial barrier washer	0.91	0.83	-8.6 %
WM5 Industrial continuous tunnel washer	28.83	26.81	-7.0 %
D1 Light duty commercial tumble dryer	0.058	0.048	-17.0 %
D2 Commercial tumble dryer	1.37	1.24	-9.9 %
D3 Commercial cabinet dryer	0.393	0.355	-9.8 %
D4 Industrial pass-through (transfer) tumble dryer	12.32	11.46	-7.0 %

Evaluation of selected design options per Base Case

WM1: Light duty commercial washer extractor

Below (**Figure 3-47**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

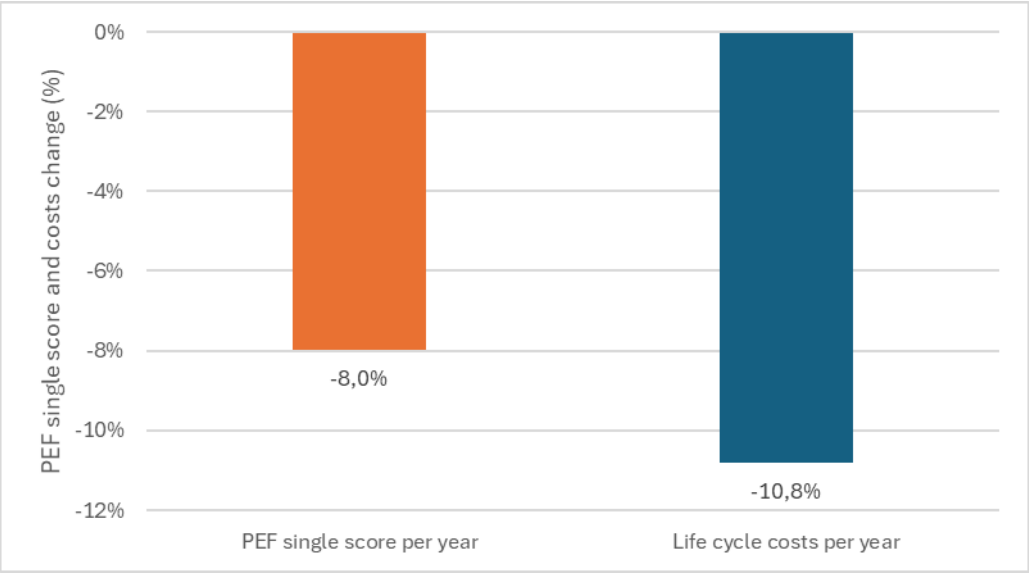

Figure 3-47: WM1 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

WM2: Commercial washer extractor

Below (**Figure 3-48**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

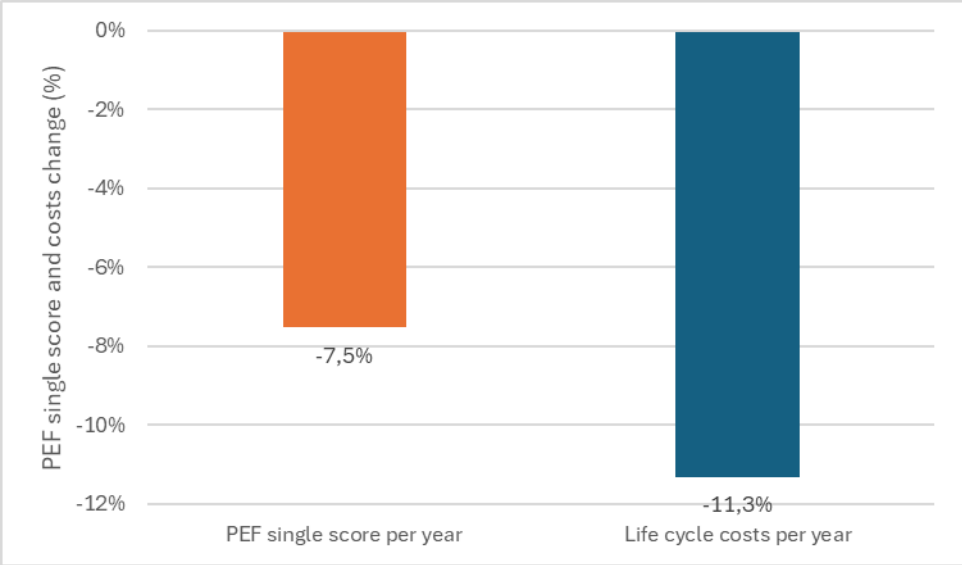

Figure 3-48: WM2 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

WM3: Commercial washer dryer

Below (**Figure 3-49**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

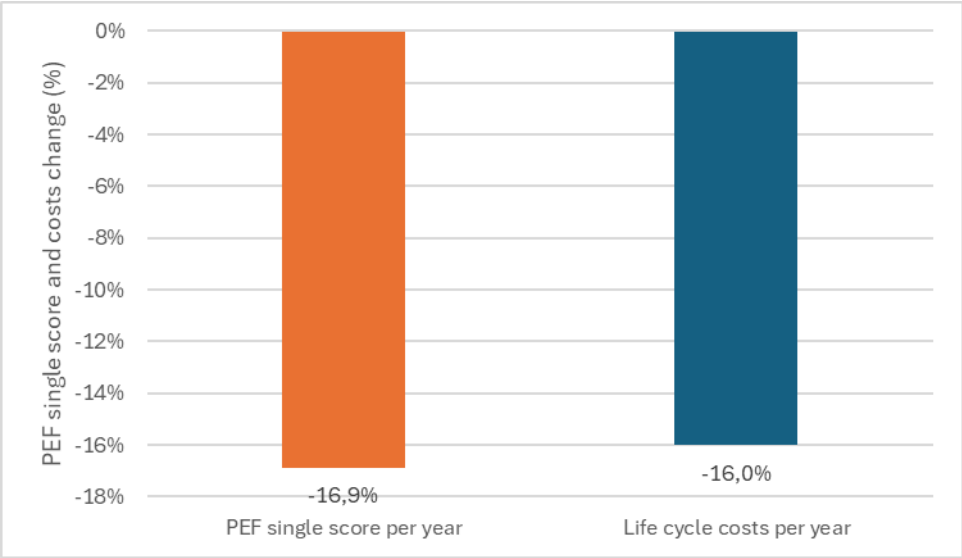

Figure 3-49: WM3 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

WM4: Commercial barrier washer

Below (**Figure 3-50**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

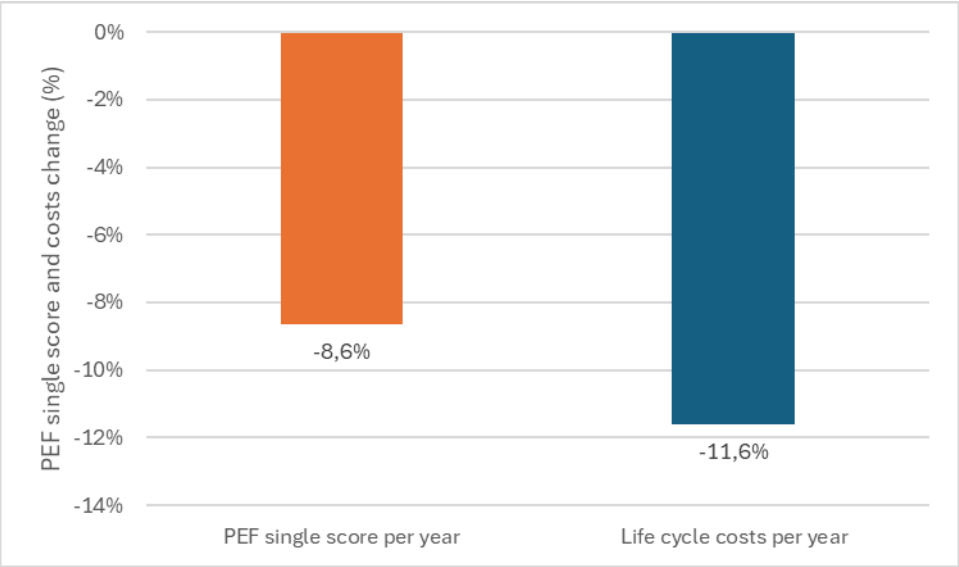

Figure 3-50: WM4 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

WM5: Industrial continuous tunnel washers

Below (**Figure 3-51**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

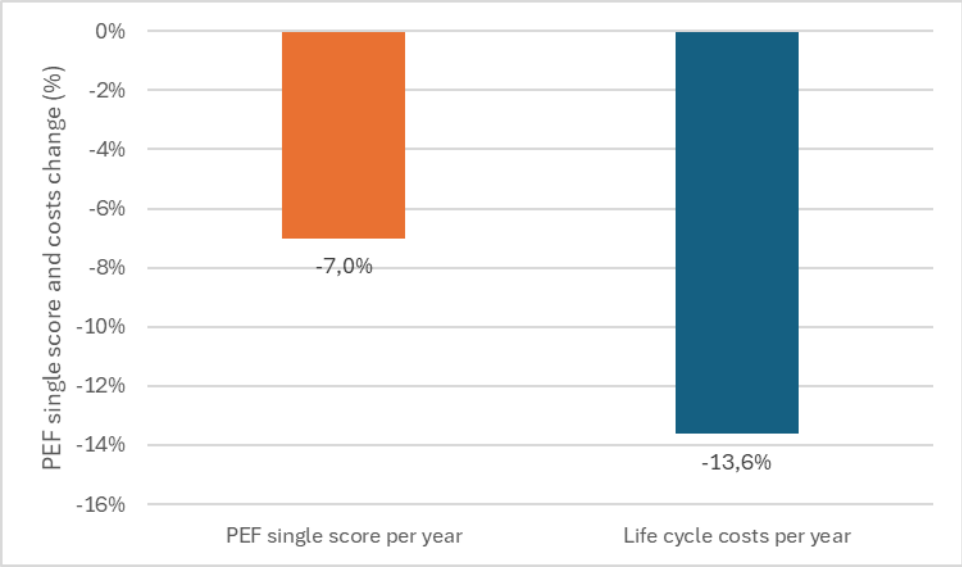

Figure 3-51: WM5 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

D1: Light duty commercial tumble dryer

Below (**Figure 3-52**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

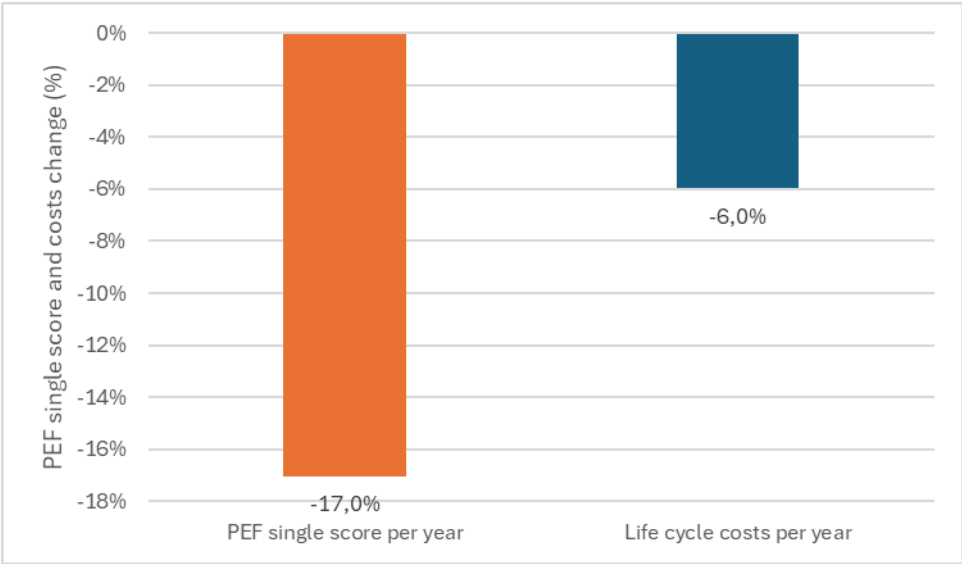

Figure 3-52: D1 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

D2: Commercial tumble dryer

Below (**Figure 3-53**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

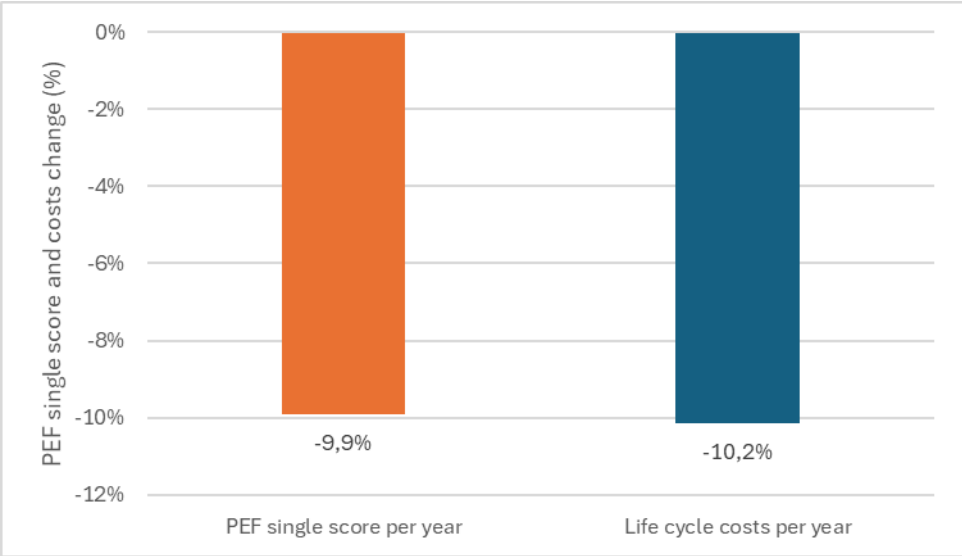

Figure 3-53: D2 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

D3: Commercial cabinet dryer

Below (**Figure 3-54**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

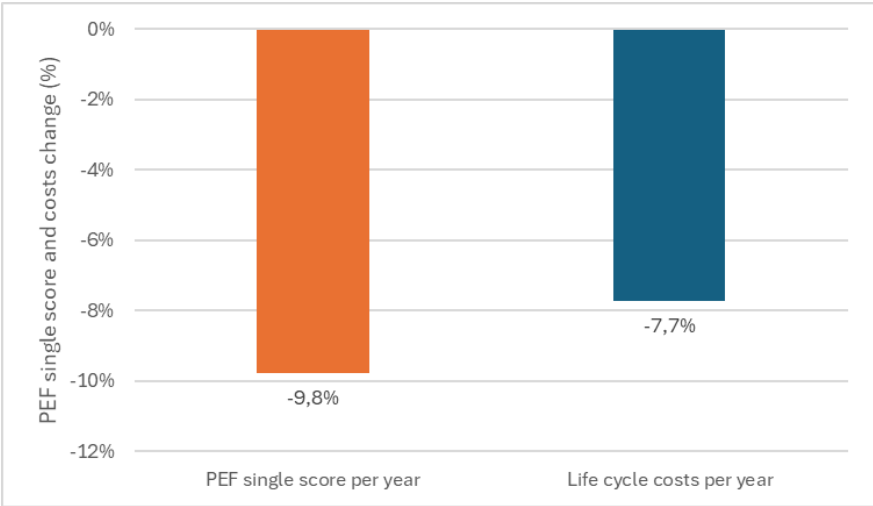

Figure 3-54: D3 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

D4: Industrial pass-through (transfer) tumble dryer

Below (**Figure 3-55**), the change in PEF single score per year of the BC with DOs compared to the reference BC is shown (left column), together with the % change in costs per year (right column).

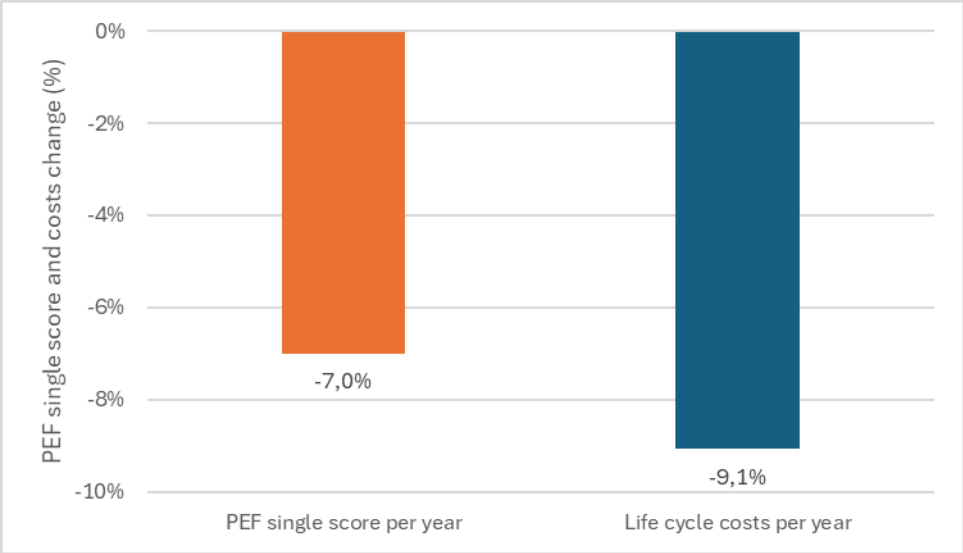

Figure 3-55: D4 - PEF score change (in %) of Design Options <u>per year of use</u> versus costs change per year (in %).

3.5.6.3. Overview of average specific environmental performance per Base Case

The following tables summarise the average energy (electricity and/or heat), water and detergent performance depending on the annual cleaned or dried laundry of the individual BCs and the assumed input parameters.

Table 3-169: Overview of average energy, water and detergent performance per Base Case (without Design Options) depending on annual cleaned or dried laundry.

BC	Annual cleaned / dried laundry (kg/year)	Annual energy consumption (kWh/year)	Annual water consumption (L/year)	Annual detergent consumption (kg/year)	Energy performance (kWh/kg laundry)	Water performance (L/kg laundry)	Detergent performance (kg/kg laundry)
WM1 Light duty commercial washer extractor	9,000	1,440	83,700	99	0.16	9.30	0.011
WM2 Commercial washer extractor	87,000	21,750	783,000	957	0.25	9.00	0.011
WM3 Commercial washer dryer	54,000	33,480	540,000	594	0.62	10.00	0.011
WM4 Commercial barrier washer	96,000	14,400	1,276,800	1,056	0.15	13.30	0.011
WM5 Industrial continuous tunnel washer	3,825,000	1,147,500	21,037,500	30,600	0.30	5.50	0.008
D1 Light duty commercial tumble dryer	6,750	1,620	n.a.	n.a.	0.24	n.a.	n.a.
D2 Commercial tumble dryer	86,321	54,382	n.a.	n.a.	0.63	n.a.	n.a.
D3 Commercial cabinet dryer	21,000	12,600	n.a.	n.a.	0.60	n.a.	n.a.
D4 Industrial pass-through (transfer) tumble dryer	1,020,000	816,000	n.a.	n.a.	0.80	n.a.	n.a.

Table 3-170: Overview of average energy, water and detergent performance and savings potential per Base Case including Design Options depending on annual cleaned or dried laundry.

BC	Annual cleaned / dried laundry (kg/year)	Annual energy consumption (kWh/year)	Annual water consumption (L/year)	Annual detergent consumption (kg/year)	Energy performance (kWh/kg laundry)	Water performance (L/kg laundry)	Detergent performance (kg/kg laundry)
WM1 Light duty commercial washer extractor	9,000	1,325 (-8 %)	78,678 (-6 %)	91 (-8 %)	0.15 (-8 %)	8.74 (-6 %)	0.010 (-8 %)
WM2 Commercial washer extractor	87,000	20,010 (-8 %)	736,020 (-6 %)	880 (-8 %)	0.23 (-8 %)	8.46 (-6 %)	0.010 (-8 %)
WM3 Commercial washer dryer	54,000	26,784 (-20 %)	507,600 (-6 %)	546 (-8 %)	0.50 (-20 %)	9.40 (-6 %)	0.010 (-8 %)
WM4 Commercial barrier washer	96,000	13,248 (-8 %)	1,200,192 (-6 %)	972 (-8 %)	0.14 (-8 %)	12.50 (-6 %)	0.010 (-8 %)
WM5 Industrial continuous tunnel washer	3,825,000	1,090,125 (-5 %)	19,985,625 (-5 %)	27,540 (-10 %)	0.29 (-5 %)	5.23 (-5 %)	0.007 (-10 %)
D1 Light duty commercial tumble dryer	6,750	1,296 (-20 %)	n.a.	n.a.	0.19	n.a.	n.a.
D2 Commercial tumble dryer	86,321	48,944 (-10 %)	n.a.	n.a.	0.57	n.a.	n.a.
D3 Commercial cabinet dryer	21,000	11,340 (-10 %)	n.a.	n.a.	0.54	n.a.	n.a.
D4 Industrial pass-through (transfer) tumble dryer	1,020,000	758,880 (-7 %)	n.a.	n.a.	0.74	n.a.	n.a.

3.5.7. Conclusions

The evaluation of selected DOs presented in the previous sections allows to draw several major conclusions:

- In all cases, the examined DOs have the potential to generate environmental benefits, which go hand in hand with cost savings.
- The combined DOs can reach a decrease in PEF score from 7 to 17 % depending on the BC category. While for most categories, the environmental savings potential is around 7 to 10 %, BC categories WM3 (commercial washer dryer) and D1 (Light duty commercial tumble dryer) have the higher decrease of around 17 % in the PEF score. This is due to the assumed application of a heat pump for the drying function which has a more relevant savings potential compared to the remaining other design options such as load control or smart detergent dosing.
- The savings potential in LCC is around 6 to 10 % for the commercial and industrial dryers as the assumed design options for the drying function (heat pump, modulating gas dryer) are expected to have higher initial costs, and around 10 to 16 % for the commercial and industrial washing machines for which the chosen design options presumably have lower initial costs.

3.6. MEErP Task 7: Policy Options and Scenarios

3.6.1. Objectives of MEErP Task 7

The MEErP Task 7 identifies and discusses policy options aimed at reducing the impacts of commercial and industrial laundry appliances on the environment as analysed in previous tasks. It provides an analysis of the impacts of future scenarios in line with policy measures that could be introduced at EU level. This is a key task as it combines the results of the previous MEErP Tasks. It discusses potential ESPR requirements, and it is aimed at providing an analytical basis in support of the decision-making process within the ESPR framework as to the need to introduce ESPR legislation for this product group.

As in MEErP Task 6 only one package of combined DOs was selected, only two scenarios are considered in Task 7:

- the Business-as-Usual (BAU) scenario, and
- the Best Available Technology (BAT) scenario, which is also a Least Lifecycle Cost (LLCC) scenario for each BC.

To this end, a stock model has been developed to estimate environmental and economic impacts according to future stocks of both scenarios.

This document describes a set of policy options for commercial and industrial laundry appliances within the scope proposed in MEErP Task 1, namely commercial and industrial appliances. The environmental impact improvement and the key parameters to do this were previously discussed in MEErP Task 6, while this MEErP Task 7 discusses how the DOs can potentially be converted into policy (performance and information requirements on ecodesign). In relation to the proposed policy options this task also analyses and models impact scenarios. This is the final reviewed version elaborated after collecting feedback in writing and consulting a few stakeholders in bilateral meetings. A summary of stakeholder positions with regard to the proposed policy is included as a support to the subsequent policy making process.

3.6.1.1. Introduction to the evaluation of Scenarios using the MEErP methodology

The MEErP provides a structured and comprehensive framework for assessing the environmental, economic, and technical performance of product design options. At its core, the MEErP methodology facilitates a life-cycle-based evaluation that integrates environmental impact assessments with techno-economic analysis to identify the LLCC and BAT. This ensures that design decisions not only meet regulatory requirements but also promote sustainability and cost-effectiveness.

The evaluation of DOs within MEErP is prepared by several tasks, including the definition of product scope (MEErP Task 1), market analysis (MEErP Task 2), use-stage and technical analysis of existing products (MEErP Task 3 and Task 4), as well as the subsequent LCA and LCC (MEErP Task 5). The revised MEErP methodology (2024) introduces refinements to better align the framework with the EU's Green Deal objectives, emphasising aspects related

to climate neutrality, circularity, and SoCs related to the product group under study. The work process for developing DOs remains structured around seven core Tasks, with MEErP Task 6 playing a pivotal role in identifying and evaluating improvement potentials. Design options are first mapped and evaluated, taking stakeholder input into account, and then assessed using the ERT. The latter helps to quantify the improvement potential of environmental impact against the BCs. This structured approach enables policymakers and stakeholders to compare alternatives objectively and select the most sustainable and economically viable solutions. Thus, the MEErP method ensures that product innovations are aligned with broader environmental goals, such as reducing greenhouse gas emissions and improving energy efficiency and the adoption of a circular economy.

MEErP Task 7 of the preparatory study encompasses the following sections:

- Policy analysis (see Section 3.6.2),
- Scenario analysis (see Section 3.6.3),
- Socio-economic impact analysis for industry, consumers and society (see **Section 3.6.3.5**),
- Sensitivity analysis of the main parameters (see Section 3.6.3.6),
- Summary of results and main policy recommendations per product (see Section 3.6.4).

3.6.2. Policy analysis

3.6.2.1. Stakeholder consultation

Building on its ongoing efforts to foster collaboration and transparency, the study team has engaged since the start of the study in March 2024 with a broad range of stakeholders.

The second stakeholder meeting of the project was held on 10 April 2025. During the meeting, the results of MEErP Task 5 and the status of MEErP Task 6 were presented, along with initial ideas for potential policy options, which were presented to the participants. Stakeholders had the opportunity to comment during the meeting (see discussion in **Annex IX: Stakeholder meeting 2:**).

From July 2025 onward, the study team engaged intensive exchanges with manufacturer associations and selected members - most notably with laundry appliance stakeholders APPLiA[79] (30 July 2025, 23 October), ETCT[80] (4 August 2025), and ETSA (16 October 2025). At a stakeholder interaction held online on 15 September 2025, the draft results of Tasks 6 and 7 were presented to stakeholders with the possibility to provide further written input afterwards.

The following stakeholders provided written comments in various stages.

[79] Representing leading home appliance manufacturers in Europe.

[80] ETCT European Textile Care Technology, represents the interests of European manufacturers of industrial textile care technology.

Switzerland

Within the Federal Energy Efficiency Ordinance (EnV)[81], the Swiss Federal Office of Energy (Bundesamt für Energie, BfE) has introduced an incentive programme to support the replacement of existing commercial laundry equipment with more energy-efficient models. The requirements for the new equipment are specified in the "Standardised Measure GG-03a". According to this document, the scope of the incentive programme covers commercial tumble dryers with a capacity of up to 40 kg of laundry and built-in electric heating, as defined by the standard EN 50594:2018, as well as commercial cabinet dryers with built-in electric heating.

Table 3-171: Requirements.

	Old System	New System
Technology	Devices with built-in electric heating	-
Energy Efficiency	The new tumble dryers must meet the following consumption, determined according to EN 50594-2018 standard. The new cabinet dryers must have a **heat pump**.	
	Tumble dryer with a load capacity of 5 to 9 kg:	0.20 kWh/kg
	Tumble dryer with a load capacity of 10 to 23 kg:	0.25 kWh/kg
	Tumble dryer with a load capacity of 24 to 40 kg:	0.55 kWh/kg
	Cabinet dryer:	With heat pump

Source: BfE 2025, translation: Fraunhofer ISI

APPLiA

Due to the current lack of data, APPLiA advocates a two-step approach for commercial laundry care appliances:

- Step 1: Require the declaration of performance and consumption data, along with the implementation of harmonised measurement standards and the storage of this data in a centralised database.
- Step 2: Based on the data collected in Step 1, define minimum efficiency requirements that reflect realistic and achievable benchmarks.

Considering the current situation and insights from the sector, APPLiA recommends a reporting period of five years.

For spare parts, since the delivery process managed by the logistics provider is beyond the manufacturer's control, APPLiA emphasises that the requirement proposed during the 2nd

[81] Directive for Energy Efficiency Improvements by Electricity Suppliers Implementation Guide according to Articles 51a–51i of the Federal Energy Efficiency Ordinance (EnV): https://www.bfe.admin.ch/bfe/de/home/effizienz/energieeffizienzsteigerungen-durch-elektrizitaetslieferanten.exturl.html/aHR0cHM6Ly9wdWJkYi5iZmUuYWRtaW4uY2gvZGUvcHVibGljYX/Rpb24vZG93bmxvYWQvMTE5NTM=.html. Here, electricity suppliers are given savings targets, which are to be met by implementing various measures among end consumers (including businesses and private households). Specifically, electricity suppliers must demonstrate that end consumers have taken steps to improve electricity efficiency - such as upgrading electric drives, lighting, ventilation, cooling systems, or similar equipment and devices.

stakeholder meeting should specify the time frame up to the point when the parts are handed over to the freight company and proposes a limit of five working days.

APPLiA highlighted that requirements for the repairability of commercial laundry appliances are compromised by other regulations, particularly regarding the availability of spare parts like induction motors and fans. Under Regulation (EU) 2019/1781 for Electric Motors, exemptions allow replacement of induction motors only until 1 July 2029 for products marketed before 1 July 2022. Furthermore, spare parts fans will remain available until 2037, as per Regulation (EU) 2024/1834, which repeals the previous Regulation (EU) No 327/2011 on 24 July 2026 but allows certain provisions to remain in effect until 2037 for integrated fans and spare part fans.

APPLiA expresses serious concern regarding the approach to identifying SoCs across product groups and was unable to respond to the recent questionnaire[82] on this matter. After discussions with ZVEI[83], the stakeholder aligns with the position outlined in ZVEI's statement from May 2025 and has opted to attach that document for efficiency rather than creating a separate one.

Detailed position paper and reply from APPLiA are provided in **Annex X: Position paper** .

In an exchange with the study team held at the end of July 2025:

- APPLiA mentioned that, following the preparatory study of 2011, a Voluntary Agreement was proposed to the EC, focusing on measuring and reporting products according to EN standards. The idea was that mandatory requirements would only be developed once sufficient EU market data was available.
- APPLiA confirmed that a harmonised wash/dry programme would ease the comparability of the product performance. However, APPLiA stressed that such a programme should not be the default one. Commercial customers change settings and/or ask for customised tuning according to the type of laundry and the business they run.
- APPLiA informed that they do not have figures from test reports. Some members might have tested products according to the standards EN 50640 or EN 50594 but results of these have not been made available as of yet.

According to a manufacturer, testing a commercial washing machine in an independent laboratory in compliance with EN 50640 costs approximately 1 k€ / kg capacity.[84]

Electrolux Professional

Electrolux Professional shared a presentation focused on the relevant standards for commercial laundry equipment. The EN 50640 standard is applicable to measuring the

82 See consultation on SoC, May 2025.
83 German Electro and Digital Industry Association.
84 Based on a 20 kg washer-extractor. For information: a 8 kg WM would cost around 6-8 k€ for a test according to the EN 60456:2016.

performance and consumption of commercial washers (WM1, WM2, WM3 and WM4), and the EN 50594 for commercial tumble dryers (D1 and D2). According to Electrolux Professional, both standards can be used for testing batch load machines, and no-load size limit is needed.

ETCT

During the exchange in early August 2025, ETCT provided additional insights into industrial laundry appliances (see below). Finally, ETCT shared additional data on water and detergent consumption for an average product.[85]

Table 3-172: Average performance of the tested industrial products.

Standard	EN 17116 -2	EN 17116 -3	EN 17116 -4
Total energy consumption kWh/kg	Water: @ FMC* = 2 %: 1.709 @ FMC = 9 %: 1.513 Textile: @ FMC = 2 %: 0.882 @ FMC = 9 %: 0.616	Textile: 0.411	Textile: 0.540
l/kg laundry		4,8 bis 5,5	10.5 - 13
g/kg laundry		8-9	18-20
Typical time required for in-situ testing	approx. 2 days	approx. 3 days	approx. 2 days
Typical costs to testing in €	6,000	30,000	?
Additional typical loss for laundry company due to in-situ testing in €[86]	4,320 – 8,640	64,800	2,160

*FMC: final moisture content

The figures of **Table 3-172** are based on tests conducted by the companies in industrial laundries. Various machines were tested (dryers, washer-extractors and tunnel washers of different capacities) and laundry loads (25, 50, and 60 kg), with results documented in a comprehensive test run protocol provided by WfK[87].

ETCT confirmed that the capacity has no impact on the specific energy efficiency performance of the products.

85 The energy data have been shared earlier.
86 Assuming that 50 % of the costs are offset by additional shifts or similar measures in the laundry company.
87 Institut - wfk - Institut für angewandte Forschung GmbH, see: https://wfk-iaf.de/.

3.6.2.2. Opportunities and barriers for improvements

Opportunities

For most impact categories, MEErP Task 5 indicates that the use phase is the dominant stage in the product's life cycle. In terms of overall environmental impact, when assessing the PEF single score,[88] the use phase contributes to 74 % to 99 % of the lifecycle impact, the energy consumption in the use phase contributes alone to 23 % to 99 %.

Table 3-173: Contribution to the LCA impact (PEF single score) over the total lifetime of the product, at product level.[89]

Use phase	WM1	WM2	WM3	WM4	WM5	D1	D2	D3	D4
Energy consumption	42 %	55 %	77 %	23 %	54 %	78 %	99 %	97 %	100 %
Water consumption	20 %	17 %	8 %	26 %	14 %	n.a.	n.a.	n.a.	n.a.
Detergent consumption	28 %	25 %	11%	25%	25%	n.a.	n.a.	n.a.	n.a.
Total use phase	90 %	97 %	96 %	74 %	93 %	78 %	99 %	97 %	100 %

Accordingly, the most effective way to reduce the product's environmental impact is to reduce the energy consumption, as well as the water and detergent use (for WM).

The LCC results also confirm that the use phase is the main cost driver across all BCs examined in the study, accounting for between 65 % and 97 % of the total LCC. Depending on the WM BC considered, costs related to detergent consumption alone can account for up to 60 % of the total LCC (see **Table 3-174**).

Table 3-174: Relevance of the use phase in the LCC of the Base Cases, at product level.[90]

Use phase	WM1	WM2	WM3	WM4	WM5	D1	D2	D3	D4
Energy consumption	25 %	38%	58%	11%	21%	67%	96%	92%	97%
Water consumption	15 %	15%	8%	17%	8%	n.a.	n.a.	n.a.	n.a.
Detergent consumption	38 %	36%	22%	37%	60%	n.a.	n.a.	n.a.	n.a.
Total use phase	78 %	89%	88%	65%	88%	67%	96%	92%	97%

The MEErP Task 6 report identified small to significant potential savings in energy, detergent, and water consumption. When coupled with extended product lifetimes, these efficiency

88 PEF single scores were calculated for each BC, aggregating impacts across all life-cycle stages over the product's entire lifetime. Although the ERT already calculates all sixteen PEF impact categories and provides the necessary inputs for single-score calculation, it does not perform a full, PEF-aligned LCA study. Therefore, scores derived from the tool should be treated as an indicative guidance than as a comprehensive PEF assessment when comparing results.

89 Based on the LCA results of the sensitivity analysis carried out in MEErP Task 5.

90 Based on the sensitivity analysis carried out in MEErP Task 5.

improvements can translate into substantial annual reductions in LCC (LCC/a) (see **Table 3-175**):

Table 3-175: Improvement potentials, at product level.[91]

	WM1	WM2	WM3	WM4	WM5	D1	D2	D3	D4
Energy consumption	-8 %	-8 %	-20%	-8%	-5%	-20%	-10%	-10%	-7%
Water consumption	-6 %	-6 %	-6%	-6%	-5%	n.a.	n.a.	n.a.	n.a.
Detergent consumption	-8 %	-8 %	-8%	-8%	-10%	n.a.	n.a.	n.a.	n.a.
Yearly LCC	-11 %	-11 %	-16%	-12%	-14%	-6%	-10%	-8%	-9%

The improvement potentials were also analysed on market level, see **Table** 3-176. The figures take into account both the savings at product level and the market volumes in 2025[92] for each Base Case. The upper part of the table illustrates the relevance of each Base Case for the WM and D markets individually, while the lower part considers their relevance for the combined WM and D market.

When considering the combined WM and D market, WM2 and D2 together deliver over 75 % of the savings in the four categories reported earlier, and each Base Case represents around 33 % of the sales. When only considering the whole WM market, WM5 contributes also to large savings despite its lowest market share.

Table 3-176: Contribution of each BC to the achievable savings of the whole market.

	WM1	WM2	WM3	WM4	WM5	D1	D2	D3	D4
	Whole WM market					Whole D market			
Market share	31.9 %	65.6 %	0.5 %	1.6 %	0.3 %	20.5 %	65.2 %	12.8 %	1.5 %
Total energy savings	2 %	81 %	2 %	1 %	13 %	1 %	76 %	3 %	19 %
Total water savings	4 %	84 %	0 %	3 %	9 %	n.a.	n.a.	n.a.	n.a.
Total detergent savings	4 %	79 %	0 %	2 %	15 %	n.a.	n.a.	n.a.	n.a.
Total costs savings (LCC/a)	4 %	70 %	1 %	3 %	22 %	1 %	81 %	5 %	14 %
	Whole WM and D market								
Market share	15.7 %	32.4 %	0.3 %	0.8 %	0.2 %	10.4 %	33.0 %	6.5 %	0.8 %

91 Based on MEErP Task 6.
92 See Table 3-189.

	WM1	WM2	WM3	WM4	WM5	D1	D2	D3	D4
Total energy savings	1 %	19 %	1 %	0 %	3 %	1 %	58 %	3 %	15 %
Total water savings	4 %	84 %	0 %	3 %	9 %	0 %	0 %	0 %	0 %
Total detergent savings	4 %	79 %	0 %	2 %	15 %	0 %	0 %	0 %	0 %
Total costs savings (LCC/a)	2 %	38 %	1 %	1 %	12 %	0 %	37 %	2 %	6 %

Barriers

The aforementioned potential improvements are noticeable (see Table 3-175), ranging from 5 % to 20 % for energy consumptions and from 6 % to 16 % for the yearly LCC; nevertheless, they can hardly be tapped: One key barrier is the lack of transparency in market information. Currently, customers can have access to some data on product performance – specifically regarding energy, water, and detergent consumptions, as the associated costs are highly relevant to them, however:

- The consumption figures are typically derived from proprietary testing protocols developed by individual manufacturers and do not conform to standardised EN performance test methods, hindering comparability between products of different manufacturers.
- Performance data made publicly available are scarce, which further limits the possibility of comparison.

APPLiA and ETCT recognise that, under these conditions, customers are unable to make objective comparisons between products based on environmental performance criteria. This lack of harmonised and accessible data undermines informed decision-making.

In greater detail, the market is facing the following challenges:

- **Limited uptake of EN standards:** Although most of the relevant EN test standards[93] have been established, they are not yet in widespread use. This results in:
  - An absence of reliable and comparable data on the energy, water, and detergent consumption of the BCs analysed in MEErP Task 5, as well as the improvements achieved through the DOs in MEErP Task 6.
  - A lack of a database of products on the EU market with performance assessed according to the newly developed EN standards.
- **Reduced competitive pressure**: Due to the lack of comparable data on energy, water, and detergent consumption across products, two key risks emerge:

[93] No standard has been developed for commercial cabinet dryers, see **Section 3.6.2.4.**

  - Lack of transparency for high-performing products: Manufacturers that deliver environmentally superior solutions face challenges in effectively showcasing their performance benefits. This limits their ability to differentiate in the market and reduces the impact of sustainability-driven innovation on consumer purchasing decisions.
  - Weak innovation incentives: In the absence of standardised benchmarks and transparent performance comparisons, manufacturers face limited external pressure to pursue advancements in efficiency. This weakens the business case for investing in the development of high-performance, environmentally optimised technologies.

- **Unclear product classification:** Ambiguity remains regarding how a machine is classified as commercial or industrial, and consequently which EN standard should be applied when assessing performance of certain appliance categories for which currently both commercial or industrial standards would be applicable.
- **Inconsistent testing results:** To ensure comparability between competing products, all similar products should be tested under a programme, which fulfils the same requirements in terms of service (e.g. washing performance). This is still not the case, as e.g. two commercial washers tested according to EN 50640 might have a different efficiency but show the same energy consumption if the washing performance in both tests is not the same.
  The specifications of such a declaration programme (e.g. washing performance) used for the product declaration, if not available in the EN standard, should be given in the regulation.

Finally, challenges for the elaboration of an adequate EU regulation include the following aspects:

- **Limitations of the MEErP Task 6 analysis:** The evaluation in MEErP Task 6 could not account for all factors associated with the DOs, such as the potential changes in the BOM or the possible impact on productivity when aiming for improved environmental performance.
- **System-level efficiency considerations:** For products used within a process, particularly in industrial laundries, the most efficient *system* is not necessarily made up of the most efficient individual products. For example, if the waste heat from an industrial dryer is used elsewhere in the whole process, the overall energy efficiency of the laundry care system can remain high despite lower efficiency of its single sub-systems.

3.6.2.3. ESPR Framework

The ESPR[94] seeks to enhance the sustainability of products in the EU market by improving their circularity, energy performance, recyclability, and durability. It aims to foster a unified

[94] https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/ecodesign-sustainable-products-regulation_en

market for sustainable products, replacing the Ecodesign Directive 2009/125/EC by extending its scope to nearly all physical products (excluding food, feed, and medicinal products) and reinforcing ecodesign requirements. This regulation supports economic opportunities in innovation, job creation, and sustainability.

The ESPR establishes a framework allowing the setting of ecodesign requirements for product categories, focusing on parameters that are relevant to the product in question such as:

- Durability, reusability, upgradability, and reparability,
- Maintenance and refurbishment potential,
- Energy and resource efficiency,
- Limiting substances that hinder circularity,
- Increasing recycled content,
- Simplifying remanufacturing and recycling,
- Carbon and environmental footprint rules,
- Waste reduction,
- Information on product sustainability.

ESPR enables horizontal rules for product groups with shared characteristics and introduces several new measures to enhance product sustainability.

Figure 3-56: Type of requirements within the ESPR framework.

Source: EC

3.6.2.4. Potential policy options

Definition of the scope and standards

Scope

In terms of scope, it would be meaningful that a potential regulation covers both commercial and industrial laundry appliances. The table below provides an overview of the scope and the corresponding standards to be applied.

Table 3-177: Overview of the scope and standards to be applied.

	Commercial	Industrial
Washers	EN 50640:2018 (washing machines and washer-dryers)	EN 17116-4 (washer extractors)
		EN 17116-3 (continuous tunnel washer)
Dryers	EN 50594:2018 (tumble dryers)	EN 17116-2 (drying tumblers)
	No standard (cabinet dryers)	

However, as already mentioned in MEErP Task 1, a **clear definition between what is a commercial and an industrial product is not yet available**. The five standards mentioned in **Table 3-177** do not make a clear differentiation between commercial and industrial products and there is a potential risk that a product could be declared as a commercial or as an industrial product, which might be an issue for a regulation as the EN test standards are different and will deliver different results.

Therefore, in addition to the work already carried out in MEErP Task 1, the safety standards applied to commercial and to industrial products were also investigated to check whether safety standards could be used for a better differentiation between the products. As shown in **Table 3-178**, washing machines and washer-extractors between 60 l and 150 l and air dryers between 160 l and 350 l are not exclusively considered as either commercial or industrial.

Table 3-178: Overview of the EN performance and safety EN standards for commercial and industrial laundry products.

Appli-ance	Full reference	Title of the standard	Focus	Declaration	Capacity
WM	EN 50640:2018	Household and similar electric appliances - Methods for measuring the performance of clothes washing machines intended for commercial use	Perfor-mance	Commercial	**Not specified** *(test specifications are included for* ***load capacities between 2 kg and 300 kg****)*[95]
WM	EN 171164-4:2019	Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics – Part 4: Washer extractors;	Perfor-mance	Industrial	> 400 l > 40 kg
WM	EN 17116-3:2019	Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics - Part 3: Continuous tunnel washer; German version EN 17116-3:2019	Perfor-mance	Industrial	not specified
D	EN 50594:2018	Household and similar electric appliances - Methods for measuring the performance of tumble dryers intended for commercial use	Perfor-mance	Commercial	**not specified**
D	EN 17116-2:2018	Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics – Part 2: Batch drying tumblers;	Perfor-mance	Industrial	> 1,000 l > 40 kg
WM	DIN EN 50571 *VDE 0700-571	Household and similar electrical appliances - Safety - Particular requirements for commercial electric washing machines; German version EN 50571:2013 + A1:2018	Safety	Commercial	<= 150 l[96]

[95] Also, EN 50640 provides a formula for the composition of the load for machines above 300 kg (see EN 50594, table 4, clause 6.6.6.2. and in 6.6.6.3).

[96] Considering the ratio 1 kg = 10 l from the EN 17116-4:2019, this would correspond to a capacity <= 15 kg.

Appli-ance	Full reference	Title of the standard	Focus	Declaration	Capacity
WM	EN 10472-2:2009	Safety requirements for industrial laundry machinery – Part 2: Washing machines and washer-extractors (ISO 10472-2:1997) English version of DIN EN ISO 10472-2:2009-10	Safety	Industrial	> 150 l (> 60 l)[97]
WM	DIN EN ISO 10472-3:2009-10	Safety requirements for industrial laundry machinery – Part 3: Washing tunnel lines including component machines (ISO 10472-3:1997) English version of DIN EN ISO 10472-3:2009-10	Safety	Industrial	not specified
D	DIN EN 50570/A2*VDE 0700-570/A2	Household and similar electrical appliances - Safety - Particular requirements for commercial electric tumble dryers; German and English version EN 50570:2013/prA2:2021	Safety	Commercial	<= 350 l98
D	DIN EN ISO 10472-4:2009-09	Safety requirements for industrial laundry machinery – Part 4: Air dryers (ISO 10472-4:1997) English version of DIN EN ISO 10472-4:2009-09	Safety	industrial	> 350 l (> 160 l)99

Remark: assuming a tumble drum with a diameter of 55 cm (as household machines are 60 cm width), 60 l correspond to a 30 cm deep tumble, and 160 l would correspond to 81 cm.

As can be seen from the previous table:

- The capacity thresholds for the safety and performance standards <u>are not harmonised.</u>
- Regarding the safety standards: in the opinion of the study team, there is still an overlap between commercial and industrial for washing machines in the range 60 L to 150 L and for dryers in the range 160 L and 350 L.

ETCT interpretates the EN-10472 standards as follows:[100]

- Washer extractors:
  - Up to 60 litres: the application pertains to purely household machines.

97 Considering the ratio 1 kg = 10 l from the EN 17116-4:2019, this would correspond to a capacity > 15 kg (> 6 kg).
98 Considering the ratio 1 kg = 25 l from the EN 17116-2:2018, this would correspond to a capacity <= 14 kg.
99 Considering the ratio 1 kg = 25 l from the EN 17116-2:2018, this would correspond to a capacity > 14 kg (> 6.4 kg).
100 Communication on 12.08.2025.

  - From 60 to 150 litres (commercial machines), the choice of application is between EN 60335 (Safety of Household and Similar Electrical Appliances) or EN 60204 (Safety of Machinery – Electrical Equipment of Machines).
  - For drum volumes greater than 150 litres, EN 10472 (Safety Requirements for Industrial Washing Machines) and EN 60204 (Safety of machinery – Electrical equipment of machines – General requirements) must be applied.
- Dryers:
  - Up to 160 litres of drum volume, the application pertains to purely household machines.
  - Between 160 litres and 350 litres of drum volume (commercial machines), the choice of application is between EN 60335 (Safety of Household and Similar Electrical Appliances) and EN 60204 (Safety of Machinery – Electrical Equipment of Machines).
  - For drum volumes greater than 350 litres, EN 10472 (Safety Requirements for Industrial Dryers) and EN 60204 must be applied.

For the study team, the current situation remains unclear, and further discussions with and inputs from the stakeholders will be necessary to finalise a clear definition of the scope and the standard to be applied in the context of a possible regulation. The objective is to have ensured that any given appliance could only be tested based on a single standard, i.e., that there are no overlaps.

At this stage, the project team has developed a proposal for the unambiguous allocation of the relevant EN standard (independent of the load size but rather based on functional differences) to each product to be tested within the framework of a possible ESPR regulation which has been further specified based on stakeholder feedback.

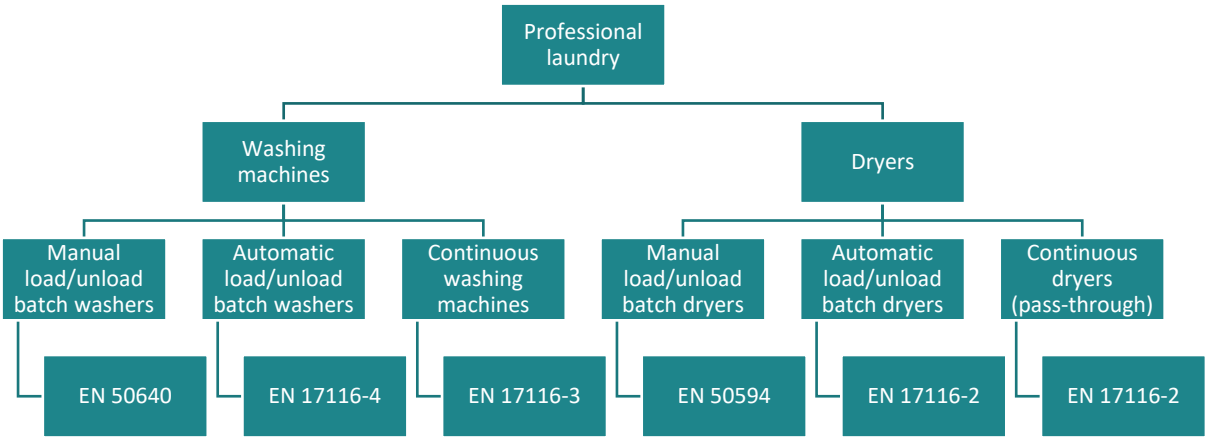

Figure 3-57: Suggested EN standards to be applied in a possible ESPR regulation according to the product to be tested

This proposal is supported by the manufacturers of commercial machines but not by the manufacturers of industrial machines.

Standards

Following the mandate M495[101] given by the Commission to CENELEC and CEN to develop new performance standards for 'professional washing machines, dryers and dishwashers', a few new standards were developed regarding the performance and related test procedures for commercial and industrial washing and drying appliances. The standards differ for industrial laundry machines (EN 17116 series) and commercial ones (EN 50640 and EN 50594).

M/495 described the standardisation needs for 'professional washing machines, dryers and dishwashers' as follows:

> *"For washing machines, dryers and dishwashers[102], standardisation work should define:*
>
> – *Ambient temperature and humidity,*
> – *Input water temperature,*
> – *Input temperature for the wash ware,*
> – *Selection of programme ('standard' washing and drying programmes) and programme duration,*
> – *Cleaning capacity,*
> – *Type (formulation) and dosage of detergent (and rinse aid for dishwashers),*
> – *Standard wash ware and laundry,*
> – *Soiling of the items including dry-on time of the soiling,*
> – *Type and dosage of detergents.*
>
> *Measurement methods for the following parameters should be developed:*
>
> – *Cleaning and possibly rinsing results and hygienic performance,*
> – *Energy and water consumption during continuous use or per cycle at full and partial loads; possibly consumption in other than 'standard' programme,*
> – *Energy demand in standby modes (ready-to-use, left-on, and if applicable: off mode),*
> – *For professional washing machines: residual moisture content and spinning efficiency.*
>
> *The standardisation work should aim at giving results close to real-user behaviours and include an estimate of measurement variation, which should be reduced to the minimum possible."*

[101] Standardisation mandate to CEN, CENELEC and ETSI under Directive 2009/125/EC relating to harmonised standards in the field of Ecodesign, M/495 EN.

[102] M/495 described the Standardisation needs for "Professional washing machines, dryers and dishwashers".

While the elaborated EN standards provide a measurement method, they do not provide requirements for a 'declaration programme'[103] in terms of service delivered by the tested product.[104] This could be provided within the regulation.

Test procedure for washing machines

In addition to a test standard, a 'declaration programme' for the test should be provided and should include requirements on:

- Wash performance[105],
- Remaining Moisture Content (RMC) after extraction (except for continuous tunnel washer as extraction is not part of the test in EN 17116-3:2019[106]):
  - Rinse performance,
  - Max. programme time (cap). This parameter is intended to ensure the comparability of products and to prevent unrealistic programmes that artificially optimise environmental performance over an extended washing time.

For commercial barrier washers, it could be relevant that the declaration programme includes compliance to hygiene standards.[107]

In the absence of sufficient data and test reports, the study team was unable to perform the necessary analysis to develop a proposal for the declaration programme requirements. Hence, following the exchange on 30 July, APPLiA suggested certain values to be used as a basis for machines tested in accordance with EN 50640:

- Minimum wash performance: 0,93 (Reference Programme Wascator CLS: Cotton 60),
- Maximum time: 60 minutes,
- Maximum Residual Moisture Content (RMC): 50 %.

APPLiA made also further recommendations:

- Rinsing effectiveness: No values are currently available. A new method for measuring rinsing effectiveness using Linear Alkylbenzene Sulfonate LAS[108] has been in use for at least five years. Data collection is required, but no threshold will be defined in the first tier.[109]

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103 Declaration programme: The programme with which the service-related performance results (e.g. washing performance, rinsing performance, drying performance, etc.) must be met. Please note that this declaration programme is not the reference programme of the reference machine (see, for example, EN 17116-3).

104 EN 17116-2 (industrial tumble dryers) provides a final moisture content while EN 50594 (commercial tumble dryers) does not.

105 Wash index in EN 50640.

106 Contrary to washer extractors, dewatering of the load is carried out in separate machines, like presses or centrifuges. Therefore, these machines are not included in this standard.

107 Feasibility must be assessed, as standards, best practices, and tender requirements vary across industries and countries. Nevertheless, the M/495 mandate also encompasses hygienic performance.

108 See CLC/TS 50677: Clothes washing machines and washer-dryers for household and similar use - Method for the determination of rinsing effectiveness by measurement of the surfactant content at textile materials.

109 Remark: The study team highlights that the M/495 mandate also included requirements related to rinsing performance.

- Hygiene regulations: These should not be included, as relevant regulations already exist and vary significantly between countries - and often within countries - depending on the industry and tender specifications.
- 'Declaration programme': The 'Declaration Programme' should not be designated as the default programme. However, it must meet specific requirements, including: washing at full load (rated capacity), compliance with ecodesign criteria for wash performance, programme duration and maximum residual moisture content (RMC).
- Reference machine: It is clearly defined in EN 50640:2018 Annex D.[110] It is essential for evaluating wash performance, which can vary due to differences between batches of soil strips and even minor fluctuations in ambient conditions.

Remark: the suggested values from APPLiA need to be carefully checked. Some of them seem to be based on the performance of a reference programme of the reference machine as reported in EN 17116-3.[111]

When testing, following parameters should be measured and reported:

- electricity consumption,
- steam consumption,
- gas consumption,
- water consumption,
- duration information,
- wash performance.

An overview of the main difference between the EN standards for washing machines is provided in **Table 3-179.** This clarifies why the results are not comparable, emphasising the necessity of accurately declaring products and testing them in accordance with the correct standard.

[110] "Wascator FOM71CLS".

[111] See Annex F: Reference machine: 'Wascator FOM71CLS'. RMC at the end of rinse 3: 50 % to 55 %. Washing cycle time: 70 min + 6 min for the final spin.

Table 3-179: Main differences between standards EN50640:2018 & EN17116-3/4:2019.

Topic	EN 50640			EN 17116			Effect/comments
	Answer	Explanation	Section	Answer	Explanation	Section	
Detergent consumption determination?	NO	Fixed dose (12,7g/kg at full load)	Table 2 -6.3.2	YES	Determination of detergent consumption is clearly specified	10	EN 50640 not suitable for measuring detergent consumption. EN 17116 yes. The scope of the standard is machine testing and not for detergent qualification or testing.
Test programme with detailed test temperature and time	NO	No specification of test programme. Temperature inside load measured and reported. Example is given for test temp 60C without holding the temp. This is not required for the std.	8.2.3	YES	No specification of test programme, but YES 70C at 10 minutes in main wash	5.6.1	EN 17116 provides higher values of energy consumption kWh-kWh/kg and cycle time. Temp could be part of the regulations.
Water recovery system	N.S	Not specified	-	NO	The washing programme is carried out without use of recycled water	5.6.1 - 5.3.2	Water savings out of the scope. The process should consider this as the customers are willing this
Nominal test load	YES	Rated capacity or partial load	-	YES	Rated capacity	5.4.2	EN 50640 can be tested with partial loads. Less water consumption, less productivity
Rinsing performance	NO	Not considered. Planned (LAS method) to be added in future revisions.	-	YES	Method of how to measure the rinsing performance	7.7	EN 50640 can incur on cycles with less rinses, thus, less water consumption
Base load	YES	Polycotton sheets (small and large) Annex C	Annex C	YES	Terry fabrics 100 % cotton (small, medium, large)	5.2.8.2	EN 17116 provides greater values of water consumption as towels need more water to be processed
Ambient conditions controlled	YES	-	-	NO	-	-	Important for improving the result thanks to accuracy and repeatability and reproducibility
Conditioning of the load	YES	-	-	YES	-	-	-
Spinning efficiency	YES	RMC is measured and reported	-	YES	RMC is measured and reported	-	-
Reference machine	YES	-	-	YES	-	-	Same specification of the reference machines in both standards

Topic	EN 50640			EN 17116			Effect/comments
	Answer	Explanation	Section	Answer	Explanation	Section	
Soiling strips	YES	EMPA strips	-	YES	Different soilings	-	The soiling strips are different and thereby not comparable and also different base material

Source: APPLiA

Test procedure for dryers

The declaration programme for the test should include requirements on:

- Final moisture content, and
- Maximum duration.

APPLiA suggested some values as a basis for machines tested according to EN 50594:

- Final moisture content:
  - Single test (0 ± 3 %),
  - Test series average to be below 1.5 %.
- Additional comments provided by APPLiA:
  - Maximum time 200 min for D1 and 130 min for D2. The suggested threshold times are not at all typical however they exist and must be considered.
  - Depending on customer requirements, the power input limits the heat inputs which significantly affects the drying time (compare i.e. single phase and 3 phase installations, but not only).
  - Drying times are significantly affected by the load size. Larger load size in general is more efficient than smaller. Putting a too short time might hinder increase of load size to optimise energy efficiency.
  - 'Declaration programme' shall not be specified as default programme.
  - 'Declaration programme' has to fulfil particular requirements: drying the rated capacity; reach nominal final moisture content 0 %; maximum programme duration 200 min for D1 and 130 min for D2.
  - No reference dryer is needed as the goal of residual moisture % does not need to be measured against a reference, but its weight only.

In addition, Electrolux Professional suggested following requirements on the declaration programme:

  - Maximum time: 45 min air vented dryers,
  - Maximum time: 75 min heat pump dryers.

For drying tumblers tested according to EN 17116-2, the final moisture content fmc of 9 % (± 2 %) after drying is already specified in the standard. Additional tests are also carried out with a final moisture content of 2 % (± 0.5 %). Therefore, the study team suggests applying the same final moisture content of 9 % (± 2 %) and 2 % (± 0.5 %) when testing a tumble dryer according to EN 50594.

Finally, as mentioned earlier (see **Table 3-177**), no standard has been developed for commercial cabinet dryers (D3). It would be necessary to develop an EN test standard for this category of product, in order to be able to regulate this specific market. However, no on-going

standardisation work is known, accordingly, the process to develop a standard would take about 5 years.

Important remark:

When the process of covering a product with a harmonised standard takes too long, a fallback solution is possible under Article 42 of the ESPR. This allows common specifications to be formulated in the implementing act because the conditions in points 1(a)(ii) and 1(b) are met, see box below.

Article 42

Common specifications

1. The Commission may adopt implementing acts establishing, for products covered by delegated acts adopted pursuant to Article 4, common specifications covering ecodesign requirements, the essential requirements for digital product passports referred to in Articles 10 and 11 or the test, measurement or calculation methods referred to in Article 39.

Those implementing acts shall only be adopted where the following conditions are fulfilled:

(a) the Commission has requested, pursuant to Article 10(1) of Regulation (EU) No 1025/2012, one or more European standardisation organisations to draft a harmonised standard for an ecodesign requirement, for an essential requirement for digital product passports referred to in Articles 10 and 11 of this Regulation or for a test, measurement or calculation method referred to in Article 39 of this Regulation; and:

(i) the request has not been accepted;
(ii) the harmonised standard addressing that request is not delivered within the deadline set in accordance with Article 10(1) of Regulation (EU) No 1025/2012; or
(iii) the harmonised standard does not comply with the request; and

(b) no reference to harmonised standards for an ecodesign requirement, for an essential requirement for digital product passports referred to in Articles 10 and 11 of this Regulation or for a test, measurement or calculation method referred to in Article 39 of this Regulation is published in the *Official Journal of the European Union* in accordance with Regulation (EU) No 1025/2012 and no such reference is expected to be published within a reasonable period.

The implementing acts referred to in the first subparagraph of this paragraph shall be adopted in accordance with the examination procedure referred to in Article 73(3).

Following the standardisation request M495[112], which covers standardisation needs for commercial and industrial washing machines, dryers and dishwashers, standards have been elaborated covering all Base Cases except D3. The reason for this omission is unclear; however, if case (i), (ii) or (iii) were confirmed, Article 42 could be applied for Base Case D3 (Cabinet Dryer). The common specifications could, for example, be based on the testing methods currently used by some manufacturers.

[112] See https://law.resource.org/pub/eu/mandates/m495.pdf

Performance requirements (ESPR Art. 6)

Approaches to set requirements

In this preparatory study, there is a lack of data, as the following table shows.

Table 3-180: Data available to assess performance requirements.

	Commercial	Industrial
Washers	EN 50640:2018 • no requirements for a declaration programme, but thresholds suggested by stakeholders • data of products tested according to the standard not available	EN 17116-3 and EN 17116-4 • no requirements for a declaration programme • some products have been tested by manufacturers (average performance available)
Dryer	EN 50640:2018 • no requirements for a declaration programme, but thresholds suggested by stakeholders • data of products tested according to the standard not available	EN 17116-2 (drying tumblers) • fmc defined • some products have been tested by manufacturers (average performance available)

To deal with this situation, the following approaches have been considered in order to elaborate performance requirements (thresholds) in a future regulation:

- **Approach 1**: The performance requirements could be formulated as a relative figure in the regulation: e.g. "***minimum performance is set at the level reached by [x %] of the models on the market***".

  The approach would look like:

  - **From T0 + [6 months] to T0 + [2 years]:** information requirement and data collection, test reports based on the EN standards (or, in the absence of such definition in the standard, the Delegated Act).
  - **From T0 + [2 years] to T0 + [5 years]:** continuation of the information requirement.
  - **At T0 + [2 years]:** compilation of the performance data collected, as specified above, on the models relevant for each BC during the data collection period. For each BC, a statistical distribution of performance levels is obtained.
  - **At T0 + [2.5 years]:** publication by the Commission of the performance requirements, based on a rule fixed ex ante in the Delegated Act and based on the statistical distribution of the performance observed on the market during the data collection period, i.e. from T0 + [6 months] to T0 + [2 years]: the minimum performance is set at the level reached by [80%] of the models on the market, so that the [20%] worst-performing machines would be removed.
  - **After T0 + [5 years]:** entry into force of the performance requirements.

Remark: Such an approach has some similarities with the Japanese TopRunner programme.[113]

- **Approach 2**: From the beginning, an information requirement would be set. 2 years later, minimum performance would be mandatory: the regulation would mention when the requirements would be mandatory, but not which level of the requirement is foreseen.
  The threshold would be defined later, allowing the time to evaluate the market. Therefore, the regulation would be formulated as such:

  "The Commission is **empowered to adopt a delegated act** in accordance with Article XX to supplement this Regulation by providing the Ecodesign requirement YY".

- **Approach 3**: The forthcoming regulation would only include an information requirement.

  The minimum requirements would be elaborated later within the **review of the forthcoming regulation** including an improved process-based analysis, i.e. for machines not based on "batch process".

- **Approach 4**: Minimum requirements to be assessed before the regulation is published, based on a sample of data reflecting the market.

The first approach has not previously been applied within the Ecodesign framework, and its legal feasibility would require further assessment. As for the second approach, consultations with the European Commission confirmed that it is legally not possible.

Approach 3 is supported by several manufacturers and by APPLiA, which previously proposed a similar strategy through a voluntary agreement. However, this approach has the drawback of generating only limited savings under the initial regulation. In this case, minimum performance requirements would be introduced solely in the review regulation and implemented two years thereafter, resulting in an overall process that is considerably prolonged.

For these reasons, approach 4 is preferred. However, it entails some challenges:

- It would require a rapid and intensive testing campaign.
- In particular, commercial products should be prioritised, as:
  - No relevant test report results have been made available to the study team. Moreover, due to the absence of a declaration programme, the tests conducted to date may have limited relevance and comparability.
  - The largest saving potentials are expected for the base cases WM2 (commercial washer extractor designed for extra-long durability) and D2 (commercial tumble dryer designed for extra-long durability).

[113] H.P. Siderius and H. Nakagami (2007) *Top Runner in Europe? Inspiration from Japan for EU Ecodesign Implementing Measures*, source: https://www.eceee.org/static/media/uploads/site-2/library/conference_proceedings/eceee_Summer_Studies/2007/Panel_6/6.024/paper.pdf

- For industrial machines: average figures based on products tested are already available and have been shared by ETCT (see **Table** 3-172). These values could serve as a useful starting point for defining reasonable minimum performance requirements, enabling the removal of the lowest performing products from the market. Additional data from ETCT or its members during the elaboration of a potential regulation and the Impact Assessment could help assess whether the average figures would be too stringent or not.

Remark: In relation to energy efficiency and space constraints of process laundry machines, as well as possible trade-offs (especially when existing industrial laundry facilities are upgraded or refurbished), the regulation could potentially allow a given product to be less efficient, provided that the waste heat it generates is recovered and used elsewhere in the process to maintain a high overall system efficiency. This point should be further analysed when elaborating the draft regulation and the Impact Assessment.

While for dryers, performance requirements based solely on energy efficiency would be sufficient, the situation for washing machines is more complex: in addition to energy consumption, detergent use and water consumption have significant influence in both LCA and LCC analyses.

Possible requirements

Due to the lack of test reports and of declaration programmes, the study team cannot suggest any requirement level based on any analysis as this was not available.

Still, for commercial products, APPLiA suggested the following requirements:

- WM1 and WM2:

  Assuming a declaration programme based on standard EN 50640:2018 with the following thresholds:

  - Minimum wash performance ratio: 0.93[114],
  - Maximum time: 80 minutes,
  - Maximum RMC: 50 % for soft mounted machines,
  - Maximum RMC: 75 %** for solid mounted machines.

  APPLiA recommends the following requirements for WM1 and WM2 washers:

  - Total energy consumption: < 0.46 kWh/kg,
  - Total water consumption: < 15 l/kg.

- D1 and D2:

  Assuming a declaration programme based on EN 50594:2018 with the following thresholds:

[114] Equal to a wash performance index 65 (Reference Programme Wascator CLS: Cotton 60°).

- Final moisture content:
  - Single test (0 ± 3 %),
  - Test series average to be below 1.5 %.
- Maximum time:
  - 200 min for D1,
  - 130 min for D2.

APPLiA recommends the following requirements for D1 and D2 dryers in terms of total energy consumption:

- For heat pump tumble dryers: <0.64 kWh/kg,
- For other gas, steam and electric heated tumble dryers: <1.9 kWh/kg.

It is highly positive that the principle of establishing requirements for commercial laundry products seems to get support from relevant stakeholders. However, in the subsequent process, the stringency of these requirements should be carefully assessed based on data collected and shared with the study team and the European Commission (see above, Approach 3). It can be observed that the thresholds proposed by APPLiA for dryers with heat pumps (0.64 kWh/kg), although not directly comparable, are slightly above the upper limit of the Swiss programme (0.2 - 0.55 kWh/kg depending on capacity), which was specifically designed to promote the acquisition of heat pump dryers. Moreover, the ratio between the proposed thresholds for dryers without and with heat pump suggest that a coefficient of performance[115] of approximately 3[116] was assumed for heat pump technologies .

Regarding industrial laundry appliances, the average figures provided by ETCT during its own testing campaign cannot be directly used to define requirements. However, they offer useful orientation on the expected order of magnitude:

- Industrial Continuous Tunnel Washer (WM5) (performance according to EN 17116-3[117]):
  - Total energy consumption: 0.41 kWh/kg laundry,
  - Water consumption: 4,8 to 5.5 l/kg laundry,
  - Detergent consumption: 8 to 9 g/kg laundry.

- Washer extractors (performance according to EN 17116-4):
  - Total energy consumption: 0.54 kWh/kg laundry,
  - Water consumption: 10,5 to 13 l/kg laundry,
  - Detergent consumption: 18 to 20 g/kg laundry.

[115] Reflecting the efficiency of a heat pump
[116] 1.9 / 0.64 = 2.97
[117] Using linen textile for the test, see section 5.4.4.2. of the EN 17116-3 standard.

- Dryers (performance according to EN 17116-2):
  - Average values of specific total energy in water:
    - fmc 2 %: 1.7 kWh/kg laundry,
    - fmc 9 %: 1.51 kWh/kg laundry,
  - Average values of specific total energy in textile:
    - fmc 2 %: 0.88 kWh/kg laundry,
    - fmc 9 %: 0.61 kWh/kg laundry,

Table 3-181: Average values of dryers.

Average values of specific total energy in kWh/kg laundry		Averages values of specific total energy in kWh/kg laundry	
Water		**Textile**	
fmc 2 %	fmc 9 %	fmc 2%	fmc 9%
1.7	1.51	0.88	0.61

Further reflections

Instead of setting specific minimum requirements for each parameter (energy, detergent, and water consumption in the use phase) as measured in line with the EN standard for the declaration programme, an alternative approach would be to set a minimum requirement on a parameter combining of the three aforementioned parameters[118] and reflecting the environmental impact of each one as follows:

$$performance = \frac{w_e \times E + w_d \times D + w_w \times W}{M}$$

With:

E: energy consumption in the use phase (in kWh or MJ),

D: detergent consumption in the use phase (in kg),

W: Water consumption in the use phase (in m³),

w: weighting factor,

M: mass of the laundry washed.

[118] Not for products tested according to EN 50640.

The weighting factors could be derived from the environmental impact of each parameter based on the PEF single score as suggested in **Table 3-182**.[119]

Table 3-182: Suggested weighting factor to convert specific consumption in PEF single score.[120]

Consumption in the use phase	Quantity	Corresponding PEF single score
Electricity	1 kWh	3.06E-05
Heat	1 MJ	3.47E-06
Water	1 m^3	2.05E-04
Detergent	1 kg	2.44E-04

Further technical and methodological analysis would be needed to validate the weighting and ensure comparability of the results. The industry mentioned in their stakeholder feedback that they would not support such an approach.

In case that there is no possibility to set quantitative requirements, Article 6(2) Point b of the ESPR could be used:

> *"2. The performance requirements shall be based on the relevant product parameters referred to in Annex I and shall, as appropriate, include either or both of the following:*
>
> *(a) minimum or maximum levels in relation to a specific product parameter or a combination thereof;*
>
> *(b) non-quantitative requirements that aim to improve performance in relation to one or more of such product parameters."*

This means that in cases where no metric or threshold can be defined for a relevant product parameter, an alternative approach would be to set mandatory requirements based on the analysis conducted in MEErP Task 6. For example, regarding energy efficiency: if no specific criteria or minimum performance level can be determined, then DOs identified as contributing to reduced environmental impact and lower lifecycle costs may be set as non-quantitative requirements for new products.

Information requirements (ESPR Art. 7)

As already emphasised, the lack of a (harmonised) data basis represents one of the greatest challenges in the context of this study. Accordingly, information requirements play a crucial role. Information requirements could address several key areas.

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119 PEF single scores were calculated for each BC, aggregating impacts across all life cycle stages over the product's entire lifetime. Although the ERT already calculates all sixteen PEF impact categories and provides the necessary inputs for single-score calculation, it does not perform a full, PEF-aligned LCA study. Therefore, scores derived from the tool should be treated as an indicative guidance than as a comprehensive PEF assessment when comparing results.

120 Based on MEErP Task 6

- Products should be tested according to the standards mentioned above. At least, the following information should be reported:
  - information related to the declaration programme,
  - name of the programme chosen and settings,
  - electricity consumption,
  - steam consumption,
  - gas consumption,
  - detergent consumption (for WM[121]),
  - water consumption,
  - duration information or productivity,
  - wash performance (for WM),
  - remaining moisture content.
- General information such as:
  - heating source (electric, gas, steam, non-heated) and type,
  - nominal capacity,
  - loading: manual / automatic,
  - batch / continuous,
  - noise level.
- SoCs: see information requirements in the section further below.

Remark: Please note that the information requirements that will be laid down in the Delegated Act, shall then be provided in the DPP according to Art. 7(7) ESPR.

Labelling requirements

The 2011 study proposed the introduction of an energy label for both 'professional washing machines' and 'professional dryers', based on the label developed for household appliances.

Given that commercial and industrial laundry appliances are B2B (B2B) products purchased by professional customers who typically prioritise operating costs (directly linked to energy, detergent, and water consumption), it is assumed that robust information requirements alone would be sufficient to guide purchasers towards more sustainable choices.

Consequently, no specific need for an additional label (such as an ESPR label or energy label) has been identified in this context.

[121] Not for products tested according to EN 50640.

Hence, in accordance with Article 7, paragraph 2, point (b)(i), classes of performance could be defined, where appropriate, particularly for the performance parameters specified in the section further above.

Digital Product Passport (DPP) (ESPR Art. 9)

This chapter evaluates the DPP requirements for the product group of commercial and industrial laundry appliances, in line with the provisions of ESPR Article 9, Annex III and referenced or related articles.

Commercial and industrial laundry appliances machines are not covered by EPREL (EU Product Database for Energy Labelling) established under the Energy Labelling Framework Regulation (EU) 2017/1369. Therefore, the exemption clause in ESPR Article 9(4)(b), which allows DPP exemptions for products already covered by EPREL, does not apply to commercial and industrial laundry appliances. This reinforces the importance of implementing a DPP for this product group.

Commercial and industrial laundry appliances represent a high-impact product group in terms of energy consumption, water usage and material durability due to their intensive use in commercial environments. This makes them subject to frequent maintenance cycles, repairs and potential second-hand use, which make them relevant for the implementation of a DPP as it potentially allows to track such individual product information (usage cycled, individual repairs and product condition). However, the benefit of item-level information should be carefully evaluated against the implementation effort for such a DPP. Beneath, starting in **Table 3-184,** the project team suggests mandatory and optional DPP requirements.

There is no official or harmonised approach **to elaborate on the DPP requirements**, yet; the harmonised methodology is expected to be delivered at the end of 2025 by the European Commission's Joint Research Centre (EC-JRC) under the service contract *Technical assistance in defining requirements for the inclusion of data and information in the Digital Product Passport (DPP)*.

Therefore, the **approach used** and the elaborated requirements presented in this chapter are to be seen as preliminary and may need to be reviewed and aligned once the harmonised EC-JRC approach is made available.

The **scope** covers both technical aspects (e.g. data carrier, layout, granularity, accessibility, governance, and update arrangements) and information aspects (e.g. sustainability-related data fields, access rights for different actors, and traceability requirements). Each requirement is considered in relation to its specific use-cases within the commercial and industrial laundry appliance sectors, recognising that the relevance and configuration of individual DPP elements will vary depending on the actors involved and the intended purpose of the information.

From an **implementation perspective**, it may not be necessary at this stage for every individual actor who puts a product on the market to build and maintain a fully independent DPP system or to deeply engage with every regulatory detail. DPP service providers already offer DPP-compliant services that can handle data storage, validation, and access rights in

line with ESPR requirements. Costs for such services depend on the approach (do-it-yourself, delegated solution or DPP as a service) and several factors. A qualitative evaluation can be found in a study "A study on DPP costs and benefits for SMEs" of the CirPass project[122] . Alternatively, a centralised DPP platform could be hosted by sectoral industry associations, which are typically familiar with regulatory obligations and have both technical and organisational capacity for data management. This centralisation can streamline compliance, especially for small and medium-sized enterprises, and enhance interoperability across actors involved in the product life cycle.

Table 3-183 shows a comprehensive overview of DPP use cases, related stakeholder and for which use-cases a DPP is necessary (highlighted in bold). See also **Annex XI: Further DPP aspects** in this document for the full table-based overview of specific use-cases / goals and corresponding ESPR DPP requirements. Rows highlighted in green show use-cases that are seen potentially relevant by the project team. A validation of the relevance is necessary by the involved stakeholder in order to make a final decision regarding which use cases should be prioritised for implementation. The chosen use-cases determine the associated stakeholder and regulatory needs.

To note, the right column still shows if a use case could also be realised through EPREL, extended by specific information. Due to the circumstance, that commercial and industrial laundry appliances are not and will not be covered by EPREL, this option is obsolete.

Table 3-183: Overview of use-cases per stakeholder and whether a DPP is necessary.

Stakeholder	Use-case (CE-goal)	Information to be provided	Feasible with EPREL / DPP
Customer	Sustainable purchase	CO2 footprint, circularity indicators (e.g. reparability), recycled content	EPREL (extended with sustainability information)
Customer	Sustainable purchase	Environmental and social label	EPREL (extended with label)
Customer	Sustainable purchase	Technical specifications / documentation	EPREL
Customer	Prolong use (maintenance, DIY repair)	Use, maintenance and DIY repair instructions	EPREL (extended with manuals)
Customer	Resell & second hand purchase	Usage history, repair history	DPP (item level information)
Customer	Proper disposal	Disposal and return options	EPREL (extended with disposal information)
Repairer	Professional (certified) repair	Dismantling instructions, spare part availability, etc.	EPREL (extended with repair information)
2nd hand operator	Enable reuse	Usage history, repair history	**DPP (item level information)**

[122] Online available at https://cirpassproject.eu/wp-content/uploads/2024/02/CIRPASS-A-study-on-DPP-costs-and-benefits-for-SMEs-v1.0-1.pdf, last accessed on 13.01.2026

Stakeholder	Use-case (CE-goal)	Information to be provided	Feasible with EPREL / DPP
Refurbisher	Enable refurbishment	Dismantling instructions, usage & repair history	**DPP (item level information)**
Remanufacturer	Enable remanufacturing / repurposing	Dismantling instructions, usage & repair history	**DPP (item level information)**
Collection & Presorting	Preparation for reuse	Energy efficiency, Usage/repair history, purchase date, original product price	**DPP (item level information)**
Collection & Presorting	Component sorting	Dismantling instructions	EPREL (extended)
Collection & Presorting	Separation of products/components with prohibited substances (WEEE, RoHS, REACH, etc.)	Prohibited / hazardous substances per component (incl. Batteries)	EPREL (extended with material information)
Collection & Presorting	Separation of products/components with valuable materials	Valuable materials	EPREL (extended)
Collection & Presorting	Closed loop recycling	Application type, model	EPREL (extended)

Based on the above use cases which are evaluated as relevant, the aspects according to ESPR article 9 need to be determined, shown in following table. This means, that the following table initial suggestions and indication of potentially relevant requirements:

Table 3-184: Overview of aspects to be determined according to ESPR Article 9

(a) the data to be included in the digital product passport pursuant to Annex III. See **Table 3-185**, **Table 3-186**
*(b) one or more **data carriers** to be used* Recommended: QR code combined with optional RFID. QR code placed on the machine exterior (service panel or control housing). RFID tag embedded in industrial models for use by service teams. This ensures access for both end-users and professionals under typical use and service conditions.
*(c) the **layout** in which the data carrier is to be presented and its positioning.* QR code must be visible without disassembly, ideally near the product nameplate. Label should indicate it links to a DPP. Must withstand humidity, detergents, and mechanical cleaning.

(a) the data to be included in the digital product passport pursuant to Annex III.

See **Table 3-185**, **Table 3-186**

*(d) whether the digital product passport is to be established at **model, batch or item level**, and the definition of such levels.*

Recommended level: Model-level with optional item-level extension

- This matches industry practices where technical configurations are standardised across units.
- Batch-level data (e.g. production date ranges) can be optionally linked.
- Item-level data (e.g. individual condition, repaired parts) might be considered when individual machines have to be recognised (use-cases: repair, predictive maintenance, with high variability and presence of personalised configurations.

*(e) the **manner in which the product passport is to be made accessible** to customers before they are bound by a contract for sale, hire or hire purchase, including in the event of distance selling.*

The DPP must be accessible via:

- URL or QR code in online product listings;
- Scannable code on showroom displays;
- PDF or data link in downloadable brochures or sales platforms. This supports transparency and compliance with EU consumer law.

*f) the actors that are to **have access to data** in the Digital Product Passport and to what data they are to have access;*

See next section

- Public
  - Information: e.g. energy and water performance, durability, repair instructions.
- Professionals
  - Manufacturers/importers: full access and control rights.
  - Recyclers: e.g. material composition, hazardous substance & location.
- End-users/customers: to be clarified
  - Service technicians: e.g. disassembly instructions, software versioning, spare part IDs.
- Market authorities: all information including conformity and substance declarations.

*g) the actors that are to **create a Digital Product Passport or update the** data in a Digital Product Passport and what data they may introduce or update.*

- Manufacturers or DPP service provider: create the initial DPP and ensure updates for revisions.
- Importers: update localisation fields where required (language, distributor info).
- Other professionals (e.g. repairers, refurbishers): add repair status, refurbishment status or updated maintenance logs, where permitted.
- Service providers: may add non-binding service logs or condition reports.

h) the detailed arrangements for introducing or updating data.

- Use of central DPP platforms authorised by industry or EC-recognised bodies.
- Version-controlled updates with timestamped logs.
- Role-specific authorisation to prevent unauthorised overwrites.

To note, further actors are listed in ESPR "Article 11 The technical design and operation of the digital product passport shall comply with the following essential requirements", which might be specified in detail, depending on the decision which use-case are relevant: "ESPR Article 11 (b) customers, manufacturers, importers, distributors, dealers, professional repairers, independent operators, refurbishers, remanufacturers, recyclers, market surveillance authorities and customs authorities, civil society organisations, trade unions and

other relevant actors shall have free of charge and easy access to the digital product passport based on their respective access rights set out in the applicable delegated act adopted pursuant to Article 4;"

The **validation of the proposed DPP use cases and related requirements** for commercial and industrial laundry appliances is essential to ensure their practical relevance, technical feasibility, sectoral alignment and (most important) acceptance amongst all stakeholders. This validation should involve a comprehensive stakeholder engagement process, including all stakeholders that are involved in the use-cases along the product's life cycle and DPP handling (have access, can write or update data). Workshops, structured interviews, or online surveys are potential formats to gather detailed input. Due to the complexity and number of affected actors, this validation will require substantial coordination and resources.

Table 3-185: Evaluation of data / requirements related requirements according to ESPR ANNEX III Information requirements.

Digital Product Passport Data Element (Annex III ESPR)	Relevant for DPP? (Yes/No)
(a) Information required under Article 7(2)(b), Article 7(5), or other Union law	See next section
(b) Unique product identifier at level indicated in delegated act	Yes - To be determined by standardisation
(c) the Global Trade Identification Number as provided for in International Organization for Standardisation/International Electrotechnical Commission standard ISO/IEC 15459-6 or equivalent of products or their parts; or (upcoming) 18219 Unique Identifiers	Yes - To be determined by standardisation
(d) relevant commodity codes, such as a TARIC code as defined in Regulation (EEC) No 2658/87;	Yes - To be determined by standardisation
(e) Compliance documentation (e.g., declaration of conformity, technical documentation, certificates)	Yes
(f) User manuals, instructions, warnings, or safety information as required by EU law	Yes
(g) Manufacturer information (including unique operator identifier, Article 27(7) info)	Yes
(h) Unique operator identifiers (others than manufacturer) *Excerpt from ESPR Article 2 Definitions: Operator = "actor involved in a product's value chain"*	Yes
(i) Unique facility identifiers *Excerpt from ESPR Article 2 Definitions and preamble (36): Facility = „locations or buildings involved in a product's value chain or used by actors involved in a product's value chain;" "[…] allowing the actors and manufacturing facilities related to that product to be traced."*	Yes
(j) Importer information, including Article 29(3) info (name, registered trade name or registered trademark, postal address) and EORI number	Yes
(k) Responsible EU-based economic operator info (Article 4 Reg. 2019/1020 or Article 15 Reg. 2023/988)	Yes

Digital Product Passport Data Element (Annex III ESPR)	Relevant for DPP? (Yes/No)
(l) Reference of the DPP service provider hosting the backup copy	Yes
Standards compliance (where relevant): ISO/IEC 15459-1 to -6 or (upcoming) 18219 Unique Identifiers	Yes – where relevant
Optional ecodesign-relevant data: Additional manufacturer-provided information (e.g., voluntary labels)	Yes – where relevant
– Includes indication whether an EU Ecolabel has been awarded (Reg. (EC) No 66/2010)	Yes – where relevant

Table 3-186: Evaluation of data related requirements according to ESPR Article 7 Information requirements.

Information Requirement (from Article 7 ESPR)	Relevant? (Yes/No)
1. General compliance: Compliance with information requirements laid down in delegated acts under Article 4	Yes
2(a). Minimum requirement: Digital product passport (Chapter III)	Yes
2(a). Minimum requirement: Information on substances of concern (Article 7.5)	Yes
2(b)(i). Performance parameters: Repairability score	(Likely) No – only if information or performance requirement are set
2(b)(i). Performance parameters: Durability score	(Likely) No – only if information or performance requirement are set
2(b)(i). Performance parameters: Carbon footprint	(Likely) No – only if information or performance requirement are set
2(b)(i). Performance parameters: Environmental footprint	Likely no
2(b)(ii). Customer instructions: Installation, use, maintenance, and repair	Yes
2(b)(ii). Customer instructions: Installation of third-party operating systems (where relevant)	Yes
2(b)(ii). Customer instructions: Collection for refurbishment or remanufacture	To be clarified
2(b)(ii). Customer instructions: Return or handling at end-of-life	Yes
2(b)(iii). Treatment instructions: Disassembly, reuse, refurbishment, recycling, disposal	Yes
2(b)(iv). Other relevant information: For sustainable product choices and end-of-life handling by third parties	Yes
2(c). Clarity Requirement: Information must be clear, understandable, and tailored to the target audience	Yes
3. Substances labelling restriction: No info on hazards for labelling purposes per Annex I(f)	To be clarified
4. Performance classes: If set, must reflect significant improvements and include minimum class level	Yes – if performance classes are set

Information Requirement (from Article 7 ESPR)	Relevant? (Yes/No)
5 (a)-(d) Substance information (SoC contained in the product)	See MEErP Task (SoC)
5(a)(i). Substance identification: IUPAC name or international name	Yes
5(a)(ii). Substance identification: Other/trade names, abbreviations	Yes
5(a)(iii). Substance identification: EC number (EINECS/ELINCS/NLP/ECHA)	Yes
5(a)(iv). Substance identification: CAS name and number	Yes
5(b). Substance location: Within the product or components	Yes
5(c). Substance concentration: At product/component/spare part level	See MEErP Task 5 (SOC)
5(d). Safe use instructions: For hazardous substances	If relevant
5(e). End-of-Life info: For disassembly, reuse, recycling, environmentally sound disposal	Yes
6(a). Applicability dates: Differentiation of start dates for different substances	Yes
6(b). Exemptions: Based on technical feasibility, analytical methods, CBI protection, etc.	Yes
6(c). Alignment of information requirements with other EU laws and minimisation of admin burden	To be clarified
7. Format of availability: Information must be provided via DPP and possibly also:	
- on the product itself	Yes (at least selected information)
- on packaging	Yes (at least selected information)
- on a label (Art. 16)	No
- in a user manual or other docs	Yes (at least selected information)
- on a free-access website or app	Yes
7. Data carrier requirement: Info on substances of concern must be on product or accessible via data carrier	Via data carrier
8. Language requirement: Easily understood by customers in target Member State	Yes

Green Public Procurement GPP (ESPR Art. 65)

In MEErP Task 2, no specific data could be collected regarding the market share of products purchased by public authorities. However, the European Commission indicates that public procurement represents 14 % of the European Union's GDP,[123] highlighting its substantial impact on the economy. Commercial and industrial laundry machines are operated in or by various public entities, including hospitals, nursing homes, prisons, and similar facilities. Thus,

[123] See ESPR regulation: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401781.

it is reasonable to assume that Green Public Procurement (GPP) could have a meaningful impact on the EU market for commercial and industrial laundry machines.

Article 65 of the Ecodesign for Sustainable Products Regulation (ESPR) states that "the minimum requirements shall be based on the two highest performance classes, the highest scores, or, when not available, on the best possible performance levels as set out in the delegated act adopted pursuant to Article 4 applicable to the product groups in question.". This provision emphasises the need for establishing high performance standards that align with environmental sustainability objectives. Setting GPP requirements close to the Best Available Techniques (BAT) level appears to be justified, as MEErP Task 6 indicated that the BAT level corresponds to the lowest LCC level.

Circular economy

Spare parts

In order to ease repairability of the commercial and industrial laundry appliances and to extend the lifetime, the following requirements on the spare-parts are suggested:

- All products shall offer access to spare parts within a maximum delivery time. Current Ecodesign regulations require 15 working days. For commercial and industrial products, it is proposed to reduce this period to 5 working days, given the high volume of laundry processed by clients and the need to minimise operational downtime.
- APPLiA has emphasised that the actual delivery process lies outside the manufacturers' control. Therefore, the proposed 5-working day timeframe should refer specifically to the handover of spare parts to an express logistics provider, rather than final delivery to the end user.
- This availability must be guaranteed for a minimum period of ten years following the placement of the last unit of the model on the market.

Following parts are suggested to be covered by the requirements:

Table 3-187: Suggested list of spare parts.

Washers	Dryers
Heating elements	Tumble drums, motors, parts of the 'traction systems'
Hoses	Filters
Belts and chains	Belts and chains
Springs and dampers	Support rollers
Temperature sensors and thermostats	Temperature sensors and thermostats
Door lock systems	Door lock systems
Bearings and sealings (incl. door sealings)	Bearings and sealings (incl. door sealings)

Washers	Dryers
Relays (contactors)	Relays (contactors)
Water sensors	Drum felt sealings
Parts of the dosing system124	Electronics
Parts related to the water circulation system e.g. circulation pump, piping.	Tumble drums, motors, parts of the 'traction systems'
Electronics	
Tumble drums, motors, parts of the 'traction systems'	

Remark: For discontinued components, it was suggested to allow the possibility of replacement options.

In addition, manufacturers shall provide comprehensive repair and maintenance information to facilitate servicing by professional repairers and, where applicable, end-users.

Important remark:

Concerns have been raised regarding motors (spare parts after 2029) and fans (spare parts after 2037). However, these components fall under the scope of dedicated motor and fan regulations, including their respective ongoing reviews. Therefore, they are not covered by the potential regulation for commercial and industrial laundry appliances under the Ecodesign framework.

Critical raw materials

Washing machines and dryers are already explicitly mentioned in the scope of Article 28 of the CRM Act Regulation (EU) 2024/1252:

- Art. 28 (Recyclability of permanent magnets),
- Art. 29 (Recycled content of permanent magnets).

Furthermore, the CRM Act mentions in Article 29, Point 3: *"After the entry into force of the delegated act adopted pursuant to paragraph 2, and in any event by 31 December 2031, the Commission shall adopt* ***delegated acts supplementing this Regulation by laying down minimum shares*** *for neodymium, dysprosium, praseodymium, terbium, boron, samarium, nickel and cobalt recovered from post-consumer waste that must be present in the permanent magnet incorporated in the products referred to in paragraph 1."*

Consequently, no specific need to regulate additional CRM aspects under ESPR has been identified.

[124] If integrated into the washer

Substances of concern

The ESPR requires manufacturers of commercial and industrial laundry appliances to provide requested information, resulting in tracking obligations for all SoCs present in their products concerning their identity, location, concentration, safe-use instructions, and EOL treatment.[125] Based on the analysis carried out in Task 5, to meet these obligations with minimal duplication and maximum alignment, the following thresholds (based on draft JRC guidance) are recommended:

- A 0.1 %w/w threshold for SVHCs (Art. 2(27)(a)) and POPs (Art. 2(27)(c)) in line with REACH Art. 33(1),
- UN Globally Harmonised System (GHS) generic concentration limits (or, where absent, the lowest CLP GCLs) for hazard-classed substances under Art. 2(27)(b), supplemented by the latest endocrine-disruptor and PMT/PBT criteria, and
- A uniform 0.1 % w/w cutoff for SoCs affecting circularity (Art. 2(27)(d)), pending more granular data.

Because full lifecycle intentionally added substances (IAS) and non-intentionally added substances (NIAS) data collection is time- and resource-intensive, the scope is limited to product-specific IAS present in the final product, including its components and spare parts. Three implementation scenarios are proposed:

- Ambitious: covering all SoCs without exemptions,
- Intermediate: case-by-case exemptions for substances based on solid justification, and
- Limited: tracking only Art. 2(27)(a–c) substances with broader approach towards exemptions within the flexibilities offered by the legal text, coupled with a targeted study to identify additional Art. 2(27)(d) candidates for selected regulation through amending the delegated act.

A five-year roll-out is recommended across all scenarios to allow for supplier engagement, data gathering, and Digital Product Passport integration. An assessment of feasibility and administrative burden should be undertaken as part of the impact assessment.

Finally, performance requirements under Art. 6 of the ESPR need not be imposed at this stage: current WEEE/RoHS recycling frameworks are working satisfactorily, and stakeholder feedback has not identified any specific performance gaps. As new research or recyclability insights emerge, revisiting performance criteria should be considered.

Stakeholders have expressed concerns regarding the proposed requirements and the burden it may place to businesses. However, these concerns mainly relate to the ESPR's general approach on SoC rather than to the way the framework has been applied to this product group. Consequently, the majority of the comments fall outside the scope of the study and the mandate of the study team.

[125] SoCs are in the scope of Ecodesign requirements (Art. 5) and Information requirements (Art. 7) of the ESPR regulations.

3.6.3. Scenario analysis

The scenario analysis is performed using a stock model calculation, comparing a BAU scenario with BAT for the different base cases. Inputs are the EcoReport data for base cases (Task 5) and design options (Task 6), as well as the sales data in the reference year and projections for market trends (based on Task 2).

Section 3.6.3.1 starts by describing the data inputs for the scenario analysis, including inputs from previous Tasks as well as necessary assumptions such as on market development. Thereafter, **Section 3.6.3.2** introduces the logic behind the stock model, including its components and the granularity level. Results of the environmental assessment are presented in **Section 3.6.3.3**, structured according to sales and stock, use-stage electricity, gas, water and detergent consumption. After the environmental results, socio-economic impacts are presented (**Section 3.6.3.5**) and finally a sensitivity analysis (**Section 3.6.3.6**).

3.6.3.1. Inputs from previous Tasks and necessary assumptions

Base Cases, Design Options and policy timing

The analysis includes the seven BCs described in MEErP Task 5 and Task 6. Five are washing machines, four are dryers. **Table 3-188** lists the BCs and selected input data for the BAU and BAT products variations.

Table 3-188: Selected input data from MEErP Tasks 5 and Task 6 for BAU[126] and BAT.

Base cases	Lifetime [years]		Product price (including installation/ acquisition cost) [Euro]		Electricity consumption (use phase) [kWh/year]		Thermal energy (use phase) [MJ/year]		Water consumption (use phase) [m³/year]		Detergent consumption (use phase) [kg/year]	
	BAU	BAT	BAU	BAT	BAU	BAT	BAU	BAT	BAU	BAT	BAU	BAT
WM1: Light duty commercial washer extractor	10	12 (+20 %)	2,080	2,184 (+5 %)	987	907 (-8 %)	1,724	1,589 (-8 %)	84	79 (-6 %)	99	91 (-8 %)
WM2: Commercial washer extractor	10	12 (+20 %)	9,360	9,360 (+0 %)	13,237	12,177 (-8 %)	32,264	29,686 (-8 %)	783	736 (-6 %)	957	880 (-8 %)
WM3: Commercial washer dryer	10	12 (+20 %)	13,520	15,080 (+12 %)	33,481	26,785 (-20 %)	-	-	540	508 (-6 %)	594	546 (-8 %)
WM4: Commercial barrier washer	10	12 (+20 %)	36,400	36,400 (+0 %)	2,361	2,173 (-8 %)	45,621	41,970 (-8 %)	1,277	1,213 (-5 %)	1,056	972 (-8 %)
WM5: Industrial continuous tunnel washer	13.7	18.7 (+37 %)	637,650	643,100 (+1 %)	57,375	54,507 (-5 %)	4,131,000	3,924,447 (-5 %)	21,089	20,021 (-5 %)	30,675	27,589 (-10 %)
D1: Light duty commercial tumble dryer	10	12 (+20 %)	1,664	2,496 (+50 %)	1,623	1,299 (-20 %)	-	-	-	-	-	-
D2: Commercial tumble dryer	15	17 (+13 %)	6,240	7,800 (+25 %)	37,537	33,784 (-10 %)	63,833	57,451 (-10 %)	-	-	-	-
D3: Commercial cabinet dryer	10	12 (+20 %)	2,080	2,600 (+25 %)	12,602	11,342 (-10 %)	-	-	-	-	-	-
D4: Industrial pass-through tumble dryer	25	30 (+20 %)	54,500	59,950 (+10 %)	89,760	83,478 (-7 %)	2,752,067	2,259,422 (-7 %)	-	-	-	-

[126] As mentioned in Task 5, WM1-4 and D1-3 use the revised inputs (APPLiA 2025 updated data)

Sales, stocks and market development for the business-as-usual (BAU)

MEErP Task 2 provides sales and stock data for the reference year 2025 (see **Table 3-189**). Due to long lifetimes of e.g. BC D4 (25 years), the modelling timeframe is started in 1980 to establish a continuous inflow and outflow of appliances in the stock. Before this modelling timeframe, a linear ramp up of sales is assumed, over a period corresponding to the lifetime of the BAU BC.

Assumptions for market growth are based on MEErP Task 2. Therein, "*a moderately high growth rate over the last decade of +3.8 % / year CAGR is assumed, with a strong post-Covid recovery at +13.9 % / year CAGR over the years 2020 – 2023*". For individual market segments more nuanced evolutions are considered:

- Coin & Card Laundry (CCL) and Apartment Household Laundry (AHL): linked to the evolution of the overall population, which is stagnating in the EU27, but subject to the competition of privately detained household appliances, which leads to a probable decline in the market.
- Hospitality Laundry (HPL): linked to the activity of the sector NACE I "Accommodation and food services activities", which grew at an average of 1.7 %/year over the years 2011 to 2021.
- Healthcare Laundry (HCL), linked to the evolution of the elderly population, in hospitals and in nursing homes. The population aged 80 years and more has increased its share in the total population of the EU27 from 5.2 % to 6.0 % between 2014 and 2023, at an annual growth rate of 1.44 %/year.
- Commercial Industrial Laundry (CIL), linked to the evolution of the activity of textile services providers, which grew by 1.1 % / year in the years preceding 2014.
- Speciality Laundry (SP), linked to the evolution of the activity of the dedicated sub-segment of the textile services providers which grew by 3.8 %/year in the years preceding 2014.

Following the stated assumptions, the sales in the decade before the reference year (2015-2025) are increased with a constant growth rate of +3.8 %/year.

$$sales(year) = sales_{reference\ year} * 1.038^{year - reference\ year}$$

A different value is assumed for those market segments where information is available. For WM4 (commercial barrier washer) a value of 1.44 % per year is assumed, corresponding to the Healthcare Laundry (HCL) market segment. Similarly, for D2 (commercial tumble dryer), a value of 2.8 % per year is assumed, reflecting its role in the Hospitality Laundry (HPL) market segment.

Prior to 2015, back until 1980, as well as after 2025, a more moderate linear growth is assumed, with an average increase of 1 % per year, compounded annually. In the years preceding 2015 this approximately reflects overall population growth. The further back in time, the less is the influence on the stock in the reference year (different for bases cases due to

their respective lifetimes), therefore this assumption is deemed reasonable. For market segments where more nuanced data was available in MEErP Task 2, the numbers were adjusted accordingly.

In the years after 2025 the sales are expected to grow at a moderate rate of 1.9 % per year due to an increase of elderly population (see also **Table 3-189).**

Table 3-189: Input data from Tasks 5 and 6 and Task 7 assumptions.

Base Case	Annual sales in base year 2025 (units per year)	Dominant market segment	Task 7 sales growth assumptions (per year)		
			1980-2015	2015-2025	2025-2050
WM1: Light duty commercial washer extractor	24,300	Coin & Card laundry (CCL) and Apartment household laundry (AHL)	1 %	3.8 %	1.9 %
WM2: Commercial washer extractor	50,000	Commercial Laundry (CL)	1.1 %	3.8 %	1.9 %
WM3: Commercial washer dryer	405	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	1 %	3.8 %	1.9 %
WM4: Commercial barrier washer	1,215	Healthcare Laundry (HCL)	1 %	1.44 %	1.9 %
WM5: Industrial continuous tunnel washer	250	Commercial Industrial Laundry (CIL)	1.1 %	3.8 %	1.9 %
D1: Light duty commercial tumble dryer	16,000	Coin & Card laundry (CCL) and Apartment household laundry (AHL)	1 %	3.8 %	1.9 %
D2: Commercial tumble dryer	51,000	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL), Hospitality Laundry (HPL), Commercial Industrial Laundry (CIL)	1 %	2.8 %	1.9 %
D3: Commercial cabinet dryer	10,000	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	1 %	3.8 %	1.9 %

Base Case	Annual sales in base year 2025 (units per year)	Dominant market segment	Task 7 sales growth assumptions (per year)		
			1980-2015	2015-2025	2025-2050
D4: Industrial pass-through tumble dryer	1,200	Commercial Industrial Laundry (CIL)	1.1 %	3.8 %	1.9 %

Moving from the BAU to the BAT scenario, the stock is expected to remain identical, as the demand for the number of washing machines and also the cycles per washing machine (functionality of the devices) is expected to be independent from the type of product used. Even with an identical stock, the sales will be lowered however, due to the longer lifetimes of the BAT products (less sales are necessary for the same stock).

Further assumptions are needed for the electricity mix. As the energy consumption during the use phase was identified as an environmental hotspot in MEErP Task 5, it was decided to keep the respective values for global warming impacts (kg CO2 per kWh) and costs (€ per kWh) dynamic, to reflect future changes in the analysis. More specifically a EU policy scenario for delivering the European Green Deal was used for a consistent scenario (starting from the Reference Scenario 2020[127], and building upon the Climate Target Plan, whereas energy, transport and overall GHG emissions are stemming from the PRIMES model (see **Table 3-190**). This scenario depicts a consistent scenario development of carbon intensities and energy costs. The relative development in the scenarios was linked to the absolute, but static assumptions of the MEErP Task 5 environmental assessment. In MEErP Task 5, values are fixed to 0.234 €/kWh for costs and 0.419 kg $CO_{2eq.}$/kWh for greenhouse gas intensity of the electricity grid mix. These values are taken as the reference point in 2025 and are linked to the relative development of the scenarios. For the electricity price, additionally the yearly escalation rate from MEErP Task 5 is added (see below).

Table 3-190: Data on greenhouse gas intensity of electricity production and electricity prices from the EU reference scenario and derived dynamic data for MEErP Task 7.

	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Reference values										
Average Price in final demand sectors[128] *(€'15/kWh)*	- (no value)	0.1332	0.1371	0.1487	0.1545	0.1613	0.1615	0.1628	0.1638	0.1656

[127] https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en

[128] Based on 2020 EU reference scenario (https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en).

	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Greenhouse gas intensity [129] *(kg CO_{2eq}/kWh)*	0.45	0.40	0.37	0.26	0.19	0.12	No values	No values	No values	No values
Dynamic data for Task 7 (reference values normalised to MEErP Task 5 data from base year 2025)										
Electricity price *(€/kWh)*	0.215	0.222	0.228	0.247	0.257	0.268	0.269	0.271	0.272	0.275
Greenhouse gas intensity [130] *(kg CO_{2eq}/kWh)*	0.992	0.882	0.816	0.573	0.419	0.265	0.198	0.132	0.066	0.000

This approach can be understood as an additional layer of detail, tailored to the life cycle stage with the highest impact, and to the impact category with high relevance and highest data availability. Additionally, the yearly escalation rates from MEErP Task 5 (**Annex V: Inputs for LCA / LCC per Base Case**) are considered for the costs of water (0.16 %), electricity (1.62 %), natural gas (2.15 %) and detergent (1.21 %). Investment costs for new products and repair costs are considered with an inflation rate of 2 %.

The technical improvement options, labelled as BAT, are set to be active from January 2028 for all BCs and to apply to all sales from this year onwards. Thereby it is assumed that all new products purchased from 1.1.2028 correspond to the BAT level. This scenario reflects the technical improvement potential which could theoretical be achieved on the commercial and industrial laundry appliance market.

3.6.3.2. Stock model description

The stock model is meant to establish scenarios according to the DOs described in MEErP Task 6 and the policy options described in MEErP Task 7 (**Section 3.6.2**). The model is implemented in Microsoft Excel (several files) and comprises several components. Compared to former approaches, all data (including all impact categories and all life cycle stages) are imported from the ERTs, allowing for a very detailed analysis. As input data from previous Tasks serve especially the MEErP Task 5 assessments for the 9 BCs, respectively for BAU and BAT (in total 18 ERTs), including:

- Purchase price, installation costs, repair costs, electricity, gas, water and detergent costs.

[129] Based on FF55 REG scenario (https://energy.ec.europa.eu/data-and-analysis/energy-modelling/policy-scenarios-delivering-european-green-deal_en). This projection represents an energy system and economy-wide GHG emissions balance compatible with at least 55 % GHG reductions by 2030. The projection ends in 2030, therefore, no values are available for the following years.

[130] With linear extrapolation of values after 2030, assuming that the reduction will continue with decarbonisation of the electricity production until 2050.

- Inflation (or escalation) rates.
- Product lifetime and annual sales (basis for calculating stocks).
- Annual resource consumption (electricity, gas, water, detergents) during the product's use.
- Material and energy flows of all other life phases: product weight and components, materials, energy and processes of manufacture, packaging, transport, repair and disposal.

The stock models serve as the core calculation modules of the model. They calculate the metrics of Sales, Stock, and EOL over time for a base case and the implementation of policy options at various levels. These metrics are interdependent and fundamentally rely on the lifespan of the BCs. The modelling of stocks in this framework follows the formulas outlined in the 2011 MEErP guidelines and the revised version from 2024. The logic of the stock model depends on whether it is driven by sales or stock.

In this context, the terms **Sales**, **Stock**, and **EOL** require further clarification to understand their usage within the stock model.

- **Stock** denotes the total inventory of each BC per time unit. The stock encompasses all active devices within their lifespan at a given time. Thus, the stock serves as the foundation for calculating the environmental impacts during the usage phase. In market data collection, the stock is represented by the value at the beginning of the year, specifically on January 1st of each year.
- **Sales** or **Total Sales** refers to the sales per time unit, which consist of **New Sales** and **Replacement Sales**. A **New Sale** increases the total stock of base cases. A **Replacement Sale** refers to the replacement of a product that has reached the end of its lifespan. Both types of sales imply that another product has been produced; however, in the case of replacement sales, the total inventory remains unchanged. Sales is the controlling factor, allowing for the accounting of all life phases prior to the usage phase.
- **EOL** describes the devices that have reached their maximum lifespan and are now being disposed of. This includes the calculation of emissions and/or credits associated with disposal and recycling.

Generally, in both cases, stock is calculated as the sum of sales between the current time and the current time minus the lifespan of the device.

Here, the sales are provided as the input value (developed based on the inputs from Task 2), based on which the stock in year y can be calculated.

$$stock_y = \sum_{t=y-lifetime+1}^{t=y} sales_t \quad (1)$$

We use a stock-driven approach, therefore changes in lifetime of the BAT should not impact the overall number of products in stock. First, a target stock must be calculated. Thereafter, sales figures are adjusted based on changes in lifetime to match the target stock.

Technical, environmental and economic data is imported from the environmental assessment from MEErP Task 5 and Task 6 for all nine BCs, each with the BAU and the BAT. These product-level impacts are scaled-up using the calculated sales and stock data. For some parameters, dynamic changes over time are considered, namely for the carbon intensity as well as the price of the electricity consumption (see **Section 3.6.3.1)**

The disaggregation level is set on monthly basis, resulting in 840 timesteps for the period 1980 to 2050. For the results calculation, the relevant reference period is from 2025 to 2050.

Figure 3-58 presents a visual representation of the modelling logic and its components.

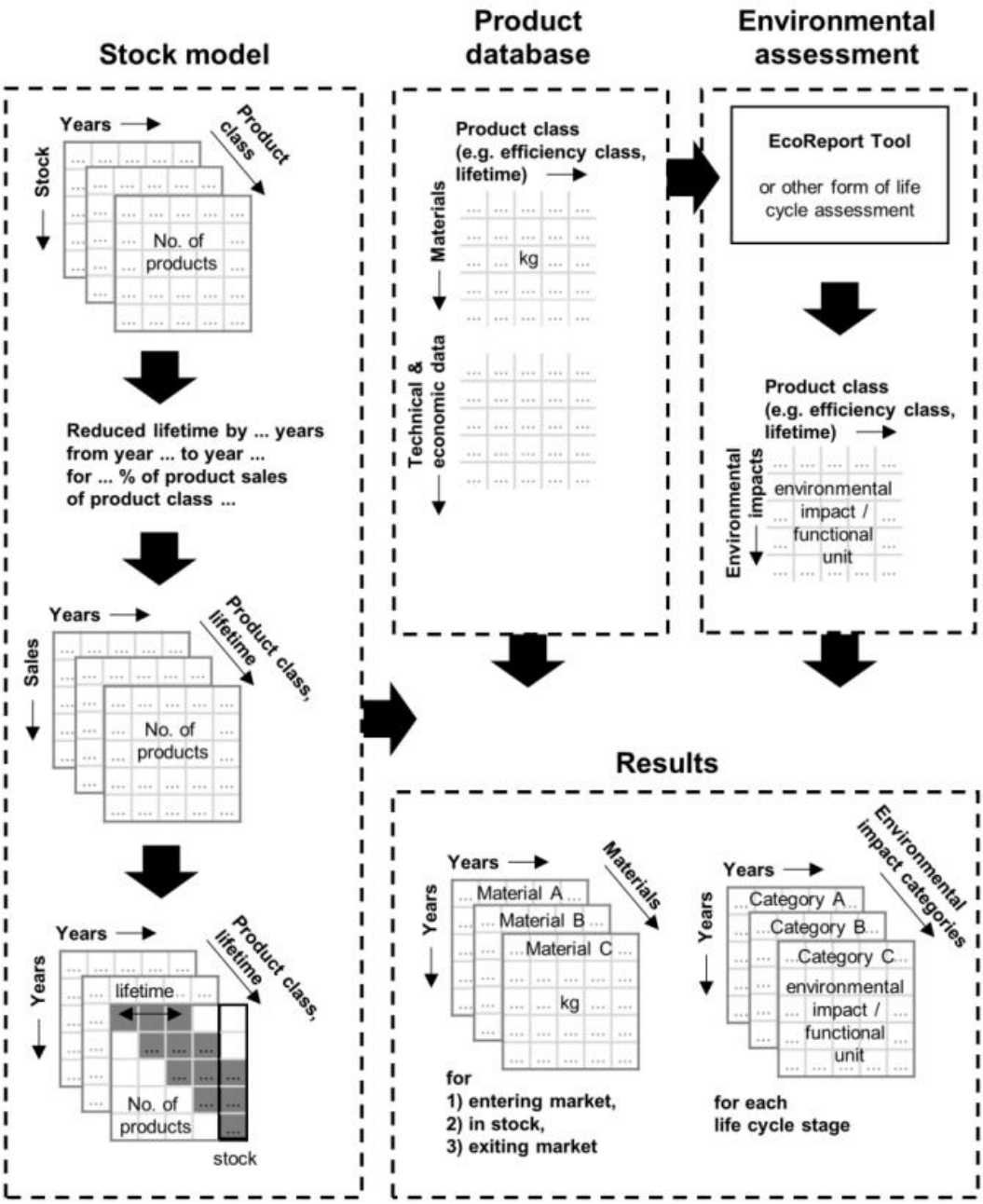

Figure 3-58: Schematic representation of the scenario analysis model.

source: Fraunhofer ISI

3.6.3.3. Results: Sales and stock

Based on the described sales data the stocks for the BAU can be calculated and are shown in **Figure 3-59**. In 2025, sales for the four dryer BCs (D1-D4) accumulate to 873,845 units while for the five BCs representing washing machines the number is 637,857. As can be seen from the graph, BC D2 (Commercial tumble dryer) and WM2 (Commercial washer extractor) are the ones with the highest number of sales. They are followed by WM1 (Light duty commercial washer extractor), D1 (Light duty commercial tumble dryer), and D3 (Commercial cabinet dryer). Very low sales numbers are calculated for WM4 (Commercial barrier washer),

D4 (Industrial pass-through tumble dryer), WM3 (Commercial washer dryer) and WM5 (Industrial continuous tunnel washer).

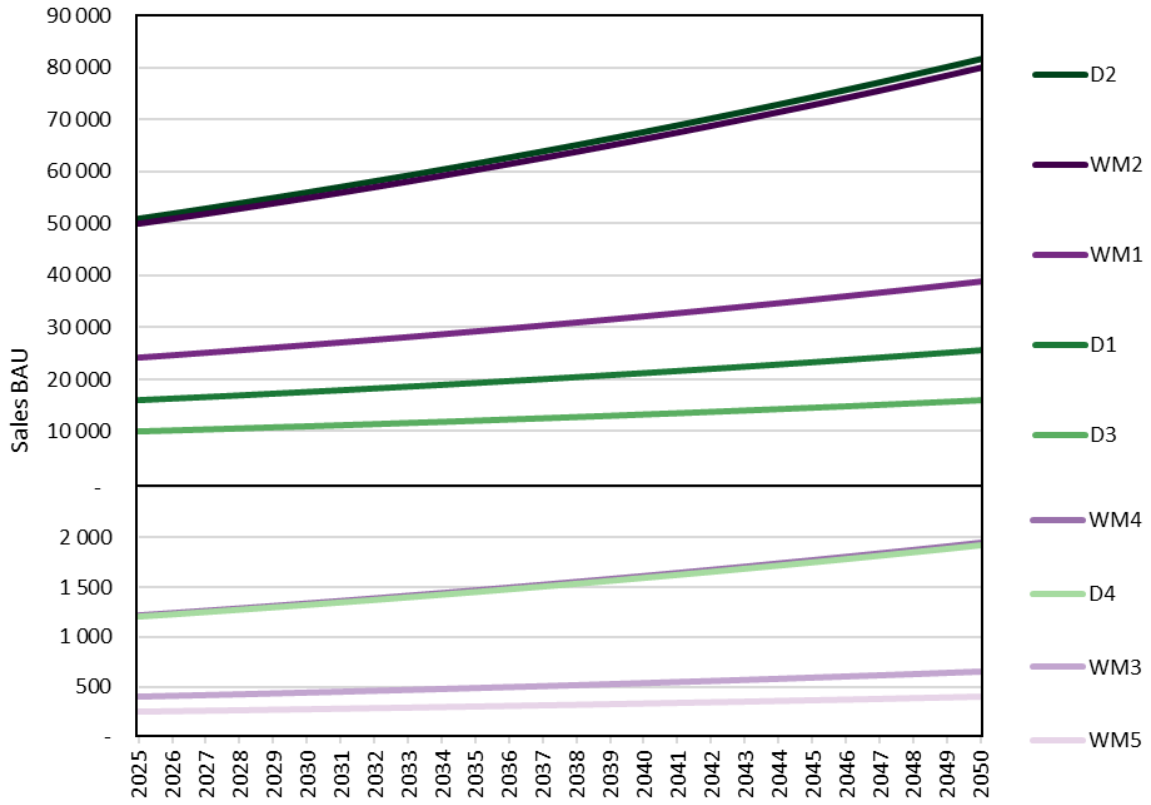

Figure 3-59: Sales in the BAU scenario for all Base Cases (sorted according to sales numbers).

The stock is shown in **Figure 3-60**. It raises from a total of 1,511,706 in 2025 (637,857 washing machines and 873,849 dryers) to 2,599,462 in 2050 (1,113,578 washing machines and 1,485,885 dryers).

Corresponding to the sales figures, also stock is dominated by the BCs D2 and WM2. The total stock in 2050 is made up to 69 % from BC D2 und WM2 (D2: 1,067,835, corresponding to 72 % of dryer market; WM2: 730,210, corresponding to 66 % of washing machine market).

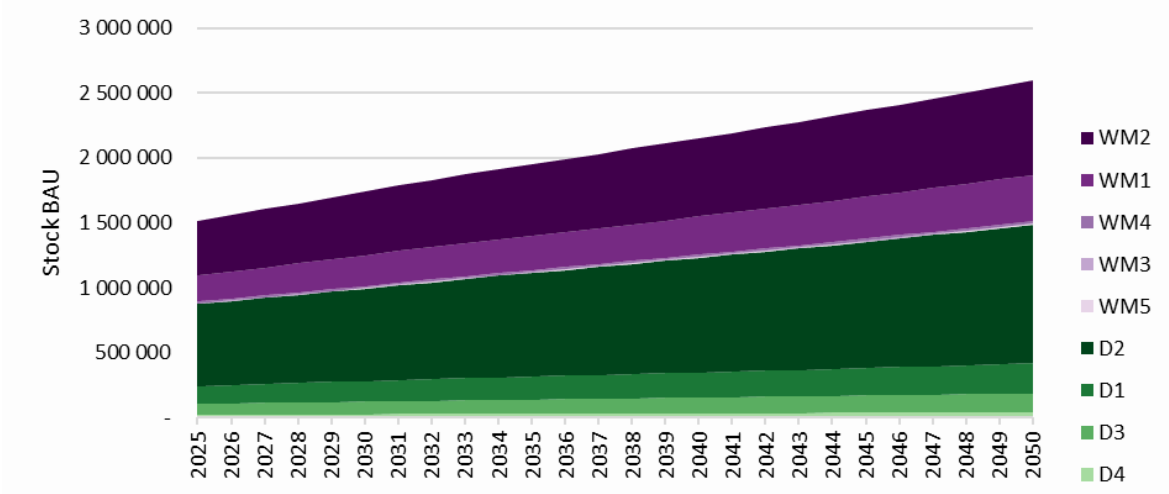

Figure 3-60: Calculated stock in the BAU scenario based on sales data assumptions and lifetimes.

The change in the stock due to the introduction of BAT products is shown in **Figure 3-61** for BC D2. As the BAT products are introduced to the market, they replace BAU sales from 2028 onwards and induce a transformation in the stock that is completed in year 2043, when 100 % of the D2 market is made up of the BAT.

The drop in sales that can be observed in 2043 stems from the changes in lifetime between the BAU and the BAT. The lifetime is increased by two years (15 to 17 years), resulting in a two-year period (2043-2044) in which zero replacement sales are occurring since the products do not yet exit the stock. The sales that are remaining are those that represent the new sales.

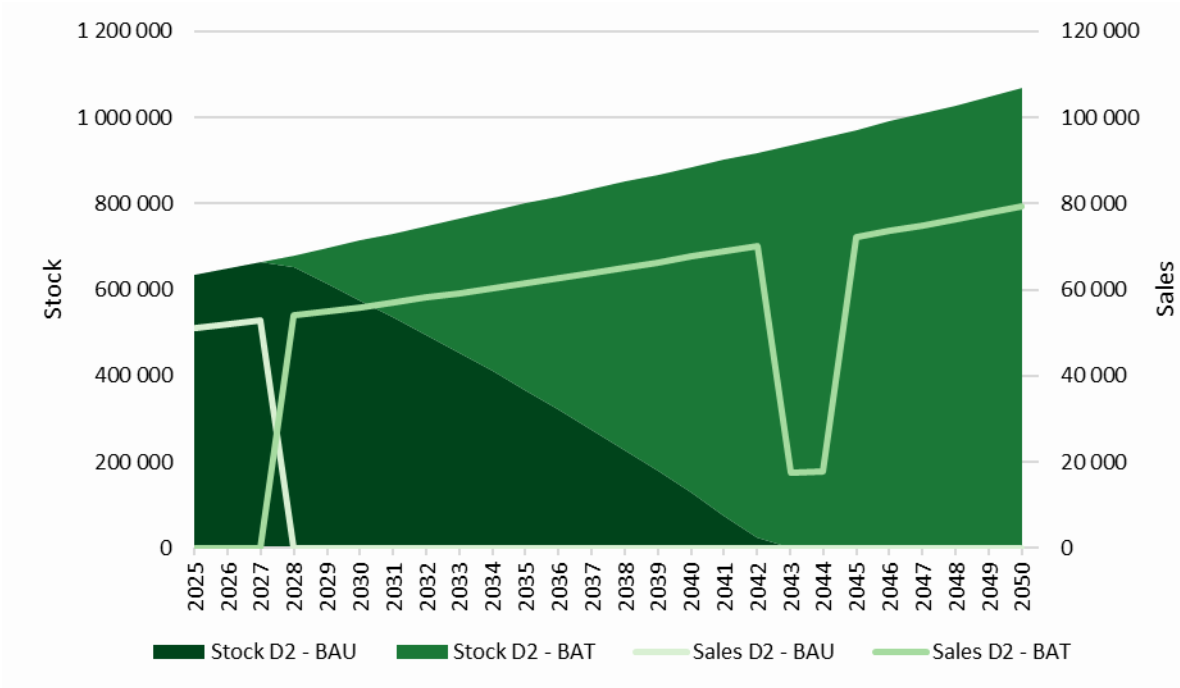

Figure 3-61: Changes in the stock of the BAT scenario for Base Case D2 due to BAU and BAT product sales.

3.6.3.4. Results: Environmental Impacts

Energy (electricity and gas) consumption

The impacts of the BAT scenario on the use-stage energy consumption are shown in **Figure 3-62**, accumulated for all BCs.

Table 3-191 provides a deeper insight into the individual BCs and includes both use-stage electricity as well as use-stage gas consumption for selected years.

For the period from 2025 to 2050 and all BCs accumulated, the relative savings of electricity are 6.48 % and those for gas 4.83 %. These equal cumulative savings of 74.81 TWh for electricity, and 59.29 TWh for gas. As described earlier, these savings are calculated under the stated assumptions and reflect the technical potential.

Zooming in on the year 2050 alone, use-stage electricity savings accumulate to 5.35 TWh, representing a reduction of 9.5 % compared to the BAU scenario for the same year. Similarly, for gas, 2050 savings are at 4.61 TWh, representing a reduction of 7.6 % compared to the BAU scenario.

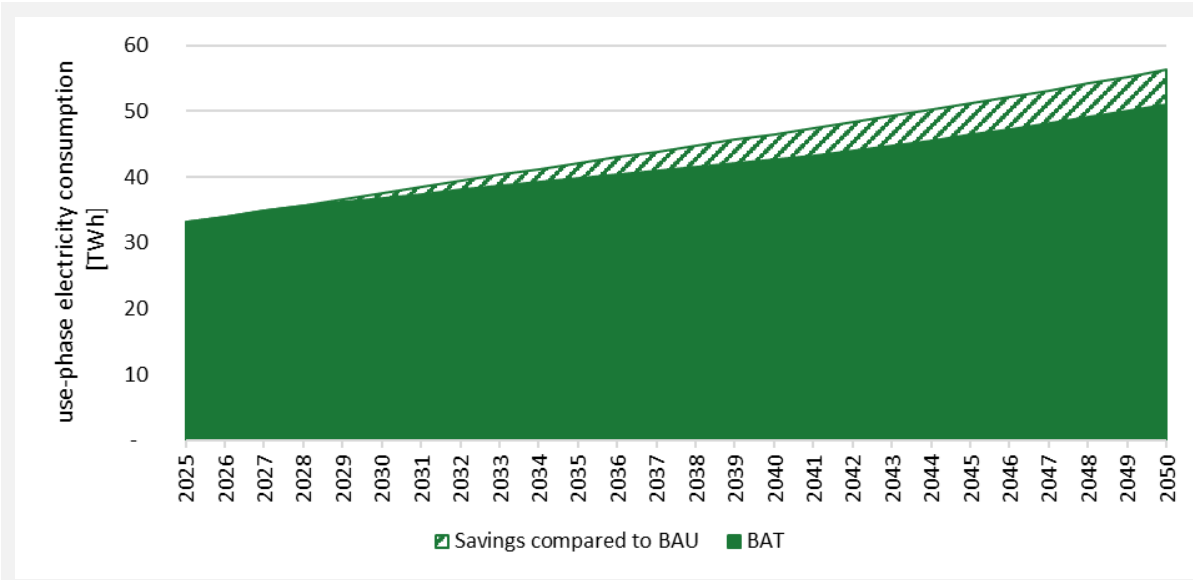

Figure 3-62: Energy (electricity and gas) consumption of the BAT scenario and savings compared to the BAU scenario.

Table 3-191: Use-stage electricity and gas consumption of the BAU and the BAT scenario (the BAT scenario includes BAU products while they are phased out from the stock).

All in GWh		2025		2030		2035		2040		2045		2050	
		electricity	gas	electricity	gas	electricity	gas	electricity	gas	electricity	gas	electricity	gas
WM 1	BAU	200	97	235	114	235	114	264	128	290	141	350	170
	BAT	200 (+0%)	97 (+0%)	230 (-2%)	112 (-2%)	230 (-2%)	112 (-2%)	248 (-6%)	120 (-6%)	267 (-8%)	130 (-8%)	322 (-8%)	157 (-8%)
WM 2	BAU	5,534	3,747	6,497	4,399	6,497	4,399	7,288	4,935	8,007	5,421	9,666	6,544
	BAT	5,534 (+0%)	3,747 (+0%)	6,352 (-2%)	4,301 (-2%)	6,352 (-2%)	4,301 (-2%)	6,838 (-6%)	4,630 (-6%)	7,366 (-8%)	4,988 (-8%)	8,892 (-8%)	6,021 (-8%)
WM 3	BAU	126	0	137	0	137	0	149	0	164	0	198	0
	BAT	126 (+0%)	0 (+0%)	129 (-5%)	0 (+0%)	129 (-5%)	0 (+0%)	126 (-15%)	0 (+0%)	131 (-20%)	0 (+0%)	158 (-20%)	0 (+0%)
WM 4	BAU	24	129	28	151	28	151	32	170	35	186	42	225
	BAT	24 (-0%)	129 (-0%)	28 (-2%)	148 (-2%)	28 (-2%)	148 (-2%)	30 (-6%)	159 (-6%)	32 (-8%)	171 (-8%)	39 (-8%)	207 (-8%)
WM 5	BAU	155	3,109	182	3,633	182	3,633	207	4,144	229	4,588	277	5,539
	BAT	155 (-0%)	3,109 (-0%)	180 (-1%)	3,594 (-1%)	180 (-1%)	3,594 (-1%)	201 (-3%)	4,022 (-3%)	219 (-5%)	4,376 (-5%)	263 (-5%)	5,262 (-5%)
D1	BAU	217	0	255	0	255	0	286	0	314	0	379	0
	BAT	217 (+0%)	0 (+0%)	241 (-6%)	0 (+0%)	241 (-6%)	0 (+0%)	242 (-15%)	0 (+0%)	251 (-20%)	0 (+0%)	303 (-20%)	0 (+0%)
D2	BAU	23,836	11,259	26,793	12,656	26,793	12,656	30,033	14,187	33,207	15,686	40,084	18,934
	BAT	23,836 (+0%)	11,259 (+0%)	26,271 (-2%)	12,409 (-2%)	26,271 (-2%)	12,409 (-2%)	28,407 (-5%)	13,418 (-5%)	30,368 (-9%)	14,345 (-9%)	36,076 (-10%)	17,041 (-10%)
D3	BAU	1,054	0	1,237	0	1,237	0	1,388	0	1,525	0	1,840	0
	BAT	1,054 (-0%)	0 (+0%)	1,203 (-3%)	0 (+0%)	1,203 (-3%)	0 (+0%)	1,281 (-8%)	0 (+0%)	1,372 (-10%)	0 (+0%)	1,656 (-10%)	0 (+0%)
D4	BAU	1,927	16,414	2,169	18,471	2,169	18,471	2,448	20,847	2,769	23,582	3,441	29,309
	BAT	1,927 (+0%)	16,414 (+0%)	2,148 (-1%)	18,295 (-1%)	2,148 (-1%)	18,295 (-1%)	2,384 (-3%)	20,302 (-3%)	2,657 (-4%)	22,630 (-4%)	3,220 (-6%)	27,419 (-6%)
Total	BAU	33,073	34,755	37,533	39,424	37,533	39,424	42,095	44,411	46,540	49,604	56,277	60,721
	BAT	33,073 (0 %)	34,755 (0 %)	36,782 (-2 %)	38,859 (-1,4 %)	36,782 (-2 %)	38,859 (-1,4 %)	39,757 (-5.5 %)	42,651 (-4 %)	42,663 (-8.3 %)	46,640 (-6 %)	50,929 (-9,5 %)	56,107 (-7,6 %)

Connected to the energy savings are reductions of greenhouse gases, shown in **Figure 3-63** for all BCs from 2025 to 2050 for use-stage electricity. The carbon intensity, i.e. the environmental impact of the electricity consumption of the commercial machines is calculated with dynamic emission factors, representing a scenario with ongoing decarbonisation of the electricity mix. Despite the growing electricity demand due to the growing stock, the decarbonisation of the electricity mix leads to a reduction in emissions, in both the BAU and BAT scenario. In the BAT scenario, due to more efficient devices, additional savings are achieved, accumulating to 7.58 Mt CO_2eq., representing savings of 4.16 % compared to the BAU scenario in the period 2025 to 2050.

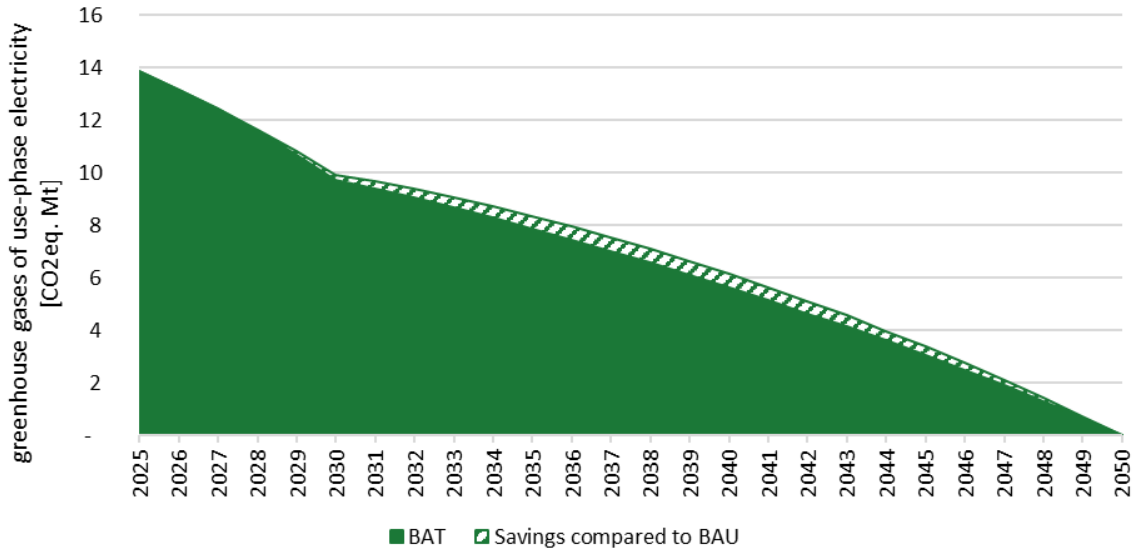

Figure 3-63: Greenhouse gases associated to use-stage electricity consumption of the BAT scenario and savings compared to the BAU scenario.

In the modelling framework, electricity is treated dynamically, whereas the emission factors for natural gas are kept static. This asymmetry arises from differences in data availability and the requirements for a consistent scenario basis. The underlying PRIMES scenario provides detailed carbon intensity indicators for electricity generation, but no comparable, cross sectoral indicators for natural gas. Since the approach in the ESPR preparatory study relies on a coherent and traceable set of scenario inputs, dynamic trajectories can only be applied where robust data are available.

The absence of gas specific indicators reflects the broader uncertainty around the future role of gaseous energy carriers. Sectoral pathways differ substantially – ranging from hydrogen options in industry to electrification in transport and heating – and recent policy discussions even revisit biogas, despite unclear long term supply potentials. Given these divergent developments and the lack of harmonised assumptions, no reliable cross sectoral decarbonisation trajectory for gas currently exists. Against this background, applying dynamic carbon intensities only to electricity is a pragmatic and methodologically sound simplification that maintains internal consistency while avoiding speculative assumptions.

Table 3-192 lists the numerical values for selected years for the greenhouse gas emissions associated with the use-stage electricity and gas consumption. As can be seen from the data, also the savings due to the reduction in gas consumption leads to significant savings (the greenhouse gas intensity of gas is set at the static value used in MEErP Task 5 and Task 6, at 0.23 kg CO_2eq./kWh). In 2050, the reduced gas consumption in the BAT scenario saves 1.04 Mt CO_2eq. compared to the BAU scenario. The Base Cases with the highest contribution to the savings of CO_2 due to the reduction in gas consumption are Base Case D4 (Industrial pass-through tumble dryer) and Base Case D2 (Commercial tumble dryer). While relative gas savings are similar for other Base Cases, these two are the ones with the highest overall gas

consumption (see Table 3-191) and therefore the relative savings lead to large absolute savings.

Table 3-192: Greenhouse gases associated to use-stage electricity and gas consumption of the BAU and the BAT scenario (the BAT scenario includes BAU products while they are phased out from the stock)

		2025		2030		2035		2040		2045		2050	
all in kt $CO2_{eq.}$		electricity	gas	electricity	gas	electricity	gas	electricity	gas	electricity	gas	electricity	gas
WM 1	BAU	84	23	62	27	47	27	35	30	19	33	0	40
	BAT	84 (+0%)	23 (+0%)	61 (-2%)	26 (-2%)	46 (-2%)	26 (-2%)	33 (-6%)	28 (-6%)	18 (-8%)	30 (-8%)	0 (-8%)	37 (-8%)
WM 2	BAU	2,318	876	1,719	1,029	1,289	1,029	964	1,154	530	1,268	0	1,531
	BAT	2,318 (+0%)	876 (+0%)	1,681 (-2%)	1,006 (-2%)	1,260 (-2%)	1,006 (-2%)	905 (-6%)	1,083 (-6%)	487 (-8%)	1,167 (-8%)	0 (-8%)	1,409 (-8%)
WM 3	BAU	53	0	36	0	27	0	20	0	11	0	0	0
	BAT	53 (+0%)	0 (+0%)	34 (-5%)	0 (+0%)	26 (-5%)	0 (+0%)	17 (-15%)	0 (+0%)	9 (-20%)	0 (+0%)	0 (-20%)	0 (+0%)
WM 4	BAU	10	30	7	35	6	35	4	40	2	44	0	53
	BAT	10 (-0%)	30 (-0%)	7 (-2%)	35 (-2%)	5 (-2%)	35 (-2%)	4 (-6%)	37 (-6%)	2 (-8%)	40 (-8%)	0 (-8%)	48 (-8%)
WM 5	BAU	65	727	48	850	36	850	27	969	15	1,073	0	1,296
	BAT	65 (-0%)	727 (-0%)	48 (-1%)	841 (-1%)	36 (-1%)	841 (-1%)	27 (-3%)	941 (-3%)	14 (-5%)	1,024 (-5%)	0 (-5%)	1,231 (-5%)
D1	BAU	91	0	67	0	51	0	38	0	21	0	0	0
	BAT	91 (+0%)	0 (+0%)	64 (-6%)	0 (+0%)	48 (-6%)	0 (+0%)	32 (-15%)	0 (+0%)	17 (-20%)	0 (+0%)	0 (-20%)	0 (+0%)
D2	BAU	9,985	2,634	7,089	2,961	5,316	2,961	3,973	3,319	2,196	3,669	0	4,429
	BAT	9,985 (+0%)	2,634 (+0%)	6,950 (-2%)	2,903 (-2%)	5,213 (-2%)	2,903 (-2%)	3,758 (-5%)	3,139 (-5%)	2,009 (-9%)	3,356 (-9%)	0 (-10%)	3,986 (-10%)
D3	BAU	441	0	327	0	245	0	184	0	101	0	0	0
	BAT	441 (-0%)	0 (+0%)	318 (-3%)	0 (+0%)	239 (-3%)	0 (+0%)	169 (-8%)	0 (+0%)	91 (-10%)	0 (+0%)	0 (-10%)	0 (+0%)
D4	BAU	807	3,840	574	4,321	430	4,321	324	4,877	183	5,516	0	6,856
	BAT	807 (+0%)	3,840 (+0%)	568 (-1%)	4,280 (-1%)	426 (-1%)	4,280 (-1%)	315 (-3%)	4,749 (-3%)	176 (-4%)	5,294 (-4%)	0 (-6%)	6,414 (-6%)
Total	BAU	**13,854**	**4,674**	**9,929**	**9,223**	**7,447**	**9,223**	**5,569**	**10,389**	**3,078**	**11,603**	**0**	**14,205**
	BAT	**13,854 (0 %)**	**4,674 (0 %)**	**9,731 (-2 %)**	**9,091 (-1,4 %)**	**7,299 (-2.0 %)**	**9,091 (-1.4 %)**	**5,260 (-5.5 %)**	**9,977 (-4 %)**	**2,823 (-8.3 %**	**10,911 (-6 %)**	**0**	**13,125 (-7.6 %)**

Water and detergent consumption

Figure 3-64 shows the water, and **Figure 3-65** the detergent consumption for the BAT scenario and the savings compared to the BAU scenario. Water savings in the period 2025 to 2050 accumulate to 653 million m³, equalling savings of 4.36 % compared to the BAU scenario. In 2050 alone, savings reach 43 million m³ (equalling savings of 5.84 % compared with the BAU scenario).

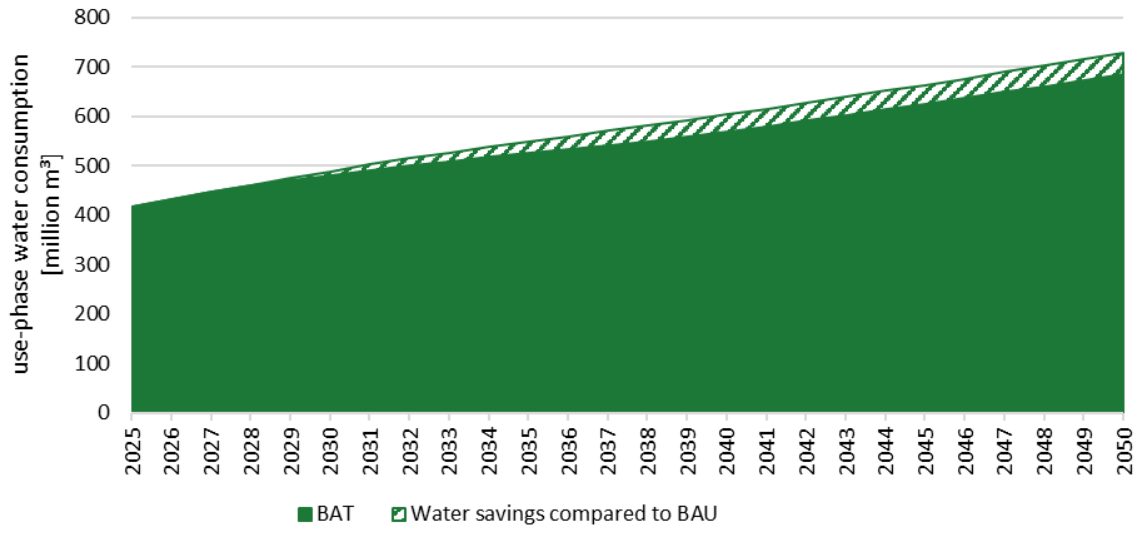

Figure 3-64: Use-stage water consumption of the BAT scenario and savings compared to the BAU scenario.

For detergent consumption (**Figure 3-65**), savings in the period 2025 to 2050 accumulate to 1,150 kt, equalling 6.20 % compared to the BAU scenario. Relative savings are increasing from 2028 until 2038, when almost all of the BAU products (at least those with detergent consumption) leave the stock (except WM5 with 13.7 years lifetime).

In 2050 alone, savings reach 75 kt (equalling savings of 8.34 % compared to the BAU scenario).

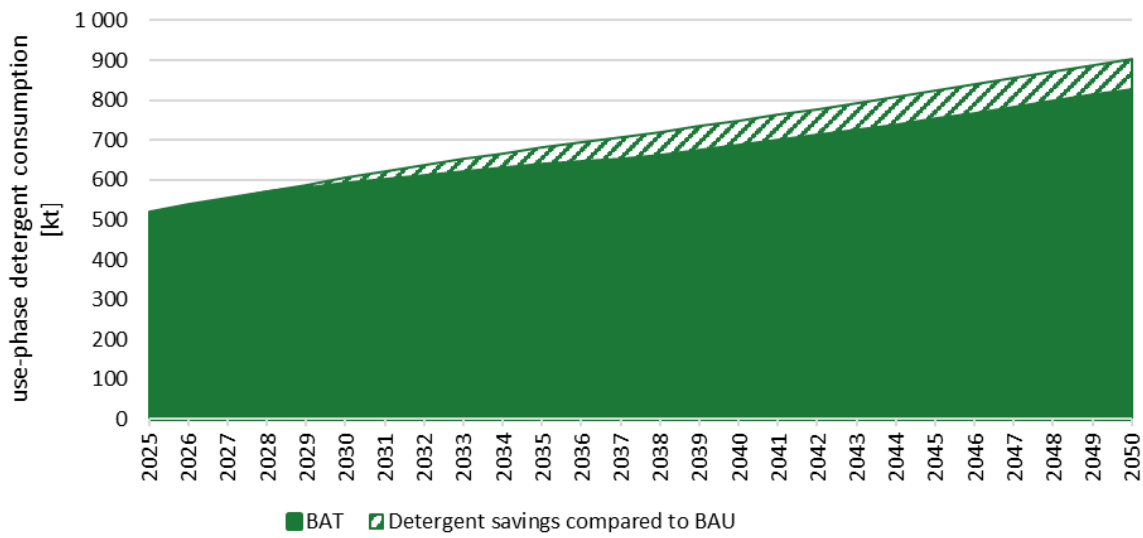

Figure 3-65: Use-stage detergent consumption of the BAT scenario and savings compared to the BAU scenario.

Table 3-193 lists the numerical values for selected years for the use-stage water and detergent consumption.

Table 3-193: Use-stage water and detergent consumption of the BAU and the BAT scenario.

Water in million m^3 / detergent in kt		2025		2030		2035		2040		2045		2050	
		water	detergent	water	detergent	water	detergent	water	detergent	water	detergent	water	detergent
WM 1	BAU	17	20	20	24	22	26	25	29	27	32	30	35
	BAT	17 (+0%)	20 (+0%)	20 (-2%)	23 (-2%)	21 (-5%)	25 (-6%)	23 (-6%)	27 (-8%)	25 (-6%)	29 (-8%)	28 (-6%)	32 (-8%)
WM 2	BAU	327	400	384	470	431	527	474	579	520	636	572	699
	BAT	327 (+0%)	400 (+0%)	378 (-2%)	459 (-2%)	411 (-5%)	494 (-6%)	445 (-6%)	533 (-8%)	489 (-6%)	585 (-8%)	537 (-6%)	643 (-8%)
WM 3	BAU	2	2	2	2	2	3	3	3	3	3	3	4
	BAT	2 (+0%)	2 (+0%)	2 (-2%)	2 (-2%)	2 (-5%)	2 (-6%)	2 (-6%)	3 (-8%)	3 (-6%)	3 (-8%)	3 (-6%)	3 (-8%)
WM 4	BAU	13	11	15	13	17	14	19	16	21	17	23	19
	BAT	13 (-0%)	11 (-0%)	15 (-1%)	12 (-2%)	16 (-4%)	13 (-6%)	18 (-5%)	14 (-8%)	20 (-5%)	16 (-8%)	22 (-5%)	17 (-8%)
WM 5	BAU	57	83	67	97	76	111	84	123	93	135	102	148
	BAT	57 (-0%)	83 (-0%)	66 (-1%)	95 (-2%)	74 (-3%)	104 (-6%)	80 (-5%)	111 (-9%)	88 (-5%)	121 (-10%)	97 (-5%)	133 (-10%)

3.6.3.5. Results: Socio-economic impact analysis

The calculated costs are considering the commodity-specific escalation or inflation rate, as well as the dynamic scenario-based development of the electricity price (see **Section 3.6.3.1**).

Figure 3-66 shows the costs of the electricity consumption. As could be expected, with the moderate market growth and resulting growth of the stock as assumed according to MEErP Task 2, also electricity costs are rising. However, the introduction of BAT reduces energy consumption and thereby costs compared to the BAU scenario. Cost savings of use-stage electricity sum up to 24.58 billion Euro for the period 2025 to 2050, representing a reduction by 6.90 %.

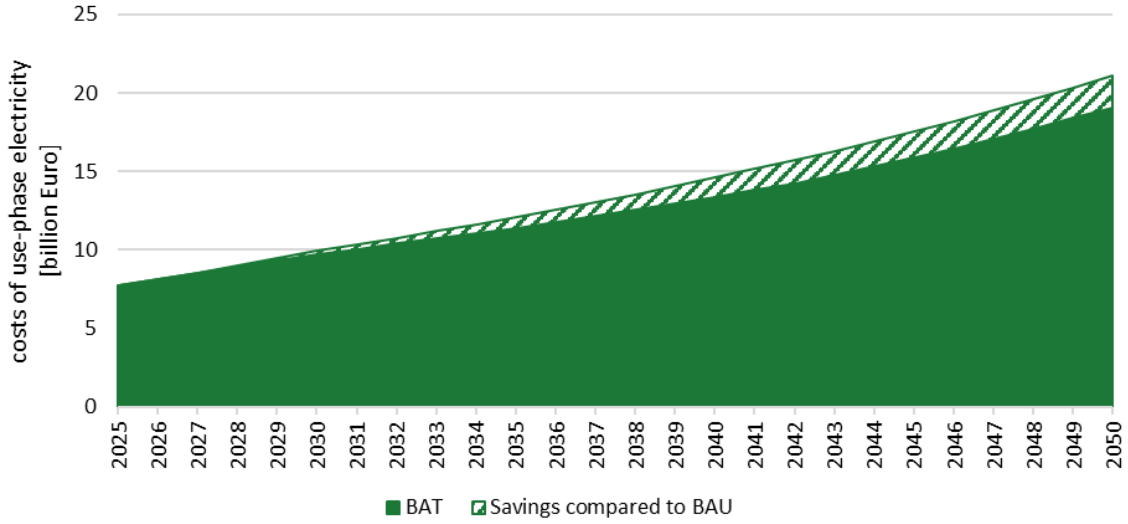

Figure 3-66: Costs of use-stage electricity consumption of the BAT scenario and savings compared to the BAU scenario.

Table 3-194 provides an overview of all costs included in the scenario analysis for selected years. The table includes the additional investment cost for the industry due to purchase (product price and installation/acquisition cost) and repair. Furthermore, costs for the use-stage consumption of electricity, natural gas, water and detergents are listed.

Some data points warrant clarification. The strong reductions for purchase and repair costs in 2040 are induced by the extension of lifetime moving from BAU to BAT in combination with the modelling logic. For BC WM1, for example, the lifetime is extended from 10 to 12 years. Therefore, the sales from year 2038 to 2040 are reduced, leading to the saving. While the product prices are still higher than the BAU products, the reduction from 2045 is induced by the lower sales figures.

In terms of overall costs, for example in year 2050, overall savings of the BAT compared to the BAU scenario are 4.13 billion Euro. The highest contribution comes from the savings associated to reduction of electricity consumption with 2 billion Euro. Other cost reduction associated to the use phase are the reduction of the consumption of natural gas (0.65 billion Euro), detergents (0.42 billion Euro) and water (0.08 million Euro).

What has already been indicated at individual product level in the previous tasks is that additional costs for the purchase of more expensive products are quickly offset to use-stage savings. Already in 2030, total cost calculations result in overall savings for the customers (179 million Euro) – in the years after this savings are increasing significantly.

Table 3-194: Overview of costs of the BAU and the BAT scenario for selected years.

		2025							2030							2035							2040							2045							2050						
all in million Euro		purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs	total	purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs	total	purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs	total	purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs	total	purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs	total	purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs	total
WM1	BAU	51	1	47	8	32	82	222	61	2	62	11	38	103	277	74	2	68	12	43	122	322	90	3	83	15	48	143	381	109	3	99	18	53	167	450	133	4	131	24	59	195	545
	BAT	51 (+0%)	1 (+0%)	47 (+0%)	8 (+0%)	32 (+0%)	82 (+0%)	222 (+0%)	64 (+5%)	2 (+5%)	61 (-2%)	10 (-2%)	38 (-2%)	101 (-2%)	276 (-1%)	78 (+5%)	2 (+5%)	66 (-2%)	11 (-2%)	41 (-5%)	115 (-6%)	314 (-2%)	92 (+2%)	3 (+2%)	78 (-6%)	14 (-6%)	45 (-6%)	131 (-8%)	363 (-5%)	111 (+2%)	3 (+2%)	91 (-8%)	16 (-8%)	50 (-6%)	153 (-8%)	426 (-5%)	43 (-68%)	1 (-68%)	121 (-8%)	22 (-8%)	56 (-6%)	179 (-8%)	421 (-23%)
WM2	BAU	468	14	1,295	310	625	1,640	4,352	568	16	1,720	405	740	2,045	5,494	689	20	1,866	451	837	2,436	6,298	835	24	2,287	562	927	2,843	7,478	1,013	29	2,740	687	1,026	3,317	8,812	1,229	35	3,623	922	1,137	3,870	10,817
	BAT	468 (+0%)	14 (+0%)	1,295 (+0%)	310 (+0%)	625 (+0%)	1,640 (+0%)	4,352 (+0%)	568 (+0%)	26 (+58%)	1,682 (-2%)	396 (-2%)	728 (-2%)	2,000 (-2%)	5,399 (-2%)	689 (+0%)	31 (+58%)	1,825 (-2%)	441 (-2%)	798 (-5%)	2,286 (-6%)	6,069 (-4%)	810 (-3%)	37 (+53%)	2,146 (-6%)	528 (-6%)	871 (-6%)	2,615 (-8%)	7,006 (-6%)	982 (-3%)	45 (+53%)	2,520 (-8%)	632 (-8%)	965 (-6%)	3,052 (-8%)	8,196 (-7%)	379 (-69%)	17 (-51%)	3,333 (-8%)	849 (-8%)	1,068 (-6%)	3,561 (-8%)	9,207 (-15%)
WM3	BAU	5	0	30	0	4	9	48	7	0	36	0	4	11	58	8	0	39	0	5	12	64	10	0	47	0	5	14	76	12	0	56	0	6	17	91	14	0	74	0	6	19	115
	BAT	5 (+0%)	0 (+0%)	30 (+0%)	0 (+0%)	4 (+0%)	9 (+0%)	48 (+0%)	7 (+12%)	0 (+4%)	34 (-5%)	0 (+0%)	4 (-2%)	10 (-2%)	56 (-3%)	9 (+12%)	0 (+4%)	37 (-5%)	0 (+0%)	4 (-5%)	11 (-6%)	62 (-3%)	11 (+8%)	0 (+1%)	40 (-15%)	0 (+0%)	5 (-6%)	13 (-8%)	68 (-10%)	13 (+8%)	0 (+1%)	45 (-20%)	0 (+0%)	5 (-6%)	15 (-8%)	79 (-13%)	5 (-66%)	0 (-68%)	59 (-20%)	0 (+0%)	6 (-6%)	18 (-8%)	88 (-23%)
WM4	BAU	44	11	6	11	25	44	140	54	13	7	14	29	55	172	65	16	8	15	33	65	203	79	19	10	19	37	76	240	96	23	12	24	41	89	284	116	28	16	32	45	104	340
	BAT	44 (-0%)	11 (-0%)	6 (-0%)	11 (-0%)	25 (-0%)	44 (-0%)	140 (-0%)	54 (-0%)	13 (+3%)	7 (-2%)	14 (-2%)	29 (-1%)	54 (-2%)	170 (-1%)	65 (-0%)	16 (+3%)	8 (-2%)	15 (-2%)	32 (-4%)	61 (-6%)	197 (-3%)	77 (-3%)	19 (-0%)	9 (-6%)	18 (-6%)	35 (-5%)	70 (-8%)	228 (-5%)	93 (-3%)	23 (-0%)	11 (-8%)	22 (-8%)	39 (-5%)	82 (-8%)	269 (-5%)	36 (-69%)	9 (-68%)	14 (-8%)	29 (-8%)	43 (-5%)	95 (-8%)	227 (-33%)
WM5	BAU	159	37	36	257	109	341	940	193	44	48	335	129	423	1,172	235	54	52	372	148	512	1,373	285	65	65	472	165	602	1,654	345	79	78	581	183	703	1,970	419	96	104	781	202	820	2,421
	BAT	159 (+0%)	37 (+0%)	36 (-0%)	257 (-0%)	109 (-0%)	341 (-0%)	940 (+0%)	195 (+1%)	45 (+1%)	48 (-1%)	331 (-1%)	127 (-1%)	414 (-2%)	1,159 (-1%)	237 (+1%)	54 (+1%)	52 (-1%)	368 (-1%)	143 (-3%)	482 (-6%)	1,336 (-3%)	287 (+1%)	66 (+1%)	63 (-3%)	458 (-3%)	157 (-5%)	546 (-9%)	1,577 (-5%)	79 (-77%)	18 (-77%)	75 (-5%)	554 (-5%)	173 (-5%)	632 (-10%)	1,532 (-22%)	393 (-6%)	90 (-6%)	99 (-5%)	742 (-5%)	192 (-5%)	737 (-10%)	2,253 (-7%)
D1	BAU	27	1	51	0	0	0	78	32	1	67	0	0	0	101	39	1	73	0	0	0	114	48	1	90	0	0	0	139	58	2	107	0	0	0	167	70	2	142	0	0	0	214
	BAT	27 (-0%)	1 (-0%)	51 (+0%)	0 (+0%)	0 (+0%)	0 (+0%)	78 (-0%)	48 (+50%)	1 (+3%)	64 (-6%)	0 (+0%)	0 (+0%)	0 (+0%)	113 (+12%)	59 (+50%)	1 (+3%)	69 (-6%)	0 (+0%)	0 (+0%)	0 (+0%)	129 (+14%)	69 (+45%)	1 (-0%)	76 (-15%)	0 (+0%)	0 (+0%)	0 (+0%)	146 (+6%)	84 (+45%)	2 (-0%)	86 (-20%)	0 (+0%)	0 (+0%)	0 (+0%)	171 (+3%)	32 (-54%)	1 (-68%)	114 (-20%)	0 (+0%)	0 (+0%)	0 (+0%)	147 (-31%)
D2	BAU	318	9	5,578	932	0	0	6,837	386	11	7,093	1,166	0	0	8,656	468	14	7,696	1,296	0	0	9,474	568	16	9,424	1,616	0	0	11,624	689	20	11,361	1,987	0	0	14,057	836	24	15,024	2,668	0	0	18,553
	BAT	318 (+0%)	9 (+0%)	5,578 (+0%)	932 (+0%)	0 (+0%)	0 (+0%)	6,837 (+0%)	483 (+25%)	12 (+8%)	6,955 (-2%)	1,143 (-2%)	0 (+0%)	0 (+0%)	8,592 (-1%)	585 (+25%)	15 (+8%)	7,546 (-2%)	1,271 (-2%)	0 (+0%)	0 (+0%)	9,417 (-1%)	710 (+25%)	18 (+8%)	8,913 (-5%)	1,529 (-5%)	0 (+0%)	0 (+0%)	11,170 (-4%)	837 (+22%)	21 (+5%)	10,390 (-9%)	1,818 (-9%)	0 (+0%)	0 (+0%)	13,066 (-7%)	1,016 (+22%)	25 (+5%)	13,522 (-10%)	2,402 (-10%)	0 (+0%)	0 (+0%)	16,965 (-9%)
D3	BAU	21	1	247	0	0	0	268	25	1	327	0	0	0	353	31	1	355	0	0	0	387	37	1	435	0	0	0	474	45	1	522	0	0	0	568	55	2	690	0	0	0	746
	BAT	21 (-0%)	1 (-0%)	247 (-0%)	0 (+0%)	0 (+0%)	0 (+0%)	268 (-0%)	32 (+25%)	1 (+25%)	318 (-3%)	0 (+0%)	0 (+0%)	0 (+0%)	351 (-1%)	38 (+25%)	1 (+25%)	345 (-3%)	0 (+0%)	0 (+0%)	0 (+0%)	385 (-1%)	45 (+21%)	1 (+21%)	402 (-8%)	0 (+0%)	0 (+0%)	0 (+0%)	448 (-5%)	55 (+21%)	2 (+21%)	469 (-10%)	0 (+0%)	0 (+0%)	0 (+0%)	526 (-7%)	21 (-61%)	1 (-61%)	621 (-10%)	0 (+0%)	0 (+0%)	0 (+0%)	643 (-14%)
D4	BAU	65	11	451	1,359	0	0	1,886	79	13	574	1,701	0	0	2,368	96	16	623	1,892	0	0	2,627	117	19	768	2,375	0	0	3,279	142	23	947	2,988	0	0	4,100	172	28	1,290	4,130	0	0	5,620
	BAT	65 (+0%)	11 (+0%)	451 (+0%)	1,359 (+0%)	0 (+0%)	0 (+0%)	1,886 (+0%)	87 (+10%)	14 (+10%)	569 (-1%)	1,685 (-1%)	0 (+0%)	0 (+0%)	2,355 (-1%)	106 (+10%)	17 (+10%)	617 (-1%)	1,874 (-1%)	0 (+0%)	0 (+0%)	2,614 (-0%)	128 (+10%)	21 (+10%)	748 (-3%)	2,313 (-3%)	0 (+0%)	0 (+0%)	3,210 (-2%)	156 (+10%)	26 (+10%)	909 (-4%)	2,867 (-4%)	0 (+0%)	0 (+0%)	3,958 (-3%)	189 (+10%)	31 (+10%)	1,207 (-6%)	3,864 (-6%)	0 (+0%)	0 (+0%)	5,291 (-6%)
Total	BAU	1,159	84	7,739	2,878	795	2,117	14,772	1,406	101	9,936	3,631	940	2,636	18,651	1,705	123	10,781	4,038	1,066	3,149	20,862	2,068	149	13,209	5,059	1,182	3,679	25,346	2,509	181	15,923	6,285	1,309	4,292	30,499	3,043	220	21,094	8,557	1,449	5,008	39,372
	BAT	1,159 (+0%)	84 (+0%)	7,739 (+0%)	2,878 (+0%)	795 (+0%)	2,117 (+0%)	14,772 (+0%)	1,538 (+9%)	114 (+13%)	9,737 (-2%)	3,579 (-1%)	926 (-2%)	2,578 (-2%)	18,472 (-1%)	1,866 (+9%)	139 (+13%)	10,565 (-2%)	3,980 (-1%)	1,019 (-4%)	2,956 (-6%)	20,524 (-2%)	2,228 (+8%)	166 (+11%)	12,475 (-6%)	4,859 (-4%)	1,113 (-6%)	3,376 (-8%)	24,217 (-4%)	2,410 (-4%)	139 (-23%)	14,596 (-8%)	5,910 (-6%)	1,232 (-6%)	3,934 (-8%)	28,221 (-7%)	2,114 (-31%)	176 (-20%)	19,089 (-10%)	7,907 (-8%)	1,365 (-6%)	4,590 (-8%)	35,241 (-10%)

In the scenario analysis, it was not possible to examine employment effects due to a lack of necessary data. In the 2024 survey, only one company reported the number of employees within its business unit that manufactures laundry appliances. This limited information is insufficient to make sector-wide conclusions (see MEErP Task 2).

3.6.3.6. Sensitivity analysis

Inputs and necessary assumptions

The aim of the sensitivity analysis is to analyse the sensitivity of the results when changing input parameters. Here the sensitivity of the electricity price will be investigated, as the input with the highest impact on overall cost savings based on the scenario results. The analysis should provide a better understanding of the robustness of the results and possible uncertainties in the underlying data assumptions.

For the sensitivity analysis the assumptions for the electricity price for the initial analysis (see **Section 3.6.3.1**) is defined as the medium scenario. Based on this, a low and high scenario are defined with a 20 % increase and a 20 % decrease (see **Table 3-195**). Values for the increase and decrease are linearly introduced from the original value in 2025 to 2030 and are then kept constant.

Table 3-195: Variations in the electricity price considered for the sensitivity analysis.

Euro / kWh	2025	2030	2035	2040	2045	2050
Low	0.234	0.195	0.196	0.198	0.198	0.201
Medium	0.234	0.244	0.245	0.247	0.248	0.251
High	0.234	0.293	0.294	0.296	0.298	0.301

Results

Results are shown in **Figure 3-67**, for the BAT scenario. As can be seen, significant changes to total electricity costs are induced by the changes in electricity prices. In 2050 costs range from 15.27 billion Euro in the low-price scenario to 22.91 billion Euro in the high price scenario.

Even in the low-price scenario, electricity costs remain the most important cost factor. In 2050, 15.27 billion Euro for electricity stand against 2.11 billion Euro in purchase costs, 7.91 billion Euro in natural gas costs and 5.01 billion Euro of detergent costs.

Total accumulated electricity costs for the period from 2015 to 2050 range from 270.39 billion Euro for the low-price scenario to 393.16 billion Euro for the high-price scenario.

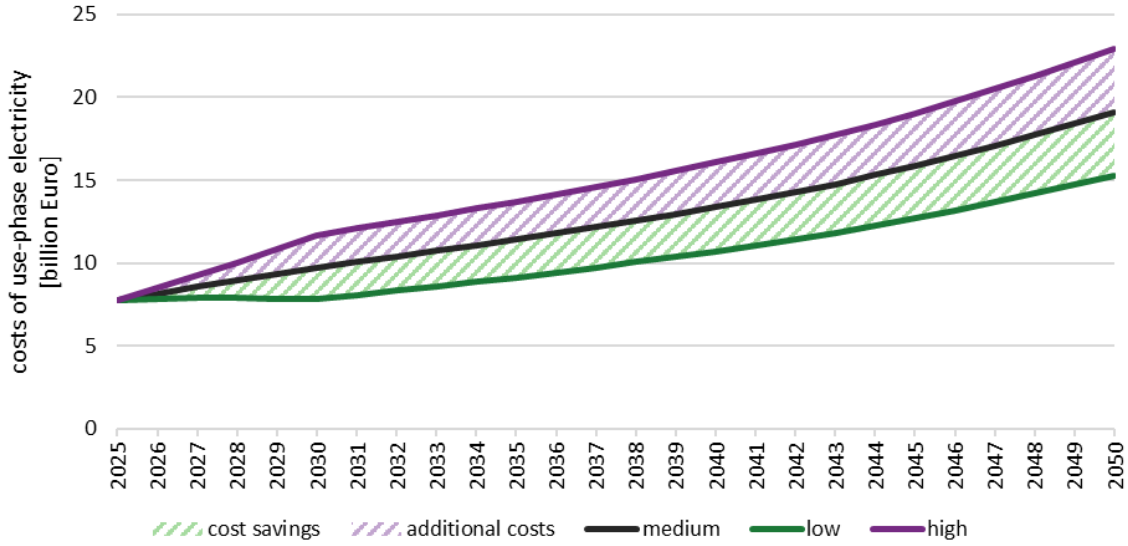

Figure 3-67: sensitivity of use-stage electricity consumption of the BAT scenario.

Table 3-196, Table 3-197 and Table 3-198 present an overview of the results for the years 2025, 2035 and 2050. They include energy consumption (electricity and gas), greenhouse gas emissions (attributed to electricity and gas consumption), consumption of auxiliary materials (water and detergents) as well as costs for purchase, repair, as well as those for energy and auxiliary material consumption.

The introduction of BAT products starts in 2028, leading to significant energy savings that - for the period from 2025 to 2050 accumulated, for all BCs, and under the stated assumptions (technical potential) - achieve relative savings of 6.48 % in electricity and 4.83 % in gas consumption, equating over these years to 74.81 TWh and 59.29 TWh, respectively (see **Section 3.6.3.4**). In 2050, annual savings are 5.35 TWh for electricity and 4.61 TWh for gas.

Greenhouse gas emissions associated to electricity consumption are reduced by 7.58 Mt CO_2eq. from 2025 to 2050, a 4.16 % decrease compared to the BAU scenario.

Resource consumption sees water savings of 653 million m³ (4.36 % reduction) and detergent savings of 1,150 kt (6.2 % reduction) from 2025 to 2050. In 2050, annual water savings accumulate to 43 million m³ (5.84 % reduction) and detergent savings reach 75 kt (8.34 % reduction).

Based on the stated assumptions, the BAT scenario leads to total savings of 24.58 billion Euro in electricity costs from 2025 to 2050, with overall savings of 4.13 billion Euro in 2050 compared to BAU. Sensitivity analysis shows that electricity price fluctuations significantly impact total costs, with expenses ranging from 15.27 billion Euro in a low-price scenario to 22.91 billion Euro in a high-price scenario in 2050. Overall, transitioning to BAT products supports both environmental sustainability and economic benefits.

Table 3-196: Overview of results for 2025.

		2025											
		energy consumption (TWh)		Emissions (kt CO2)		auxiliary materials		Costs (million Euro)					
		electricity	gas	electricity	gas	water (million m³)	detergent (kt)	Purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs
WM1	BAU	200	97	84	23	17	20	51	1	47	8	32	82
	BAT	200 (+0%)	97 (+0%)	84 (+0%)	23 (+0%)	17 (+0%)	20 (+0%)	51 (+0%)	1 (+0%)	47 (+0%)	8 (+0%)	32 (+0%)	82 (+0%)
WM2	BAU	5,534	3,747	2,318	876	327	400	468	14	1,295	310	625	1,640
	BAT	5,534 (+0%)	3,747 (+0%)	2,318 (+0%)	876 (+0%)	327 (+0%)	400 (+0%)	468 (+0%)	14 (+0%)	1,295 (+0%)	310 (+0%)	625 (+0%)	1,640 (+0%)
WM3	BAU	126	-	53	-	2	2	5	0	30	-	4	9
	BAT	126 (+0%)	-	53 (+0%)	-	2 (+0%)	2 (+0%)	5 (+0%)	0 (+0%)	30 (+0%)	-	4 (+0%)	9 (+0%)
WM4	BAU	24	129	10	30	13	11	44	11	6	11	25	44
	BAT	24 (-0%)	129 (-0%)	10 (-0%)	30 (-0%)	13 (-0%)	11 (-0%)	44 (-0%)	11 (-0%)	6 (-0%)	11 (-0%)	25 (-0%)	44 (-0%)
WM5	BAU	155	3,109	65	727	57	83	159	37	36	257	109	341
	BAT	155 (-0%)	3,109 (-0%)	65 (-0%)	727 (-0%)	57 (-0%)	83 (-0%)	159 (+0%)	37 (+0%)	36 (-0%)	257 (-0%)	109 (-0%)	341 (-0%)
D1	BAU	217	-	91	-	-	-	27	1	51	-	-	-
	BAT	217 (+0%)	-	91 (+0%)	-	-	-	27 (-0%)	1 (-0%)	51 (+0%)	-	-	-
D2	BAU	23,836	11,259	9,985	2,634	-	-	318	9	5,578	932	-	-
	BAT	23,836 (+0%)	11,259 (+0%)	9,985 (+0%)	2,634 (+0%)	-	-	318 (+0%)	9 (+0%)	5,578 (+0%)	932 (+0%)	-	-
D3	BAU	1,054	-	441	-	-	-	21	1	247	-	-	-
	BAT	1,054 (-0%)	-	441 (-0%)	-	-	-	21 (-0%)	1 (-0%)	247 (-0%)	-	-	-
D4	BAU	1,927	16,414	807	3,840	-	-	65	11	451	1,359	-	-
	BAT	1,927 (+0%)	16,414 (+0%)	807 (+0%)	3,840 (+0%)	-	-	65 (+0%)	11 (+0%)	451 (+0%)	1,359 (+0%)	-	-
total	**BAU**	**33,074**	**34,755**	**13,854**	**8,130**	**416**	**516**	**1,159**	**84**	**7,739**	**2,878**	**795**	**2,117**
	BAT	**33,074 (+0%)**	**34,755 (+0%)**	**13,854 (+0%)**	**8,130 (+0%)**	**416 (+0%)**	**516 (+0%)**	**1,159 (+0%)**	**84 (+0%)**	**7,739 (+0%)**	**2,878 (+0%)**	**795 (+0%)**	**2,117 (+0%)**

Table 3-197: Overview of results for 2035.

		2035											
		energy consumption (TWh)		Emissions (kt CO2)		auxiliary materials		Costs (million Euro)					
		electricity	gas	electricity	gas	water (million m³)	detergent (kt)	Purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs
WM1	BAU	235	114	47	27	22	26	74	2	68	12	43	122
	BAT	230 (-2%)	112 (-2%)	46 (-2%)	26 (-2%)	21 (-5%)	25 (-6%)	78 (+5%)	2 (+5%)	66 (-2%)	11 (-2%)	41 (-5%)	115 (-6%)
WM2	BAU	6,497	4,399	1,289	1,029	431	527	689	20	1,866	451	837	2,436
	BAT	6,352 (-2%)	4,301 (-2%)	1,260 (-2%)	1,006 (-2%)	411 (-5%)	494 (-6%)	689 (+0%)	31 (+58%)	1,825 (-2%)	441 (-2%)	798 (-5%)	2,286 (-6%)
WM3	BAU	137	-	27	-	2	3	8	0	39	-	5	12
	BAT	129 (-5%)	-	26 (-5%)	-	2 (-5%)	2 (-6%)	9 (+12%)	0 (+4%)	37 (-5%)	-	4 (-5%)	11 (-6%)
WM4	BAU	28	151	6	35	17	14	65	16	8	15	33	65
	BAT	28 (-2%)	148 (-2%)	5 (-2%)	35 (-2%)	16 (-4%)	13 (-6%)	65 (-0%)	16 (+3%)	8 (-2%)	15 (-2%)	32 (-4%)	61 (-6%)
WM5	BAU	182	3,633	36	850	76	111	235	54	52	372	148	512
	BAT	180 (-1%)	3,594 (-1%)	36 (-1%)	841 (-1%)	74 (-3%)	104 (-6%)	237 (+1%)	54 (+1%)	52 (-1%)	368 (-1%)	143 (-3%)	482 (-6%)
D1	BAU	255	-	51	-	-	-	39	1	73	-	-	-
	BAT	241 (-6%)	-	48 (-6%)	-	-	-	59 (+50%)	1 (+3%)	69 (-6%)	-	-	-
D2	BAU	26,793	12,656	5,316	2,961	-	-	468	14	7,696	1,296	-	-
	BAT	26,271 (-2%)	12,409 (-2%)	5,213 (-2%)	2,903 (-2%)	-	-	585 (+25%)	15 (+8%)	7,546 (-2%)	1,271 (-2%)	-	-
D3	BAU	1,237	-	245	-	-	-	31	1	355	-	-	-
	BAT	1,203 (-3%)	-	239 (-3%)	-	-	-	38 (+25%)	1 (+25%)	345 (-3%)	-	-	-
D4	BAU	2,169	18,471	430	4,321	-	-	96	16	623	1,892	-	-
	BAT	2,148 (-1%)	18,295 (-1%)	426 (-1%)	4,280 (-1%)	-	-	106 (+10%)	17 (+10%)	617 (-1%)	1,874 (-1%)	-	-
total	BAU	**37,533**	**39,424**	**7,447**	**9,222**	**549**	**681**	**1,705**	**123**	**10,781**	**4,038**	**1,066**	**3,149**
	BAT	**36,781 (-2%)**	**38,859 (-1%)**	**7,298 (-2%)**	**9,090 (-1%)**	**525 (-4%)**	**639 (-6%)**	**1,866 (+9%)**	**139 (+13%)**	**10,565 (-2%)**	**3,980 (-1%)**	**1,019 (-4%)**	**2,956 (-6%)**

Table 3-198: Overview of results for 2050.

		2050											
		energy consumption (TWh)		Emissions (kt CO2)		auxiliary materials		Costs (million Euro)					
		electricity	gas	electricity	gas	water (million m³)	detergent (kt)	Purchase costs	repair costs	electricity costs	natural gas costs	water costs	detergent costs
WM1	BAU	350	170	0	40	30	35	133	4	131	24	59	195
	BAT	322 (-8%)	157 (-8%)	0 (-8%)	37 (-8%)	28 (-6%)	32 (-8%)	43 (-68%)	1 (-68%)	121 (-8%)	22 (-8%)	56 (-6%)	179 (-8%)
WM2	BAU	9,666	6,544	0	1,531	572	699	1,229	35	3,623	922	1,137	3,870
	BAT	8,892 (-8%)	6,021 (-8%)	0 (-8%)	1,409 (-8%)	537 (-6%)	643 (-8%)	379 (-69%)	17 (-51%)	3,333 (-8%)	849 (-8%)	1,068 (-6%)	3,561 (-8%)
WM3	BAU	198	-	0	-	3	4	14	0	74	-	6	19
	BAT	158 (-20%)	-	0 (-20%)	-	3 (-6%)	3 (-8%)	5 (-66%)	0 (-68%)	59 (-20%)	-	6 (-6%)	18 (-8%)
WM4	BAU	42	225	0	53	23	19	116	28	16	32	45	104
	BAT	39 (-8%)	207 (-8%)	0 (-8%)	48 (-8%)	22 (-5%)	17 (-8%)	36 (-69%)	9 (-68%)	14 (-8%)	29 (-8%)	43 (-5%)	95 (-8%)
WM5	BAU	277	5,539	0	1,296	102	148	419	96	104	781	202	820
	BAT	263 (-5%)	5,262 (-5%)	0 (-5%)	1,231 (-5%)	97 (-5%)	133 (-10%)	393 (-6%)	90 (-6%)	99 (-5%)	742 (-5%)	192 (-5%)	737 (-10%)
D1	BAU	379	-	0	-	-	-	70	2	142	-	-	-
	BAT	303 (-20%)	-	0 (-20%)	-	-	-	32 (-54%)	1 (-68%)	114 (-20%)	-	-	-
D2	BAU	40,084	18,934	0	4,429	-	-	836	24	15,024	2,668	-	-
	BAT	36,076 (-10%)	17,041 (-10%)	0 (-10%)	3,986 (-10%)	-	-	1,016 (+22%)	25 (+5%)	13,522 (-10%)	2,402 (-10%)	-	-
D3	BAU	1,840	-	0	-	-	-	55	2	690	-	-	-
	BAT	1,656 (-10%)	-	0 (-10%)	-	-	-	21 (-61%)	1 (-61%)	621 (-10%)	-	-	-
D4	BAU	3,441	29,309	0	6,856	-	-	172	28	1,290	4,130	-	-
	BAT	3,220 (-6%)	27,419 (-6%)	0 (-6%)	6,414 (-6%)	-	-	189 (+10%)	31 (+10%)	1,207 (-6%)	3,864 (-6%)	-	-
total	BAU	**56,277**	**60,721**	**0**	**14,204**	**729**	**904**	**3,043**	**220**	**21,094**	**8,557**	**1,449**	**5,008**
	BAT	**50,929 (-10%)**	**56,107 (-8%)**	**0 (0%)**	**13,125 (-8%)**	**687 (-6%)**	**829 (-8%)**	**2,114 (-31%)**	**176 (-20%)**	**19,089 (-10%)**	**7,907 (-8%)**	**1,365 (-6%)**	**4,590 (-8%)**

3.6.4. Conclusions

In the BAU scenario for 2025, the total stock of dryers (D1-D4) reaches 873,845 units, while washing machines (WM1-WM5) total 637,857 units. The commercial tumble dryer (D2) and commercial washer extractor (WM2) lead in sales, with significantly lower figures for other BCs. The total stock, which starts at 1,511,706 units in 2025, is projected to increase to 2,599,462 units by 2050. By then, D2 and WM2 will comprise 69 % of the total stock.

The introduction of BAT products begins in 2028, replacing BAU sales. The time for this transition depends on the respective lifetime of the BAU BCs. E.g. for D2, in 2043 the stock is entirely comprised of BAT products. Due to the modelling logic, the shift also leads to a temporary decline in sales due to longer product lifetimes.

The BAT scenario leads to significant energy savings up to 6.48 % in electricity and up to 4.83 % in gas consumption from 2025 to 2050, equating over the years to 74.81 TWh and 59.29 TWh, respectively. In 2050, yearly savings are 5.35 TWh for electricity and 4.61 TWh for gas.

Greenhouse gas emissions associated to electricity consumption are reduced by 7.58 Mt CO2eq. from 2025 to 2050, a 4.16 % decrease compared to the BAU scenario. Resource consumption sees water savings of 653 million m³ (4.36 % reduction) and detergent savings of 1,150 kt (6.20 % reduction) over the whole period 2025 to 2050. In 2050 alone, water savings account to 42 million m³ and detergent savings to 75 kt (see Table 3-198). Since the scenario uses an assumption of decarbonisation of the electricity production until 2050, only the savings in gas consumption will lead to GHG savings , totalling 1,079 kt CO2eq. in the year 2050.

The BAT scenario leads to total savings of 24.58 billion Euro in electricity costs from 2025 to 2050, with overall savings of 4.13 billion Euro in 2050 compared to BAU. Sensitivity analysis shows that electricity price fluctuations significantly impact total costs, with expenses ranging from 15.27 billion Euro in a low-price scenario to 22.91 billion Euro in a high-price scenario in 2050.

Similar to electricity costs for natural gas, water and detergent are significantly reduced, while purchase and repair costs are slightly increased (due to higher prices of BAT products), but this is outweighed by the aforementioned savings. Due to the increase in lifetime in the BAT products the impact of a higher purchase cost is furthermore moderated.

Overall, transitioning to BAT products supports both environmental sustainability and economic benefits.

One of the main issues in fostering market transformation towards more sustainable products is the lack of information. As shown in MEErP Task 1, Member States have not implemented any mandatory instruments to regulate the market; only a few incentive programmes or voluntary information requirements are in place.

In this context, a market regulation at the EU level would be beneficial. Since the use phase is responsible for 74 % to 99 % of the environmental impact and for 65 % to 97 % of the LCC,[131] performance requirements focussing on the use phase are justified.

Further aspects of a possible regulation include provisions for spare parts availability and delivery time, as well as information requirements related to SoCs. As commercial and industrial laundry appliances are a typical B2B product group, the energy label is not considered as relevant, while GPP is. Finally, to align with the ESPR regulation, a DPP would be necessary.

The **Table 3-199** below provides an overview of the main potential Ecodesign Requirements.

Table 3-199: Potential Ecodesign requirements (ER) for commercial and industrial laundry appliances

Ecodesign Requirement #	Description
ER 1-1	**Information on the quality of the new product:** Mandatory public display of the consumption of energy, water and detergent, under standardised testing conditions
ER 1-2	**Information on the quality of the used but still functional product:** Mandatory public display of the history of repair and maintenance operations performed on the item
ER 2	**Information on the maintenance / repair instructions:** Mandatory public display of up-to-date maintenance / repair instructions.
ER 3	**Information on the operating mode:** Mandatory public display of the operating mode of the product, including the basic maintenance operations to be performed by the user, in the official language(s) of the Member State where the item is placed on the market
ER 4-1a	**Performance requirement on the consumption of energy, water and detergent considered separately:** Only the products whose consumption of (a) energy, (b) water and (c) detergent under standardised testing conditions is below a given threshold, defined for each of the parameters considered, are allowed to be placed on the market
ER 4-1b	**Performance requirement on the consumption of energy, water and detergent considered jointly:** Only the products whose combined consumption of (a) energy, (b) water and (c) detergent under standardised testing conditions, in a linear combination approximating the respective environmental footprints of each of these inputs, is below a given threshold, are allowed to be placed on the market

[131] See **Section 3.6.2.2.**

Ecodesign Requirement #	Description

ER 4-2	**Performance requirement on the presence of features reducing resource consumption and cost over the life cycle:** Only the products bearing all the following features are allowed to be placed on the market:
	• For washing machines:
	  ○ WM-DO2: Load control
	  ○ WM-DO3: Smart detergent dosing
	• For dryers:
	  ○ D-DO1: Heat pump
	  ○ D-DO2: Smart load control
	  ○ D-DO3: Modulating Gas Dryers

ER 4-3	**Performance requirement on the presence of a low regret feature susceptible to reduce energy consumption and cost over the life cycle**: Only the washing machines bearing the following feature are allowed to be placed on the market: • WM-DOX: Hot water valve
ER 5	**Performance requirements on the availability of spare parts:** Only the products sold under a contract guaranteeing the long-term availability of spare parts, under fast delivery conditions, are allowed to be placed on the market. This corresponds to the following Design Options: • WM-DO6: Extended time of spare part availability and repair support (for washing machines) • D-DO5: Extended time of spare part availability and repair support (for dryers)

To elaborate a regulation based on quantitative requirements, several key challenges must be addressed:

- **Clarification of applicable standards**: A precise definition of which standards apply to each product category must be validated (see current proposal).
- Definition of the requirements for a declaration programme (where the EN test standard do not specify any)
- **Collection of market-representative data**: This may require a targeted test campaign, conducted in accordance with EN standards and incorporating the defined declaration programme. Based on the analysis of such data, the ESPR minimum requirements will be developed.

Furthermore, for commercial cabinet dryers, a standardised test method would be necessary if the energy efficiency should be regulated.

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5. Annexes

5.1. Annex I: Questionnaire of 1st stakeholder consultation

Stakeholder consultation: Ecodesign preparatory study on industrial and commercial laundry appliances

Welcome to the first stakeholder consultation held as part of the "Ecodesign preparatory study on industrial and commercial laundry appliances".

DG Environment has launched the preparatory study to assess the feasibility of proposing ESPR (Ecodesign for Sustainable Products Regulation) requirements for this product group. Under a framework contract lead by VITO, the European Commission has appointed the Oeko-Institut e.V. together with Fraunhofer Institute for Reliability and Microintegration, Fraunhofer Institute for Systems and Innovation Research, Ecomatters and Trinomics to perform the study.

The overall objective of the preparatory study is to analyse the technical, economic, environmental, market and societal aspects of industrial and commercial laundry appliances following the MEErP methodology. The study will investigate the potential environmental improvements that can be introduced to industrial and commercial laundry appliances, including relevant aspects of the circular economy (upgradability, durability, reparability...). More information on the study can be found on the study online platform under: https://ecodesign-commlaundryappliances.eu/en

Professional (industrial and commercial) laundry appliances are used to clean, rinse and dry textiles in commercial customer and market segments. They are connected to the mains (electricity used for motor and electronics), sometimes also using other sources of energy to heat water or air (e.g., steam, gas). Professional washing machines may or may not have a specific drying operation at the end of the washing program, resulting in different kinds of machinery (washing machines, washer extractors, washer dryers).

The following questionnaire has been developed to request information relevant for Task 1 of the preparatory study, which aims to define the product category and system boundaries of the 'playing field' for eco-design in relation to the product group. This is important for a realistic definition of design options and improvement potential and is also relevant for technically defining any implementing legislation or voluntary measures.

The past study specified the following definitions in relation to the product group at hand:

- 'Professional washing machine' means a machine which cleans and rinses laundry like clothes, tablecloths, bedclothes, towels, and other textiles or items by using water, chemical, mechanical, and thermal means, which might also have a spin extraction or drying function and which is designed to be used principally for commercial and industrial purposes as stated by the manufacturer in the DoC.
- 'Professional dryer' means a machine which dries laundry like clothes, tablecloths, bedclothes, towels, and other textiles or items by thermally removing the moisture (evaporation) and which is designed to be used principally for commercial and industrial purposes as stated by the manufacturer in the DoC.

The scope of the 2011 preparatory study was defined and categorised as follows:

- Professional washing machines:
  - WM1: Semi-professional washer extractor
  - WM2: Professional washer extractor, <15 kg
  - WM3: Professional washer extractor, 15-40 kg
  - WM4: Professional washer extractor, >40 kg
  - WM5: Professional washer dryer
  - WM6: Professional barrier washer
  - WM7: Washing tunnel machine
- Professional dryers:
  - D1: Semi-professional dryer, condenser
  - D2: Semi-professional dryer, air vented
  - D3: Professional cabinet dryer
  - D4: Professional tumble dryer, <15 kg
  - D5: Professional tumble dryer, 15-40 kg
  - D6: Professional tumble dryer, >40 kg
  - D7: Pass-through (transfer) tumble dryer

Following the 2011 study, various points were raised by stakeholders as to the suitability of the scope and definitions proposed in the past. Hence, the revision and refinement of the past scope is the focus at this stage.

Information collected through this consultation shall be taken into consideration in the definition of the scope of professional washing and drying machines to be considered in future ESP(R) Regulation for this sector. It will also allow the definition of base cases for establishing the performance of relevant equipment in the following tasks. Therefore, shortly after the scope is established, it is planned to launch a further consultation regarding the information needed for completion of MEErP Tasks 2 through 4.

We kindly ask you to answer the following questions by 21 June 2024 COB at the latest.

The information and data that you provide to the survey shall be used by the study partners in the preparation of the “Preparatory Study and Impact Assessment support study on industrial and professional laundry appliances”. Please note that your comments and suggestions may be made public in the study reports or on the study website. If you have useful data that can only be disclosed in an aggregated form that requires an NDA please contact the study team (ecodesign-commlaundryappliances@oeko.de).

Please agree to our privacy policy (see here) and click "Next" to access the questions. Your contact details shall only be processed for the purpose of this study.

☐ I have read the privacy policy and agree with it. I also agree that my contact details (e.g., name, email) shall be shared with the partners performing the study.

The questions in this section have been added to collect general data about the participants.

Q1a: Please specify your full name (or the name of the relevant contact person regarding the data submitted):

Q1b: Please provide an email for further contact regarding this study:

Q1c: Please specify the name of the organisation you represent:

Q1d: Please specify the type of the organisation you represent.

Choose one of the following answers:

- Manufacturers or suppliers of laundry appliances
- Consumers (users of professional laundry machines)
- Waste management sector (collectors, dismantlers, shredders, recyclers)
- Associations
- Environmental NGOs
- Public authorities and organisations
- Academia and research institutes
- Other:

Q1e: Please specify the size of your organisation.

Choose one of the following answers:

- Large enterprise: turnover > € 50 million
- Medium enterprise: turnover ≤ € 50 million but > € 10 million
- Small enterprise: turnover ≤ € 10 million but > € 2 million
- Micro enterprise: turnover ≤ € 2 million

Q1f: If your organisation manufacturers laundry machines, please specify which kind (please indicate all relevant answers).

Select all that apply:

- Professional washers and/or driers
- Commercial washers and/or driers
- Industrial washers and/or driers
- Domestic washers and/or driers
- Other:

Q1g: Please indicate if you can be contacted by the study team regarding your answers to this survey.

Choose one of the following answers:

- Yes
- No

Q1h: Please specify how the information you have provided can be used.

Choose one of the following answers:

- Submitted information can be made public, referring to the name of my organisation as contributor.
- Submitted information can be made public, referring the type of organisation and an anonymous contributor.
- Submitted information can be made public only after aggregation with other data.

The technical questions:

Q2: Do you agree that the current categorisation is not fit for purpose?

Choose one of the following answers:

- Yes
- No
- I don't know.

Q2a: If so, please explain why, detailing alternative categorisation parameters that in your opinion should be considered in the future regulation.

Q3: The terms semi-professional and professional are not bound to technical features and cannot be associated with a clear-cut scope of articles. Would removal of these terms from the above categorisation change the scope of articles covered under every category?

Choose one of the following answers:

- Yes
- No
- I don't know.

Q3a: Please detail how this would affect domestic and non-domestic laundry machines and their relation to the current scope of articles covered by the above categories.

Q4: Can a differentiation between domestic and non-domestic equipment be accomplished based on the allocation of various equipment to the Machinery Directive (2006/42/EC) and to the Low Voltage Directive (2014/35/EC)?

Choose one of the following answers:

- Yes
- No
- I don't know.

Q4a: Can this interpretation be made based on the exclusion given under the Machinery Directive in Article 1(2)(k), for “household appliances intended for domestic use” or on what basis is this your interpretation?

Q4b: As the Low Voltage Directive does not exclude commercial and industrial equipment, is it correct to understand that professional laundry machines with a rated voltage between '50 and 1 000 V for alternating current and between 75 and 1 500 V for direct current’ would be in the scope of both directives?

Q5: What parameters are taken into consideration by manufacturers in their determination of the intended use of a laundry machine, i.e., the “intended use” specified in the approbation, the product information or Declaration of Conformity (DoC) of a specific appliance.

Q6: Are there technical parameters that could be used for differentiating between domestic and non-domestic laundry machines?

Choose one of the following answers:

- Yes
- No
- I don't know.

- Other:

Q6: In this context, please explain for each of the following parameters why it would be suitable for this purpose or why not:

Q6a: Planned lifetime (e.g., in number of cycles);

Q6b: Detergent dosage or detergent type;

Q6c: Power cable connection (e.g., three-phase connection or regular connection);

Q6d: Level of programmability;

Q6e: Type of materials and/or types of components (in terms of robustness) used;

Q6f: Aspects of the warranty towards the user;

Q6g: Are there parameters that pertain to the expected higher robustness of non-domestic devices in comparison with that of domestic ones?

Q6h: Please suggest other parameters that could be useful for such a differentiation.

Q7: Do the references to load ranges (i.e., <15 kg; 15-40 kg; and >40 kg) specified in the categorisation still reflect a grouping of laundry machines that is suitable for the development of performance requirements that need to be group specific?

Choose one of the following answers:

- Yes
- No
- I don't know.

Q7a: If in your opinion they should be revised, please specify how and why.

Q8: Are there additional non-domestic laundry machines that do not fall under any of the current functional/design feature related categories? Please specify which.

Q9: Would it be more suitable to introduce other technical features into the categorisation in light of their effect on performance, for example, differentiating between category groups based on the energy source used for heating of water/air? Please explain.

Q10: The following tables (Table 1 - Table 4) specify the typical water, energy and detergent consumption ranges of laundry machines falling in the various categories as well as their annual consumptions as concluded in the report of the 2011 preparatory study. Do you consider this data to be up-to-date with machines available on the market, i.e., can these ranges be used to establish the parameters of base cases for the next tasks?

Please specify your answer for each table separately in the provided spaces below.

Washing machine category	Energy consumption (range)	Water consumption (range)	Detergent / laundry aid consumption (range)
	kWh/kg laundry	*l/kg laundry*	*g/kg laundry*
WM1: Semi-professional washer extractor	0.15 (0.12–0.18)	9 (8–10)	17
WM2: Professional washer extractor, <15 kg	0.17 (0.14–0.20)	12 (10–14)	17
WM3: Professional washer extractor, 15-40 kg	0.21 (0.17–0.25)	13 (10–16)	14 (8–20)
WM4: Professional washer extractor, >40 kg	0.35 (0.20–0.50)	14 (10–18)	18 (15–20)
WM5: Professional washer dryer	0.80 (Wash and Dry)	10 (8–12)	14 (8–20)
WM6: Professional barrier washer	0.39 (0.28–0.50)	16 (14–18)	18 (15–20)
WM7: Washing tunnel machine	0.35 (0.30–0.40)	6 (4–8)	9

(Source: specified manufactures data and feedback from survey)

Q10a: Proposed update of annual consumption data of commercial and industrial washing machines (provisional data adopted from LOT24 study (2011)

Category	Cleaned laundry	Energy consumption	Water consumption	Detergent / laundry aid consumption
	tons/year	*kWh/year*	*litres/year*	*kg/year*
WM1: Semi-professional washer extractor	7.0	1 050	63 000	119
WM2: Professional washer extractor, <15 kg	14.4	2 448	172 800	245
WM3: Professional washer extractor, 15-40 kg	42.2	8 862	548 600	591
WM4: Professional washer extractor, >40 kg	194.4	68 040	2 721 600	3 499
WM5: Professional washer dryer	7.4	5 920	74 000	104
WM6: Professional barrier washer	56.3	21 957	900 800	1 013
WM7: Washing tunnel machine	3 825	1 338 750	22 950 000	34 425

(Source: calculated data based on the stakeholder feedback)

Q10b: Proposed update of specific consumption data of commercial and industrial dryers (provisional data adopted from LOT24 study (2011

Dryer category	Energy consumption (range) kWh/kg laundry
D1: Semi-professional dryer, condenser[26]	0.60
D2: Semi-professional dryer, air vented[26]	0.56
D3: Professional Cabinet dryer	0.75 (0.60–0.90)
D4: Professional tumble dryer, <15 kg	0.55 (0.40–0.70)
D5: Professional tumble dryer, 15-40 kg	0.65 (0.55–0.75)
D6: Professional tumble dryer, > 40 kg	0.85 (0.75–0.95)
D7: Pass-trough (transfer) tumble dryer	0.80 (0.70–0.90)

(Source: specified manufactures data and feedback from working paper and draft report)

Q10c: Proposed update of annual consumption data of commercial and industrial washing machines (provisional data adopted from LOT24 study (2011)

Category	Dried laundry	Energy consumption
	tons/year	*kWh/year*
D1: Semi-professional dryer, condenser	6.5	3 900
D2: Semi-professional dryer, air vented	6.5	3 640
D3: Professional cabinet dryer	6.3	4 725
D4: Professional tumble dryer, <15 kg	14.4	7 920
D5: Professional tumble dryer, 15-40 kg	40.5	26 325
D6: Professional tumble dryer, > 40 kg	168	142 800
D7: Pass-trough (transfer) tumble dryer	1 020	816 000

(Source: calculated data based on the stakeholder feedback)

Q11: Are multi-drum washing machines placed on the market in the commercial or industrial segment?

Choose one of the following answers:

- Yes
- No
- I don't know.

Q11a: If so, under which of the above categories would they fall?

Q12: Some stakeholders have voiced concern in the past on the including of laundry installations (covered by categories WM 7 - Washing tunnel machine and D7 Pass-through dryer) into the scope due to the difficulty and impreciseness of measuring their e.g., energy consumption, making their performance hard to compare. As the ESPR allows the regulation of additional aspects beyond energy consumption such as use of recycled content, use of substances of concern, recyclability, etc., please explain if in your opinion such devices should be in the scope or not and why.

Q13: Are there any types of professional laundry machines that need to be excluded from the scope in your view? Please explain which and why.

Q14: At the time of the preparatory study, standards were lacking that addressed the definition of different categories of professional laundry machines as well as methods for the testing of their performance (e.g., consumption of energy, water and detergent). New standards have been developed in the time that has elapsed since then. Please state whether you consider such standards fit for purpose.

Choose one of the following answers:

- Yes
- No
- I don't know.

Q14a: Do you apply the new standards or based on what standards do you perform performance testing?

Q14b: If there are still any shortcomings, please explain in relation to what professional laundry categories and in what sense.

Q15: If you have additional comments related to the scope, definitions, standards and legislation, please feel free to provide them.

5.2. Annex II: Questionnaire of 2nd stakeholder consultation

The questionnaire of the 2nd stakeholder consultation was Excel based. For better readability and convenience, the file can be downloaded at the project website: https://ecodesign-commlaundryappliances.eu/sites/ecodesigncommlaundryappliances/files/downloads/ESPR_SR1_Prof_laundry_2nd_Consultation_Final.xlsx

5.3. Annex III: Categorisation of 2011 study

The categorisations proposed in the 2011 study (Graulich et al. 2011) is specified in **Table 5-1**.

Table 5-1: Proposed categorisation in (Graulich et al. 2011).

Washing appliance categories	Drying appliance categories
WM1: Semi-professional washer extractor	D1: Semi-professional dryer, condenser
WM2: Professional washer extractor, <15 kg	D2: Semi-professional dryer, air vented
WM3: Professional washer extractor, 15-40 kg	D3: Professional cabinet dryer
WM4: Professional washer extractor, >40 kg	D4: Professional tumble dryer, <15 kg
WM5: Professional washer dryer	D5: Professional tumble dryer, 15-40 kg
WM6: Professional barrier washer	D6: Professional tumble dryer, >40 kg
WM7: Washing tunnel machine;	D7: Pass-through (transfer) tumble dryer

5.4. Annex IV: Aspects related to industrial laundry machines

The scope of this study was preliminarily defined by its terms of reference as 'professional' laundry machines, covering both 'commercial' and 'industrial' machines and excluding household or domestic machines. At earlier stages in which the scope of potential future legislation was looked into, manufacturers of industrial laundry machines provided some qualitative input but did not provide data as to the actual performance of the machines that they produce. After the reports for MEErP Tasks 1-4 had been completed and exchanges with stakeholders had taken place, VDMA's[132] Working Group for European Textile Care Technology (ETCT), requested to hold a meeting with the consultant in order to explain their views and provide additional information as to the products of their members in the context of this study. A meeting was scheduled for 16 January 2025 for this purpose and was followed by an exchange of questions and information. The timing of the meeting was too late to allow for significant changes to the analysis of the sector that had already been performed in the first phase of this study.

The following section summarises some of the arguments raised and how they are assessed by the consultants. This has been provided by the consultants to enable a partial integration of some of the aspects raised and to allow the European Commission to consider the relevance of these arguments at later stages during the process of potentially preparing a Delegated Act on Ecodesign for professional laundry appliances under ESPR, and how they could be taken into consideration in future ESPR Regulation.

The order of appearance adheres to the order of aspects raised in the information provided by ETCT in its initial email from 23 January 2025.

Scope

Main argumentation

ETCT (2025a) propose[133] to delete the term 'professional' and instead to use the generic term 'non-household', further subdividing this segment into industrial and commercial laundry appliances.

EFCEM ITALIA (2025) also recently informed the consultants that it supports this approach, making reference to various standards that use the terms commercial and industrial and proposing to make use of existing terms. As an alternative, EFCEM Italia refer to Regulation 1095/2015/EU which identifies as 'professional' everything that is 'not household', i.e. 'commercial and industrial' though this is not understood to be their preference EFCEM ITALIA (2025).

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132 VDMA: network organisation for the machinery and equipment manufacturing industry in Germany and Europe, see www.vdma.eu.

133 EFCEM Italia have also recently raised support for this proposal. EFCEM Italia represents Italian companies that produce professional equipment for catering and hospitality.

Consultant's reaction

The proposal raised by ETCT addresses an aspect that was in the focus of the exchange with stakeholders from the beginning of the study. The term 'professional' had been identified in the past as controversial, seeing as it is not defined in legislation and is thus open for interpretation.

At earlier stages of the study, a proposal was made to replace the term 'professional' with the term 'non-household'. This alternative was rejected by various stakeholders, including because of the lack of a definition for this term and the fear that it could create discrepancies with existing standards. The consultants explained that the use of the term 'non-household' had the purpose of applying a term that would address both 'commercial' and 'industrial machines' (as had probably also been the case with the term professional). More importantly the objective of introducing a blanket term was to make a clear-cut differentiation of laundry machines in scope of future regulation to be developed as a result of this study, and between household laundry devices, which are already covered by other Ecodesign regulations. That said, the difficulty of applying this term arose as it resulted in a removal of the term 'semi-professional' from one of the scope categories. Semi-professional machines were explained to have a lesser durability than the machines of other categories, explaining the need for a clear demarcation of such machines from other ones. Against this argumentation the consultant reverted back to the use of 'professional' in the list of categories.

The term 'non-domestic' has also been proposed by ETCT since then for the same purpose. The consultants are not aware of a legal definition of this term. Though the consultants were more comfortable with this term due to the clear demarcation between commercial and industrial machines on the one hand and household machines on the other hand, it also does not solve the resulting absence of a fitting term to describe the 'semi-professional' segment.

As to the further segmentation of 'professional', 'non-household' or 'non-domestic' into 'commercial' and 'industrial' machines, the reason this proposal has been rejected was due to the lack of clear definitions. As early as the 1st stakeholder consultation, ETCT members had proposed to apply a load capacity threshold of 40 kg to differentiate between commercial and industrial machines. Though commercial manufacturers do not agree to this threshold, the main reasoning for not accepting it has been the reference to load capacity in the various standards.

Though standards understood to apply to industrial machines (EN 17116 series) refer to this threshold as a means of creating a clear cut-off criterium, standards developed for commercial machines (i.e., EN 50640 and EN 50594) do not just ignore this threshold but furthermore have specifications for performance testing of machines with loads of up to 300 kg.

It is the consultants' understanding that a washer extractor or a tumble dryer shall always operate in a similar manner regardless of whether the load rating is above the 40 kg threshold or not. In this sense, it is beyond the consultants' mandate to define the segmentation of machines available on the market by setting an arbitrary threshold. Furthermore, looking at the existing standardisation work, applying the load capacity

parameter for creating a clear cut-off criterium would be in discrepancy with EU standardisation.

In an attempt to support the differentiation between these segments, the consultant has raised a number of alternative parameters (see also **Section 3.1.3.1**) that could be applied for this purpose based also on the information provided by ETCT. None of these has been deemed acceptable by the industrial manufacturers (nor by the commercial ones) as there seem to be exceptions for each potential rule.

For example, under section 1 of EN 50640 on scope, note 3 gives some additional clarification, explaining that the 'standard does not apply to continuous batch washing machines (e.g., tunnel washers) or washing machines only possible to operate with automatic loading and unloading'.

ETCT explained that industrial machines differ from commercial ones in that they operate on a **continuous** rather than a **batch** basis. Nevertheless, the representatives of industrial machinery could not exclude that in some cases certain machines in an industrial set-up will operate batchwise.

Similarly, it was proposed by the consultants to refer to the **automatic** (rather than **manual**) **transfer** of laundry from one machine to the next in cases of machine assemblies applied in an industrial context. However, here too the provided information by ETCT, including films of the laundry process suggest that in some cases, textiles will be transferred manually from one machine to the next.

Though the consultants can follow that most industrial machines operate as part of a continuous process and are loaded and unloaded automatically, there appears to be a small group of cases where industrial washer extractors or industrial tumble dryers are used in non-continuous batch processes and being loaded manually. Such exceptional cases hinder a clear-cut differentiation.

Given that it seems that the only clear differentiation between 'commercial' and 'industrial' appliances is the intended use of the appliance specified by the manufacturer in the approbation, it could also be considered to refer in each relevant instance to 'commercial and industrial'. This alternative would still require maintaining the term semi-professional and has thus not been recommended by the consultants; however, it may raise less objection among stakeholders than other options.

Differences between industrial and commercial laundry

In the discussions during the meeting of the 16 January 2025, various aspects were mentioned in an attempt to determine the boundaries between industrial and commercial laundry appliances. ETCT were asked to provide information on this subject in writing.

Main argumentation

ETCT (2025a) state that the difference is determined most recently through "Preparatory Ecodesign and Energy Labelling Working plans 2022-2024"[134], EN ISO 17116 Part 2, 3 and 4[135] - based on Directive 2009/125/EC[136] and Mandate M539 as well as by practice.

ETCT (2025a) provided **Table 5-2** to show the differences between commercial and industrial machines.

Table 5-2: Description of the fundamental difference between a commercial and industrial laundry.

Parameter	Industrial	Commercial
Optimising, including consumption	Across the entire process of the circular economy	Approaches within a single machine
Output	Given as output / m² in respect to spatial requirements	Given as output / m²
Productivity	Given in kg/hour	Given in kg/hour
Performance	high performance	high performance
Performance testing	EN 17116 Part 2,3,4	EN 50640; EN 50694
Textile types	prepared for changing laundry mix	foreseeable constant laundry mix
Lifetime	long life specification	reduced life specification
	defined process by specialist is needed	no specialist counselling is needed
Safety	DIN EN ISO 10472 part 1 to 6	EN 50570; EN 50571
Electric Installation	EN 60204-1	In the past EN 60335; now EN 50570; EN 50571
Electro-magnetic compatibility	EN 61000-6-4; EN 61000-6-2	EN 61000-6-3; EN 61000-6-1
Gas	EN 13577-2	EN 299
Heating	80 % Steam or Gas	70 % Electric
Load capacity	Boarder of 40 kg; DIN EN 10472: Washer extractor at 150 l volume of the drum; Dryer at 350 l Volume of the drum	

Source: ETCT (2025a)*.

*Note: the left column has been added by the consultant to ensure comprehension

134 See details under: https://energy.ec.europa.eu/publications/ecodesign-and-energy-labelling-working-plan-2022-2024_en.

135 Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics – see **Section 3.1.4.1** for details.

136 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, available under: https://eur-lex.europa.eu/eli/dir/2009/125/oj/eng.

ETCT (2025a) specified that "Accepted new border since 2012 for industrial: Load of 40 kg and above. In realistic the market use of machinery volume in Laundrette or Coin Laundry etc. is till the boundaries by 40 kg. The normal use of machines in an industrial laundry starts by 40 kg for single machinery. That doesn't mean that for special processes single machines up to 40 kg are [not][137] used in an industrial laundry".

In a later communication, on machines in an industrial setting with a load capacity below the 40 kg threshold they explain that in an industrial laundry you can find machines separated in different rooms with a capacity of 15 kg to 40 kg for special batches like socks of a retirement home or something else. These are products which couldn´t be processed in the normal industrial process. (ETCT 2025b)

To further support the use of the load capacity threshold, ETCT provided the following data on the load capacity of typical machines in scope of the proposed appliance categories. These are specified in **Table 5-3** below, left column.

Table 5-3: Description of the fundamental difference between a commercial and industrial laundry.

ETCT market specification*	Specification proposed in current study at present*
Washing machines:	
WM 3: Commercial washer-extractor 15-40 kg; typical capacity (kg): 24	WM2: Commercial washer extractor
WM 4: Industrial washer-extractor >40 kg: typical capacity (kg): 90	
WM 7: Washing tunnel machine typical capacity: 1.500 (kg/hour)	WM5: Industrial continuous tunnel washers
Drying machines	
D5: Commercial tumble dryer 15-40 kg: typical capacity (kg): 23	D2: Commercial tumble dryer
D6: Industrial tumble dryer >= 40 kg: typical capacity (kg): 70	
D7: Pass-through (transfer) tumble dryer: typical capacity (kg): >= 40	D4: Industrial pass-through (transfer) tumble dryer

Source: ETCT (2025a)*.

*Note: The categories used by ETCT are assumed to be market related and do not confirm to the current categories proposed in this study nor to those suggested at the end of the 2011 preparatory study. Specification of the categories currently proposed has thus been added in the right column by the consultant to provide context.

Consultant's reaction

It is not clear to the consultants by whom the load capacity boarder suggested by ETCT is considered to be accepted. Though the industrial laundry manufacturers who have

[137] The consultants assume that the word 'not' was omitted here as in the exchange with ETCT an example was given in which 3 machines with a load capacity of 15 kg each were used in a laundry 'wash-street' assembly.

made statements seem to support this threshold, manufacturers of commercial machines have repeatedly objected to this limit.

Though the data suggests that the load capacities of appliances placed on the market in the different segments may differ significantly, it is beyond the mandate of the consultant to settle this dispute between the sectors, which appears to be market oriented and to lack significant environmental significance (of relevance to the ESPR objectives). In the consultants understanding, a (commercial) washer extractor with a load capacity slightly below the proposed threshold and an (industrial) one with a load capacity slightly above the threshold would still function in the same manner and should be comparable at the machine level in terms of performance. The same is true for tumble dryers. As explained above, a clearer differentiation may be possible when appliances are operated as part of a continuous process as opposed to a batch process and when appliances are loaded and unloaded automatically as opposed to manually. However, the industrial stakeholders, among others, did not agree that these properties could be considered to establish a differentiation between commercial and industrial appliances. Though probably not the majority of appliances, it could be understood in all these cases that there are appliances of one segment with the properties of the other, e.g., appliances with a loaded capacity below 40 kg used in an industrial setting; appliances considered to be industrial used in a batch process and/or loaded and unloaded manually.

Measuring the consumption in a laundry process

Since the beginning of the study and also during the 2011 preparatory study, the industrial manufacturers have argued that their equipment needs to be considered in a different manner given that laundry facilities using industrial machines are process oriented rather than batch oriented. In the discussions held during the meeting, examples were given to show that this can mean that in some cases the performance at the level of the single machine shall be “compromised” due to its inclusion in a process line, however this is deemed acceptable to ensure optimisation at the process perspective. This section, among others, gives some examples to support this line of argumentation. As mentioned at the beginning of this chapter, at the stage in the process at which the meeting was held, the analysis had already been developed and it was no longer practical to revise it in order to allow an analysis at process level; however, the argumentation is raised to allow consideration of these aspects in terms of the inclusion of industrial machines in the scope of future ESPR legislation or to support investigating such appliances from a process perspective in the future.

Main argumentation

ETCT (2025a) argue that the main concern of industrial customers is the productivity of the plant (in line with saving energy, water, chemicals, etc.), while ensuring that the laundry is cleaned and treated gently. “The complete washing line must be understood as a system that is centrally controlled. Another factor that makes it difficult is the fact that laundries are different with regard to machine equipment, location (different building complexes with different halls and installations) as well as infrastructure. Our industrial machines are process-integrated machines and systems, i.e. automatic feeding devices,

tunnel washers connected to presses/centrifuges, washer extractors and dryers, downstream transportation systems to possible finishing systems" (ETCT 2025a).

For this reason ETCT (2025a) explain that the device-specific energy consumption can be completely different from one laundry facility to another, as each facility will process a different mix of textiles, work according to a different process, and operate in a different infrastructural context. A reduction of consumption in such laundry facilities needs to be viewed at the process level and not to consider single machines which function as part of the laundry processes. To this end it is explained that "consumption values must always be viewed in relation to the standard according to which the consumption test is carried out. This is also true using the EN 17116-part 2, 3 and 4. Even if the test procedure is the same, the results are different but comparable within a range of +-10%"[138]. (ETCT 2025a).

This was further elaborated as follows: Industrial laundry facilities can clean different textiles such as hotel linen, mats, mops, workwear, hospital linen, resident laundry, or a mix of the above. The degree of contamination varies greatly as do hygienic requirements. The consumption of energy, water, and detergent are a result of the requirements of the specific type of textiles – e.g., its hygienic requirements. In some cases, it may make sense to consume more energy in an individual machine in order to consume significantly less energy in the subsequent steps of the process.

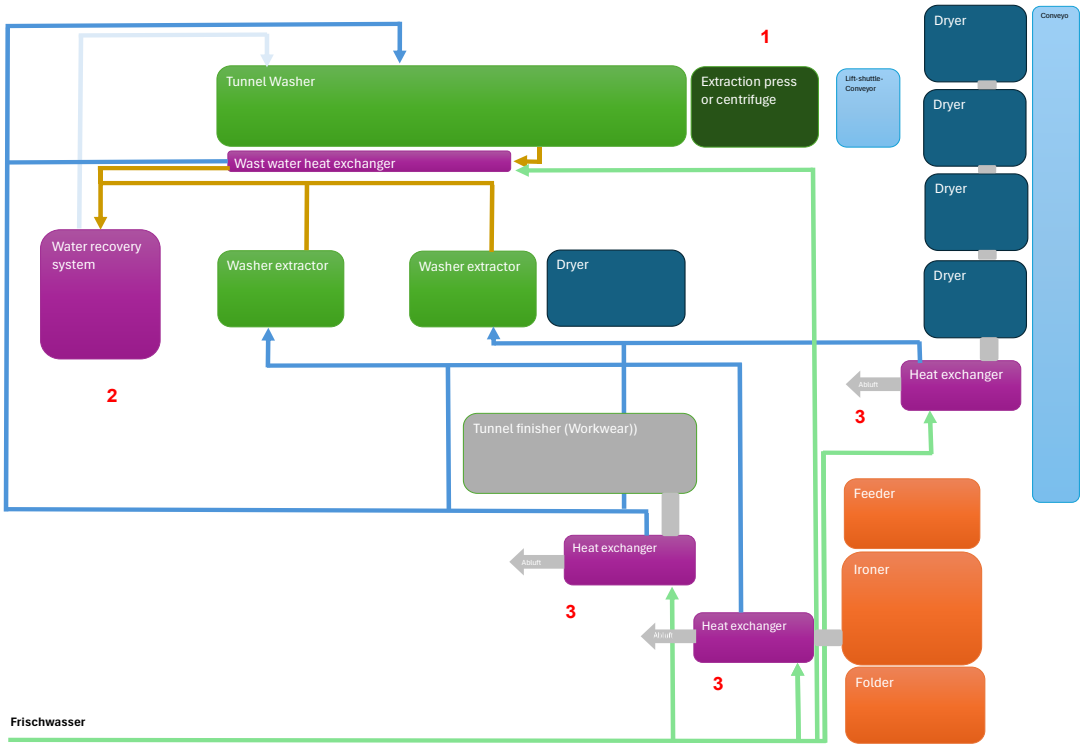
Some examples are provided (ETCT 2025a):

- It may make sense to "invest" more energy into spinning and mechanical extraction of water in order to save energy in subsequent steps of thermal drying.
- To reduce energy consumption, a heat exchanger could be integrated into the process to allow reusing heat from the exhaust air of e.g., dryer machines, tunnel finishers, ironers, in the warming up of fresh water used in e.g., washing machines (e.g., washer extractor, tunnel washer) that are part of the process line. As the heat exchanger is part of the process line but not of the washing or drying machines, when performance is measured at the device level, the savings would not be accounted for, suggesting that the machine is of lesser quality in respect of energy consumption.
- Similarly, water recovery systems can be integrated into the process line to store waste water for use in different machines for processes that are tolerant of a lower level of water purity. For example, such water could be used for the soaking of mats139 in the first stages of the washing process to reduce water consumption.

ETCT (2025a) provide the following process diagram (**Figure 5-1**) to illustrate these examples more clearly in terms of their context within an industrial laundry set-up.

[138] The reference to comparable testing is assumed to refer to tests of industrial set-ups performed according to the EN 17116 series and not as comparison with EN 50640 or EN 50594. At earlier stages of the study in various exchanges it was explained that the EN 17116 series is still not optimised and that testing performed by different parties may return results with tolerances of up to 10 %.

[139] Mats are understood to be more heavily soiled than for example hotel linen. Thus, in the first soaking stages waste water of e.g., hotel linen cleaning processes could be used to save water.



Typ of linen	special requirements	generell
Hotel Hospital Workware Resident Laundry Mats Mop	degree of contamination Hygienic Soil of Sand etc..	type of linen and degree of soiling as well as hygiene requirements define the process that can be freely configured by the operator = consumption

Type of linen can change imidiatly

1 Extraction press or centrifuge = Moisture defines the needed energy in the dryer (Energy savings could not calculated to a special type of machine. Ist a saving a a part of the intire process)

2 Reducing the Water consumtion could not calculated to a single machine a it is a saving of the

3 Energy reducing could not calculated to a single machine as it is a sawingof the intire process

Figure 5-1: Laundry process diagram.

Source: ETCT (2025a)

ETCT (2025a) explain that when considering productivity in an industrial facility, the influence of space use and throughput are in conflict with the use of the low-temperature methods (i.e., based on sinner's circle) for laundry conservation.

The need for about 30 % additional space is in conflict with reducing energy consumption and ensuring a higher lifetime for the textile. For the most part, industrial laundries will have machines with higher productivity in the case of the given space (ETCT 2025a).

Nonetheless, laundries shall have the chance to reduce consumption in different ways.

As a possible way of referring to industrial appliances in the regulatory context through a process approach, ETCT (2025a) suggest describing industrial laundry technologies at the individual level of total consumption of a laundry facility per year. For example, they suggest using the following calculations at the laundry facility level:

- Energy = kWh/kg Textile per year.
- Water = L/kg Textile per year.

According to ETCT (2025a) the data obtained in this way can be the basis for information and performance requirements to define regulatory reductions based on annual data.

ETCT (2025a) provided the table below to demonstrate examples of performance, using assumptions informed by longstanding experiences, so as to highlight the differences between commercial and industrial machines.

Table 5-4: Consumption based on lifetime of different types of machines Source: ETCT (2025b).

Machine type	Size	Number of cycles		Weekly	Yearly totals	Lifetime Years	Life span production
Household washing machine	8 kg	8	load per week	64 kg	3,328 kg	10	33,280 kg
Commercial washing machine	40 kg	8	loads per 8 hours 5 days	1,600 kg	83,200 kg	15	1,248,000 kg
Industrial Continuous tunnel washer*	50 kg	960	loads per 8 hours 5 days	48,000 kg	2,496,000 kg	20	49,920,000 kg

* Note: calculation based on 50 kg capacity 12 compartments 30 minute wash time produces 1,200 kg of linen per hour.

Consultant's reaction

The consultant can follow the explanation and examples provided by ETCT to clarify the importance of the process when measuring performance of industrial laundry appliances. Though the performance of individual appliances could be measured (e.g., energy, water and detergent consumption), this would not always be compatible with their performance in the process, which could be higher or lower at the specific appliance level but is assumed to generally strive towards the total efficiency of the laundry process.

Reflection is needed as to how aspects could be considered at the process level under ESPR. At the level of the individual appliance, it may be possible to include industrial machinery in the scope where technical requirements pertaining to e.g., the use of materials or recycled content or the provision of data to consumers is concerned. Nonetheless, it is not clear how performance requirements could be addressed at the

process level, while still placing manufacturers in the focus of compliance. Such requirements are relevant for e.g., consumption of energy, water and detergents. At the process level it is more probable that such requirements would need to be addressed at laundry facility level, meaning i.e. the end-customer of industrial laundry appliances.

Performance at the laundry facility level could be attempted through GPP requirements that can be addressed in ESPR, however this would in turn then only cover a fraction of the market (e.g., laundries in public facilities such as hospitals). An alternative may be to address performance requirements through other legislation. The Industrial Emissions directive (IED) usually addresses facilities at plant level, however facilities such as laundry facilities are currently not included, and it is not clear if this could be an option in the future.

To further understand how legislation could target more efficient performance in the future, it is furthermore important to understand the actual performance of (e.g., industrial) laundry machines at present plus the potential for improvement. Though standards have been developed for performance testing of industrial laundry machines (i.e., series 17116), only single results based on tests performed according to such standards have been made available so far and it is thus not possible to conclude to what degree different facilities could be compared to allow understanding the potential for improvement. In this respect the data provided by ETCT and reproduced in **Table 5-4** above also does not include data on consumption of energy, detergent and water, but only on the amounts of laundry to be treated throughout the appliances' lifetime.

5.5. Annex V: Inputs for LCA / LCC per Base Case

WM1: Light duty commercial washer extractor

Raw materials

Below, the BOM followed by the packaging used is provided for BC WM1 including recycled content, dataset used, data source and quality scoring. BOM data was sourced from Tasks 1-4 of this Preparatory study.

Table 5-5: Bill of Materials for WM1.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	20.61	kg	27.9 %	3-Ferro	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel Sheet galvanised	0.56	kg	0.8 %	3-Ferro	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Cast Iron	11.19	kg	15.2 %	3-Ferro	Default	Medium quality	Manual dataset - 300-Cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2,06 % carbon content	Not available

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Polypropylene (PP)	8.02	kg	10.9 %	1-BlkPlastics	Default	Medium quality	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %
Polyamide (PA)	0.09	kg	0.1 %	2-TecPlastics	Default	Medium quality	Proxy Nylon - 11-Nylon 6 fibre extrusion into fibre production mix, at plant 5 % loss, 3,5 MJ electricity	31-Nylon fibre, recycled, mechanical, post-consumer washing, drying, shredding, drum rotating spinning production mix, at plant Erec/ErecEOL, efficiency 90 %
Polycarbonate	0.19	kg	0.3 %	2-TecPlastics	Default	Medium quality	14-Polycarbonate (PC) granulate Technology mix, diphenyl carbonate route and phosgene route production mix, at plant 1.20–1.22 g/cm^3	33-Polycarbonate (PC), recycled, post-consumer chemical recycling, depolymerisation, hydrolysis production mix, at plant Erec/ErecEOL, efficiency 80 %
Epoxy	0.26	kg	0.4 %	2-TecPlastics	Default	Medium quality	4-Epoxy plastic polymerisation of liquid epoxy resins with a latent hardener (amine) production mix, at plant petrochemical based	Not available
Acrylonitrile Butadiene Styrene (ABS)	1.15	kg	1.6 %	1-BlkPlastics	Default	Medium quality	1-Acrylonitrile Butadiene Styrene (ABS) emulsion polymerisation, bulk polymerisation or combined processes production mix, at plant	36-Recycling plastic Acrylonitrile-butadiene-styrene (ABS), waste management, technology mix
Polystyrene (PS)	0.68	kg	0.9 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Polybutylene Terephthalate (PBT)	0.01	kg	0.0 %	1-BlkPlastics	Default	Medium quality	Proxy - 12-Polyethylene terephthalate (PET), petrochemical based polymerisation of ethylene glycol and terephthalic acid production mix, at plant petrochemical based	41-Polyethylene terephthalate (PET) granulate secondary; no metal fraction from post-consumer waste, via washing, granulation, pelletisation production mix, at plant 90 % recycling rate
Polyvinylchloride (PVC)	0.22	kg	0.3 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
EPDM-rubber	1.75	kg	2.4 %	1-BlkPlastics	Default	Medium quality	6-Ethylene propylene dien elastomer (EPDM) copolymerisation of ethylene and propylene production mix, at plant 69 % ethylene, 38 % propylene	39-Recycling of post-industrial waste EPDM rubber
Plastics others (assumed polypropylene)	1.10	kg	1.5 %	1-BlkPlastics	Default	Medium quality	Proxy - 16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %
Aluminium	2.23	kg	3.0 %	4-Non-ferro	Default	Medium quality	52-Aluminium ingot mix (high purity) primary production, aluminium casting single route, at plant 2.7 g/cm^3, >99 % Al	123-Recycling of aluminium into aluminium ingot - from post-consumer collection, transport, pretreatment, remelting production mix, at plant aluminium waste, efficiency 90 %
Cu wire	1.31	kg	1.8 %	4-Non-ferro	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm^3

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
CuZn38 cast	0.10	kg	0.1 %	4-Non-ferro	Default	Medium quality	55-Brass anode furnace and casting, from copper and zinc, primary production single route, at plant 8.41- 8.86 g/cm^3	99-Brass, recycled, post-consumer die casting, from copper and zinc, primary production production mix, at plant 8.41- 8.86 g/cm^3
Chrome	1.76	kg	2.4 %	4-Non-ferro	Default	Medium quality	278-Chromium oxide production; technology mix; production mix, at plant; 100 % active substance	Not available
Bitumen	0.04	kg	0.1 %	7-Misc.	Default	Medium quality	214-Bitumen at refinery from crude oil production mix, at refinery 38.7 MJ/kg net calorific value	Not available
Concrete	18.21	kg	24.6 %	7-Misc.	Default	Medium quality	216-Concrete, production mix, at plant aggregates mixing production mix, at plant C20/25	Not available
Glass	1.77	kg	2.4 %	7-Misc.	Default	Medium quality	72-Flat glass, uncoated cut, Pilkington process, from sand and soda ash production mix, at plant 2500 kg/m^3	116-Recycling glass, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant glass waste, efficiency 95 %
Wood (assumed plywood box)	2.45	kg	3.3 %	7-Misc.	Default	Medium quality	Proxy - 284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture	Not available
Electronics	0.05	kg	0.1 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95- 98% efficiency, scrap incineration: 11.0 MJ/kg NCV

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Total product weight	73.86	kg	100 %					

Table 5-6: Packaging used for WM1.

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset used	Dataset recycling
PE-Foil	0.051	kg	1.9 %	1-BlkPlastics	Default	Medium quality	Proxy - 7-HDPE granulates Polymerisation of ethylene production mix, at plant 0.91- 0.96 g/cm^3, 28 g/mol per repeating unit	28-High density polyethylene (HDPE), recycled washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 98 %
Wood	2.452	kg	89.9 %	7-Misc.	Default	Medium quality	Proxy - 284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture	Not available
Cardboard and paper	0.223	kg	8.2 %	7-Misc.	Default	Medium quality	217-Corrugated board, uncoated "virgin" Kraft Pulping Process, pulp pressing and drying production mix, at plant flute thickness 0.8- 2.8 mm, R1=0 %	238-Recycling paper and cardboard, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant paper waste, efficiency 90,9 %

Manufacturing

Table 5-7: Energy inputs Manufacturing for WM1.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	8.87	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-8: Material inputs Manufacturing for WM1.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	20.606	kg	21.17	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel Sheet galvanised	0.564	kg		Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Polypropylene (PP)	8.021	kg	8.021	Best dataset choice from tool options	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
polyamide (PA)	0.094	kg	4.511	Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polycarbonate	0.19	kg		Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE

Material	Value	Unit	Input value ERT	Comments	Dataset used
Acrylonitrile Butadiene Styrene (ABS)	1.145	kg		Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polybutylene Terephthalate (PBT)	0.008	kg		Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polyvinylchloride (PVC)	0.221	kg		Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
EPDM-rubber	1.752	kg		Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Plastics others	1.101	kg		Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Epoxy	0.26	kg	-	Excluded	No relevant dataset
Polystyrene (PS)	0.678	kg	0.678	Proxy	3-Blow moulding blow moulding production mix, at plant PET, HDPE and PP
Aluminium	2.233	kg	2.233	Best dataset choice from tool options	53-Aluminium sheet rolling primary production, aluminium deep- drawing single route, at plant 2.7 g/cm^3
Cu wire	1.305	kg	1.305	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
CuZn38 cast	0.10	kg	0.099	Best dataset choice from tool options	57-Brass fittings casting single route, at plant containing copper and zinc
Chrome	1.761	kg	1.761	Best dataset choice from tool options	95-Tin plated chromium steel sheet steel sheet tin plating single route, at plant chromium steel

Material	Value	Unit	Input value ERT	Comments	Dataset used
Bitumen	0.038	kg	-	Exclude	No relevant dataset
Concrete	18.205	kg	-	Exclude	No relevant dataset
Glass	1.773	kg	1.773	Best dataset choice from tool options	71-Flat glass, tempering of glass production mix, at plant 2500 kg/m^3
Wood	2.452	kg	-	Excluded	No relevant dataset
Electronics (control)	0.05	m2	0.05	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h
Cast Iron	11.192	kg	11.192	Proxy	42-Aluminium casting primary production, aluminium casting single route, at plant 2.7 g/cm^3

Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-9: Distribution input for WM1.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	0.077	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (**Table 5-11**), the parameters indicated in **Table 5-10** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-10: Use phase parameters for calculation for WM1.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	1,440	kWh	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Energy consumption for heating: Electricity	60 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.
Energy consumption for heating: Heat	40 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines. External heating (warm water input), any source (gas, fuel etc): 35 % Internal heating, steam: 5 %
Energy consumption for heating: Total	79 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	21 %	%	Expert judgement	Medium quality	Task 1-4, ESPR preparatory study, Table 3-54: Energy, water and detergent consumption of a commercial washer extractor (category WM2).
Annual water consumption	83,700	litres/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Cycles per day	3.75	cycles/day	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Daily cleaned laundry	30	kg/day	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)

Description	Value	Unit	Source	Data quality assessment	Reference
Number of working days per year	300	days/year	Expert judgement	Medium quality	Task 1-4, Table 3-37: Typical intensity of use of the regarded washing machine categories.
Annually cleaned laundry	9	tons/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Annual detergent consumption	99	kg/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Specific detergent consumption operation	0.011	kg/kg laundry	Stakeholder input	High quality	Updated calculation based on stakeholder input (APPLiA)
Detergent price per kg of laundry	0.082	EUR/kg laundry	Literature	Medium quality	Task 1-4, Customer expenditure database, detergent costs
Duration of the typically used washing program	1.32	hours	Previous study	Medium quality	Updated calculation based on stakeholder input (APPLiA)

Table 5-11: Use phase input data for WM1.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	0.876	kWh		Calculations based on Table 6-11. Updated calculation based on stakeholder input (APPLiA)
On-mode: No. of cycles / year	1125	#	Cycles per day* Number of working days per year	Calculations based on Table 6-11. Updated calculation based on stakeholder input (APPLiA)

Use phase inputs	Value	Unit	Comment	Reference
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Standby-mode: No. of hours / year	600	#	120 min per day = 2 hours	Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Ideal operating conditions and user behaviour
Off-mode: No. of hours / year	-	#	N/A	
Heat				
Consumption of heat per cycle	0.404	kWh	External + internal heating: 40 %	Calculations based on Table 6-11. Updated calculation based on stakeholder input (APPLiA)
No. of cycles / year	1,125	#	Cycles per day* Number of working days per year	Calculations based on Table 6-11. Updated calculation based on stakeholder input (APPLiA)
Avg. Heat Power Output	0.307	kW	Total energy per year/total operating time per year	Calculations based on Table 6-11. Updated calculation based on stakeholder input (APPLiA)
No. of hours / year	1,481.25	hrs.	Hours per cycle * cycles per year	Calculations based on Table 6-11. Updated calculation based on stakeholder input (APPLiA)
Water use				
Annual water use	83.7	m^3		Calculations based on Table 6-11. Updated calculation based on stakeholder input (APPLiA)
Auxilliary materials				
Detergent per cycle	0.088	kg		Calculations based on Table 6-11. Updated calculation based on stakeholder input (APPLiA)

Economic input data

All economic input parameters are provided below.

Table 5-12: Economic inputs for WM1.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	10	years	Stakeholder input	High quality	Broad range of cycles per lifetime (5000-15000) - average taken	Stakeholder input (APPLiA)
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024 (Gama Caldas et al. 2024) page 48
Economic life cycle data						
Latest Annual sales	0.0243	Mln Units / year	Stakeholder input	High quality	Range of estimated numbers of batch-loaded units: 20250-28350. Average number taken Based on stakeholder data (APPLiA)	Task 1-4, Table 3-16: Number of batch-loaded washing machines manufactured in the EU27.
Assumed purchase price	2,000	Euro/unit	Expert judgement	Medium quality	Average price, extrapolation of 2011 data	Stakeholder input (APPLiA)
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication (European commission/JRC, 2018)	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, page 113-115 (European commission/JRC, 2018)
Installation/acquisition costs (if any)	80	Euro/ unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, 3.2.4.2 Installation costs. Updated calculation based on stakeholder input (APPLiA)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Fuel rate (gas, oil, wood)	0.023	Euro/MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, 3.2.4.3 Gas Rate
Electricity rate	0.234	Euro/kWh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, 3.2.4.3 Electricity rate
Water rate	1.91	Euro/m^3	Literature	Medium quality	Statistics, average prices of water from EU members	Task 1-4, 3.2.4.3 Water costs
Repair & maintenance costs	60	Euro/ unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, 3.2.4.4 Maintenance and service costs. Updated calculation based on stakeholder input (APPLiA)
Discount rate (interest minus inflation)	3	%	Literature	Medium quality	MEErP Review	(Gama Caldas et al. 2024)
Escalation rate (project annual growth of running costs)	1.48 %	%				See **Table 5-13**
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	
Price of auxiliary material 1: Detergent	4.1	Euro/kg detergent	Stakeholder input	High quality	Price for commercial and industrial products: 0,082 euros/kg of laundry. Specific detergent consumption 0,023 kg detergent/kg laundry.	Calculations based on Table 5-38

Table 5-13: Escalation rate parameters for WM1

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	479.0	40.5	4.84%	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	985.0	230.1	27.51%	
Water	0.16 %	83,700.0	159.9	19.11%	
Detergent	1.21 %	99.0	405.9	48.53%	
Weighted average Escalation rate	1.17 %				

WM2: Commercial washer extractor

Raw materials

Below, the BOM followed by the packaging used is provided for BC WM2 including recycled content, dataset used, data source and quality scoring.

Table 5-14: Bill of Materials for WM2.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	52.63	kg	25.0 %	3-Ferrous	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel Sheet galvanised	105.25	kg	50.0 %	3-Ferrous	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Cast Iron	18.95	kg	9.0 %	3-Ferrous	Default	Medium quality	Manual dataset - 300-Cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2.06 % carbon content	Not available
Plastics (PP, Polyester, ABS, etc.)	5.20	kg	2.5 %	1-BlkPlastics	Default	Medium quality	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Polyamide (PA)	1.05	kg	0.5 %	2-TecPlastics	Default	Medium quality	Proxy - 11-Nylon 6 fibre extrusion into fibre production mix, at plant 5 % loss, 3,5 MJ electricity	31-Nylon fibre, recycled, mechanical, post-consumer washing, drying, shredding, drum rotating spinning production mix, at plant Erec/ErecEOL, efficiency 90 %
Polyvinylchloride (PVC)	0.21	kg	0.1 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
EDPM-rubber	2.74	kg	1.3 %	1-BlkPlastics	Default	Medium quality	6-Ethylene propylene dien elastomer (EPDM) copolymerisation of ethylene and propylene production mix, at plant 69 % ethylene, 38 % propylene	39-Recycling of post-industrial waste EPDM rubber
Aluminium	13.90	kg	6.6 %	4-Non-ferrous	Default	Medium quality	52-Aluminium ingot mix (high purity) primary production, aluminium casting single route, at plant 2.7 g/cm^3, >99 % Al	123-Recycling of aluminium into aluminium ingot - from post-consumer collection, transport, pretreatment, remelting production mix, at plant aluminium waste, efficiency 90 %
Copper	3.50	kg	1.7 %	4-Non-ferrous	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm^3

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Glass	2.10	kg	1.0 %	7-Misc.	Default	Medium quality	72-Flat glass, uncoated cut, Pilkington process, from sand and soda ash production mix, at plant 2500 kg/m^3	116-Recycling glass, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant glass waste, efficiency 95 %
Zinc	0.63	kg	0.3 %	4-Non-ferrous	Default	Medium quality	98-Zinc technology mix, primary production consumption mix, to consumer 7.14 g/cm^3	114-Zinc, recycled (post consumer, refining of EAF dust)
Electronics	1.85	kg	0.1 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95-98% efficiency, scrap incineration: 11.0 MJ/kg NCV
Total product weight	210.45	kg	100 %					

Table 5-15: Packaging used for WM2.

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Polystyrene	0.5	kg	2.7 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate
Wood	14	kg	75.7 %	7-Misc.	Default	Medium quality	Proxy - 284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture	Not available
Cardboard and paper	4	kg	21.6 %	7-Misc.	Default	Medium quality	217-Corrugated board, uncoated "virgin" Kraft Pulping Process, pulp pressing and drying production mix, at plant flute thickness 0.8- 2.8 mm, R1=0 %	238-Recycling paper and cardboard, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant paper waste, efficiency 90,9 %
Total packaging weight	18.50	kg	100 %					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 5-16**. **Table 5-17** provides the data points related to the manufacturing of the components of the product.

Table 5-16: Energy inputs Manufacturing for WM2.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	26.61	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-17: Material inputs Manufacturing for WM2.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	52.625	kg	157.88	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel Sheet galvanised	105.25	kg		Best dataset choice from tool options	
Plastics (PP, Polyester, ABS, etc.)	5.2	kg	9.2	Best dataset choice from tool options	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polyamide (PA)	1.05	kg		Proxy	
Polyvinylchloride (PVC)	0.21	kg		Proxy	
EDPM-rubber	2.74	kg		Proxy	
Aluminium	13.9	kg	13.9	Best dataset choice from tool options	53-Aluminium sheet rolling primary production, aluminium deep- drawing single route, at plant 2.7 g/cm^3
Copper	3.5	kg	3.5	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
Glass	2.1	kg	2.1	Best dataset choice from tool options	71-Flat glass, tempering tempering of glass production mix, at plant 2500 kg/m^3

Material	Value	Unit	Input value ERT	Comments	Dataset used
Electronics (control)	1.40	m2	1.40	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h
Cast Iron	18.95	kg	18.945	Proxy	42-Aluminium casting primary production, aluminium casting single route, at plant 2.7 g/cm^3
Zinc	0.63	kg	0.63	Proxy	56-Brass Die-Casting die casting, from copper and zinc, primary production mix, at plant 8.41- 8.86 g/cm^3

Distribution

Below, the transport scenario input data is provided (**Table 5-18**). Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-18: Distribution input for WM2.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	0.226	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (**Table 5-20)**, the parameters indicated in **Table 5-19** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-19: Use phase parameters for calculation for WM2.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	21,750	kWh	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Energy consumption for heating: Electricity	55 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.
Energy consumption for heating: Heat	45 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.
Energy consumption for heating: Total	87 %	%	Expert judgement	Medium quality	Task 1-4,Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	13 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Annual water consumption	783,000	litres/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Cycles per day	12	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 3-37: Typical intensity of use of the regarded washing machine categories.

Description	Value	Unit	Source	Data quality assessment	Reference
Daily cleaned laundry	230	kg/day	Expert judgement	Medium quality	
Number of working days per year	300	days/year	Expert judgement	Medium quality	
Annually cleaned laundry	87	tons/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Annual detergent consumption	957	kg/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Specific detergent consumption operation	0.011	kg/kg laundry	Previous study	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Detergent price per kg of laundry	0.082	EUR/kg laundry	Literature	Medium quality	Task 1-4, Chapter "Detergent costs
Duration of the typically used washing program	0.78	hours	Previous study	Medium quality	Stakeholder input (APPLiA)

Table 5-20: Use phase input data for WM2.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				

Use phase inputs	Value	Unit	Comment	Reference
On-mode: Consumption per cycle	4.412	kWh		Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)
On-mode: No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Standby-mode: No. of hours / year	300	#	60 min per day = 1 hour	Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Chapter 4.3.4.1 Influence of user behaviour
Off-mode: No. of hours / year	-	#	N/A	
Heat				
Consumption of heat per cycle	2.828	kWh		Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)
No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)
Avg. Heat Power Output	3.623	kW	Total energy per year/total operating time per year	Calculations based on Table 5-19 Updated calculation based on stakeholder input (APPLiA)
No. of hours / year	2,350	hrs.	Hours per cycle * cycles per year	Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)
Water use				
Water use per cycle	0.26	m^3	Annual water consumption / number of cycles per year	Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)
No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)

Use phase inputs	Value	Unit	Comment	Reference
Annual water use	783	m^3		Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)
Auxilliary materials				
Detergent per cycle	0.319	kg		Calculations based on Table 5-19. Updated calculation based on stakeholder input (APPLiA)

Economic input data

All economic input parameters are provided below.

Table 5-21: Economic inputs for WM2.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	10	years	Stakeholder input	High quality	Broad range of cycles per lifetime (30000-80000) - average taken	Stakeholder input (APPLiA)
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024, (Gama Caldas et al. 2024)
Economic life cycle data						
Latest Annual sales	0.053	Mln Units / year	Stakeholder input	High quality	"Range of estimated numbers of batch-loaded units for WM2, WM3 and WM4 Base Cases of the 2011 study - Average number taken.	Stakeholder input (APPLiA)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Assumed purchase price	9,000	Euro/unit	Expert judgement	Medium quality	WM2 (2011): 40050-48600 units	Stakeholder input (APPLiA)
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication (European commission/JRC, 2018)	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, page 113-115 (European commission/JRC, 2018)
Installation/acquisition costs (if any)	360	Euro/unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, Chapter 4.2.4.2 Installation costs. Updated calculation based on stakeholder input (APPLiA)
Fuel rate (gas, oil, wood)	0.023	Euro/MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.2 Gas rate
Electricity rate	0.234	Euro/kWh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter "4.2.4.3.1.1 Electricity rate
Water rate	1.91	Euro/m^3	Literature	Medium quality	Statistics, average prices of water from EU members	Task 1-4, Chapter Water costs
Repair & maintenance costs	270	Euro/unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, Chapter 4.2.4.4 Maintenance and service costs. Updated calculation based on stakeholder input (APPLiA)
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, (Gama Caldas et al. 2024)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Escalation rate (project annual growth of running costs)	1.26 %	%				See Table 5-22. Updated calculation based on stakeholder input (APPLiA)
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	
Price of auxiliary material 1: Detergent	3.7	Euro/kg detergent	Stakeholder input	High quality		Calculations based on Table 3-117

Table 5-22: Escalation rate parameters for WM2.

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	8,963.3	757.6	8.5 %%	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	13,234.9	3,092.1	34.7 %	
Water	0.16 %	783,000.0	1,495.5	16.8 %	

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Detergent	1.21 %	957.0	3,567.0	40.0 %	
Weighted average Escalation rate	1.26 %				

WM3: Commercial washer dryer

Raw materials

Below, the BOM followed by the packaging used is provided for BC WM3 including recycled content, dataset used, data source and quality scoring.

Table 5-23: Bill of Materials for WM3.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	30.56	kg	8.0 %	3-Ferrous	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel tube	19.10	kg	5.0 %	3-Ferrous	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel Sheet galvanised	267.40	kg	70.0 %	3-Ferrous	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Cast Iron	15.28	kg	4.0 %	3-Ferrous	Default	Medium quality	Manual dataset - 300-Cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2,06 % carbon content	Not available

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Plastics (PP, Polyester, ABS etc.)	7.64	kg	2.0 %	1-BlkPlastics	Default	Medium quality	Proxy- 16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %
Zinc	7.64	kg	2.0 %	4-Non-ferrous	Default	Medium quality	98-Zinc technology mix, primary production consumption mix, to consumer 7.14 g/cm^3	114-Zinc, recycled (post consumer, refining of EAF dust)
Polyvinylchloride (PVC)	0.76	kg	0.2 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
Aluminium	7.64	kg	2.0 %	4-Non-ferrous	Default	Medium quality	52-Aluminium ingot mix (high purity) primary production, aluminium casting single route, at plant 2.7 g/cm^3, >99 % Al	123-Recycling of aluminium into aluminium ingot - from post-consumer collection, transport, pretreatment, remelting production mix, at plant aluminium waste, efficiency 90 %
Copper	15.28	kg	4.0 %	4-Non-ferrous	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm^3

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Electronics	4.58	kg	1.2 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95- 98% efficiency, scrap incineration: 11.0 MJ/kg NCV
Total product weight	382.00	kg	100 %					

Table 5-24: Packaging used for WM3.

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Polystyrene	1.5	kg	6.0 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Wood	17.5	kg	70.0 %	7-Misc.	Default	Medium quality	Proxy - 284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture	Not available
Cardboard and paper	6	kg	24.0 %	7-Misc.	Default	Medium quality	217-Corrugated board, uncoated "virgin" Kraft Pulping Process, pulp pressing and drying production mix, at plant flute thickness 0.8- 2.8 mm, R1=0 %	238-Recycling paper and cardboard, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant paper waste, efficiency 90,9 %
Total packaging weight	25.00	kg	100 %					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 5-25**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 5-26** provides the data points related to the manufacturing of the components of the product.

Table 5-25: Energy inputs Manufacturing for WM3.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	53.22	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-26: Material inputs Manufacturing for WM3.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	30.56	kg	317.06	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel tube	19.1	kg			
Steel Sheet galvanised	267.4	kg			
Plastics (PP, Polyester, ABS etc.)	7.64	kg	8.40	Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polyvinylchloride (PVC)	0.764	kg			

Material	Value	Unit	Input value ERT	Comments	Dataset used
Aluminium	7.64	kg	7.64	Best dataset choice from tool options	53-Aluminium sheet rolling primary production, aluminium deep- drawing single route, at plant 2.7 g/cm^3
Copper	15.28	kg	15.28	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
Electronics (control)	3.47	m2	3.47	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h
Cast Iron	15.28	kg	15.28	Proxy	42-Aluminium casting primary production, aluminium casting single route, at plant 2.7 g/cm^3
Zinc	7.64	kg	7.64	Proxy	56-Brass Die-Casting die casting, from copper and zinc, primary production mix, at plant 8.41- 8.86 g/cm^3

Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-27: Distribution input for WM3.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	0.407	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (**Table 5-29**), the parameters indicated in **Table 5-28** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-28: Use phase parameters for calculation for WM3.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	33,480	kWh	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Energy consumption for heating: Electricity	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.

Description	Value	Unit	Source	Data quality assessment	Reference
Energy consumption for heating: Heat	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Energy consumption for heating: Total	80 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	20 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Annual water consumption	540,000	litres/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Cycles per day	10	cycles/day	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Daily cleaned laundry	180	kg/day	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Number of working days per year	300	days/year	Expert judgement	Medium quality	
Annually cleaned laundry	54	tons/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)

Description	Value	Unit	Source	Data quality assessment	Reference
Annual detergent consumption	594	kg/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Specific detergent consumption operation	0.011	kg/kg laundry	Previous study	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Detergent price per kg of laundry	0.082	EUR/kg laundry	Literature	Medium quality	Task 1-4, Chapter "Detergent costs"
Duration of the typically used washing program	1.25	hours	Previous study	Medium quality	Task 1-4, Table 3-43: Programme selection of commercial and industrial washing machine categories.

Table 5-29: Use phase input data for WM3.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	11.160	kWh		Calculations based on Table 5-28. Updated calculation based on stakeholder input (APPLiA)
On-mode: No. of cycles / year	3000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-28. Updated calculation based on stakeholder input (APPLiA)
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.

Use phase inputs	Value	Unit	Comment	Reference
Standby-mode: No. of hours / year	220	#	60 min per day = 1 hour	Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Chapter 4.3.4.1 Influence of user behaviour
Off-mode: No. of hours / year	-	#	N/A	
Heat				
Consumption of heat per cycle	0	kWh		Calculations based on Table 5-28
No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-28. Updated calculation based on stakeholder input (APPLiA)
Avg. Heat Power Output	0	kW	Total energy per year/total operating time per year	Calculations based on Table 5-28
Water use				
Water use per cycle	0.18	m^3	Annual water consumption / number of cycles per year	Calculations based on Table 5-28. Updated calculation based on stakeholder input (APPLiA)
No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-28
Annual water use	540	m^3		Calculations based on Table 5-28. Updated calculation based on stakeholder input (APPLiA)
Auxilliary materials				
Detergent per cycle	0.198	kg		Calculations based on Table 5-28. Updated calculation based on stakeholder input (APPLiA)

Economic input data

All economic input parameters are provided below.

Table 5-30: Economic inputs for WM3.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	10	years	Stakeholder input	High quality	Broad range of cycles per lifetime (30000-80000) - average taken	Stakeholder input (APPLiA)
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024, (Gama Caldas et al. 2024) page 48
Economic life cycle data						
Latest Annual sales	0.000405	Mln Units / year	Stakeholder input	High quality	Range of estimated numbers of batch-loaded units for WM5 (2011): 0-810. Average number taken	Task 1-4, Table 3-16: Number of batch-loaded washing machines manufactured in the EU27.
Assumed purchase price	13,000	Euro/unit	Expert judgement	Medium quality	Based on stakeholder data (APPLiA)	Stakeholder input (APPLiA)
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, (European commission/JRC, 2018)
Installation/acquisition costs (if any)	520	Euro/unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, Chapter 4.2.4.2 Installation costs. Updated calculation based on stakeholder input (APPLiA)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Fuel rate (gas, oil, wood)	0.023	Euro/ MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.2 Gas rate
Electricity rate	0.234	Euro/k Wh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter "4.2.4.3.1.1 Electricity rate"
Water rate	1.91	Euro/ m^3	Literature	Medium quality	Statistics, average prices of water from EU members	Task 1-4, Chapter Water costs
Repair & maintenance costs	390	Euro/ unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, Chapter 4.2.4.4 Maintenance and service costs. Updated calculation based on stakeholder input (APPLiA)
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, page 62, (Gama Caldas et al. 2024)
Escalation rate (project annual growth of running costs)	1.39 %	%				See Table 5-31. Updated calculation based on stakeholder input (APPLiA)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	
Price of auxiliary material 1: Detergent	5.1	Euro/kg detergent	Stakeholder input	High quality		Calculations based on Table 56

Table 5-31: Escalation rate parameters for WM3.

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	-	-	0.00 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	33,480.0	7,822.0	65.74 %	
Water	0.16 %	540,000.0	1,031.4	8.67 %	
Detergent	1.21 %	594.0	3,044.3	25.59 %	
Weighted average Escalation rate	1.39 %				

WM4: Commercial barrier washer

Raw materials

Below, the BOM followed by the packaging used is provided for BC WM4 including recycled content, dataset used, data source and quality scoring.

Table 5-32: Bill of Materials for WM4.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	441.50	kg	44.0 %	3-Ferrous	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel tube	170.60	kg	17.0 %	3-Ferrous	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel Sheet galvanised	50.10	kg	5.0 %	3-Ferrous	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Cast Iron	80.30	kg	8.0 %	3-Ferrous	Default	Medium quality	Manual dataset - 300-Cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2,06 % carbon content	Not available

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Plastics (PP, Polyester, ABS etc.)	48.20	kg	4.8 %	1-BlkPlastics	Default	Medium quality	Proxy- 16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %
Zinc	20.10	kg	2.0 %	4-Non-ferrous	Default	Medium quality	98-Zinc technology mix, primary production consumption mix, to consumer 7.14 g/cm^3	114-Zinc, recycled (post consumer, refining of EAF dust)
Polyamide (PA)	20.10	kg	2.0 %	2-TecPlastics	Default	Medium quality	Proxy - 11-Nylon 6 fibre extrusion into fibre production mix, at plant 5 % loss, 3,5 MJ electricity	31-Nylon fibre, recycled, mechanical, post-consumer washing, drying, shredding, drum rotating spinning production mix, at plant Erec/ErecEOL, efficiency 90 %
Polyvinylchloride (PVC)	2.00	kg	0.2 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
EDPM-rubber	20.10	kg	2.0 %	1-BlkPlastics	Default	Medium quality	6-Ethylene propylene dien elastomer (EPDM) copolymerisation of ethylene and propylene production mix, at plant 69 % ethylene, 38 % propylene	39-Recycling of post-industrial waste EPDM rubber

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Aluminium	30.10	kg	3.0 %	4-Non-ferrous	Default	Medium quality	52-Aluminium ingot mix (high purity) primary production, aluminium casting single route, at plant 2.7 g/cm^3, >99 % Al	123-Recycling of aluminium into aluminium ingot - from post-consumer collection, transport, pretreatment, remelting production mix, at plant aluminium waste, efficiency 90 %
Copper	30.10	kg	3.0 %	4-Non-ferrous	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm^3
Brass	20.10	kg	2.0 %	4-Non-ferrous	Default	Medium quality	55-Brass anode furnace and casting, from copper and zinc, primary production single route, at plant 8.41- 8.86 g/cm^3	99-Brass, recycled, post-consumer die casting, from copper and zinc, primary production mix, at plant 8.41- 8.86 g/cm^3
Glass	10.00	kg	1.0 %	7-Misc.	Default	Medium quality	72-Flat glass, uncoated cut, Pilkington process, from sand and soda ash production mix, at plant 2,500 kg/m^3	116-Recycling glass, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant glass waste, efficiency 95 %
Electronics	25.8	kg	2.7 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95-98% efficiency, scrap incineration: 11.0 MJ/kg NCV

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Total product weight	**1003.50**	**kg**	**100 %**					

Table 5-33: Packaging used for WM4.

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Polystyrene	0.051	kg	6.0 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate
Wood	2.452	kg	70.0 %	7-Misc.	Default	Medium quality	Proxy - 284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture	Not available
Cardboard and paper	0.223	kg	24.0 %	7-Misc.	Default	Medium quality	217-Corrugated board, uncoated "virgin" Kraft Pulping Process, pulp pressing and drying production mix, at plant flute thickness 0.8- 2.8 mm, R1=0 %	238-Recycling paper and cardboard, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant paper waste, efficiency 90,9 %

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Total packaging weight	2.73	kg	100 %					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 5-34**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 5-35** provides the data points related to the manufacturing of the components of the product.

Table 5-34: Energy inputs Manufacturing for WM4.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	124.18	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-35: Material inputs Manufacturing for WM4.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	441.50	kg	662.20	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel Sheet galvanised	50.10	kg			

Material	Value	Unit	Input value ERT	Comments	Dataset used
Steel tube	170.60	kg			
Plastics (PP, Polyester, ABS etc.)	48.20	kg	90.4	Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polyamide (PA)	20.10	kg			
Polyvinylchloride (PVC)	2.00	kg			
EDPM-rubber	20.10	kg			
Aluminium	30.10	kg	30.1	Best dataset choice from tool options	53-Aluminium sheet rolling primary production, aluminium deep- drawing single route, at plant 2.7 g/cm^3
Copper	30.10	kg	30.1	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
Glass	10.00	kg	10	Best dataset choice from tool options	71-Flat glass, tempering of glass production mix, at plant 2,500 kg/m^3
Electronics (control)	19.55	m2	19.55	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h
Cast Iron	80.30	kg	80.3	Proxy	42-Aluminium casting primary production, aluminium casting single route, at plant 2.7 g/cm^3
Zinc	20.10	kg	20.1	Proxy	56-Brass Die-Casting die casting, from copper and zinc, primary production mix, at plant 8.41- 8.86 g/cm^3
Brass	20.10	kg	20.1	Best dataset choice from tool options	56-Brass Die-Casting die casting, from copper and zinc, primary production mix, at plant 8.41-8.86 g/cm^3

Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-36: Distribution input for WM4.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	1.006	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (**Table 5-38**), the parameters indicated in **Table 5-37** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-37: Use phase parameters for calculation for WM4.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	14,400	kWh	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Energy consumption for heating: Electricity	5 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.
Energy consumption for heating: Heat	95 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.
Energy consumption for heating: Total	88 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	12 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Annual water consumption	1,276,800	litres/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA))

Description	Value	Unit	Source	Data quality assessment	Reference
Cycles per day	10	cycles/day	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Daily cleaned laundry	320	kg/day	Expert judgement	Medium quality	
Number of working days per year	300	days/year	Expert judgement	Medium quality	
Annually cleaned laundry	96	tons/year	Expert judgement	Medium quality	
Annual detergent consumption	1,056	kg/year	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Specific detergent consumption operation	0.011	kg/kg laundry	Stakeholder input	High quality	Updated calculation based on stakeholder input (APPLiA)
Detergent price per kg of laundry	0.082	EUR/kg laundry	Literature	Medium quality	Task 1-4, Chapter "Detergent costs"
Duration of the typically used washing program	0.8833	hours	Previous study	Medium quality	Stakeholder input (APPLiA)

Table 5-38: Use phase input data for WM4.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	0.787	kWh		Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)
On-mode: No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)
Standby-mode: Consumption per hour	-	kWh		Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Standby-mode: No. of hours / year	-	#		Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Chapter 4.3.4.1 Influence of user behaviour
Off-mode: No. of hours / year	-	#	N/A	
Heat				
Consumption of heat per cycle	4.013	kWh		Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)
No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)
Avg. Heat Power Output	4.543	kW	Total energy per year/total operating time per year	Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)
No. of hours / year	2,650	hrs.	Hours per cycle * cycles per year	Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)
Water use				
Water use per cycle	0.43	m^3	Annual water consumption / number of cycles per year	Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)

Use phase inputs	Value	Unit	Comment	Reference
No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)
Annual water use	1,276.8	m^3		Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)
Auxilliary materials				
Detergent per cycle	0.352	kg		Calculations based on Table 5-37. Updated calculation based on stakeholder input (APPLiA)

Economic input data

All economic input parameters are provided below.

Table 5-39: Economic inputs for WM4.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	10	years	Stakeholder input	High quality	Lifetime 45000 cycles	Stakeholder input (APPLiA)
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024 (Gama Caldas et al. 2024) page 48
Economic life cycle data						

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Latest Annual sales	0.001215	Mln Units / year	Stakeholder input	High quality	"Range of estimated numbers of batch-loaded units (WM6 - 2011): 810-1620. Average number taken Based on stakeholder data (APPLiA)"	Stakeholder input (APPLiA)
Assumed purchase price	35,000	Euro/unit	Expert judgement	Medium quality	"Estimated unit prices for WM6 Base Case of the 2011 study Average price, extrapollation of 2011 data"	Stakeholder input (APPLiA)
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication https://publications.jrc.ec.europa.eu/repository/handle/JRC114337	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, page 113-115, (European commission/JRC, 2018)
Installation/acquisition costs (if any)	1,400	Euro/ unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, Chapter 4.2.4.2 Installation costs. Updated calculation based on stakeholder input (APPLiA)
Fuel rate (gas, oil, wood)	0.023	Euro/ MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.2 Gas rate
Electricity rate	0.234	Euro/kWh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.1 Electricity rate"
Water rate	1.91	Euro/ m^3	Literature	Medium quality	Statistics, average prices of water from EU members	Task 1-4, Chapter "Water costs"

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Repair & maintenance costs	8,750	Euro/ unit	Stakeholder input	High quality	25 % of the purchase price over it's lifetime based on stakeholder's estimation	Task 1-4, Chapter 4.2.4.4 Maintenance and service costs. Updated calculation based on stakeholder input (APPLiA)
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024 (Gama Caldas et al. 2024), page 62
Escalation rate (project annual growth of running costs)	1.07 %	%				See Table 5-40
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	
Price of auxiliary material 1: Detergent	5.1	Euro/kg detergent	Stakeholder input	High quality		Calculations based on Table 5-37

Table 5-40: Escalation rate parameters for WM4.

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	12,672.0	1,071.0	11.31 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	2,361.6	551.7	5.82 %	
Water	0.16 %	1,276,800.0	2,438.7	25.74 %	
Detergent	1.21 %	1,056.0	5,412.0	57.13 %	
Weighted average Escalation rate	1.07 %				

WM5: Industrial continuous tunnel washers

Raw materials

Below, the BOM is provided for BC WM5 including recycled content, dataset used, data source and quality scoring. There is no data available for packaging for this BC.

Table 5-41: Bill of Materials for WM5.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	9,600.00	kg	79.2 %	3-Ferrous	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Steel Sheet galvanised	1,200.00	kg	9.9 %	3-Ferrous	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Cast Iron	600.00	kg	5.0 %	3-Ferrous	Default	Medium quality	Manual dataset - 300-Cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2,06 % carbon content	Not available
Polyethylene (PE)	120.00	kg	1.0 %	1-BlkPlastics	Default	Medium quality	7-HDPE granulates Polymerisation of ethylene production mix, at plant 0.91-0.96 g/cm^3, 28 g/mol per repeating unit	28-High density polyethylene (HDPE), recycled washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 98 %
Polyvinylchloride (PVC)	120.00	kg	1.0 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
EDPM-rubber	120.00	kg	1.0 %	1-BlkPlastics	Default	Medium quality	6-Ethylene propylene dien elastomer (EPDM) copolymerisation of ethylene and propylene production mix, at plant 69 % ethylene, 38 % propylene	39-Recycling of post-industrial waste EPDM rubber

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Copper	240.00	kg	2.0 %	4-Non-ferrous	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm^3
Electronics	51.4	kg	0.4 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95-98% efficiency, scrap incineration: 11.0 MJ/kg NCV
Total product weight	**12,120.0**	**kg**	**100 %**					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 5-42**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 5-43** provides the data points related to the manufacturing of the components of the product.

Table 5-42: Energy inputs Manufacturing for WM5.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	1,535.8	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-43: Material inputs Manufacturing for WM5.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	9,600.0	kg	10800.00	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel Sheet galvanised	1,200.0	kg			
Polyethylene (PE)	120.0	kg	360.00	Best dataset choice from tool options	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polyvinylchloride (PVC)	120.0			Proxy	
EPDM-rubber	120.0	kg			
Copper	240.0	kg	240.00	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
Electronics (control)	38.96	m2	38.96	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h
Cast Iron	600	kg	600.00	Proxy	42-Aluminium casting primary production, aluminium casting single route, at plant 2.7 g/cm^3

Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-44: Distribution input for WM5.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	12.120	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (**Table 5-46**), the parameters indicated in **Table 5-45** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-45: Use phase parameters for calculation for WM5.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	1,147,500	kWh	Expert judgement	Medium quality	Task 1-4, Table 3-54: Energy, water and detergent consumption of a commercial washer extractor (category WM2).
Energy consumption for heating: Electricity	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.
Energy consumption for heating: Heat	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-47: Energy Sources for water heating in commercial and industrial washing machines.
Energy consumption for heating: Total	95 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	5 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual water consumption	21,037,500	litres/year	Expert judgement	Medium quality	Task 1-4, Table 3-54: Energy, water and detergent consumption of a commercial washer extractor (category WM2).
Cycles per day	10	hours/day	Expert judgement	Medium quality	Task 1-4, Table 3-37: Typical intensity of use of the regarded washing machine categories.
Daily cleaned laundry	12,750	kg/day	Expert judgement	Medium quality	
Number of working days per year	300	days/year	Expert judgement	Medium quality	
Annually cleaned laundry	3,825	tons/year	Expert judgement	Medium quality	
Annual detergent consumption	30,600	kg/year	Expert judgement	Medium quality	Task 1-4, Table 3-54: Energy, water and detergent consumption of a commercial washer extractor (category WM2).
Specific detergent consumption operation	0.008	kg/kg laundry	Stakeholder input	High quality	Task 1-4, Table 3-54: Energy, water and detergent consumption of a commercial washer extractor (category WM2).
Detergent price per kg of laundry	0.082	EUR/kg laundry	Literature	Medium quality	Task 1-4, Chapter Detergent costs
Duration of the typically used washing program	0.75	hours	Previous study	Medium quality	Task 1-4, Table 3-43: Programme selection of commercial and industrial washing machine categories.

Table 5-46: Use phase input data for WM5.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per hour	19.125	kWh		Calculations based on Table 6-46
On-mode: No. of hours / year	3,000	#	Hours per cycle * cycles per year	Calculations based on Table 5-23
Standby-mode: Consumption per hour	-	kWh		Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Standby-mode: No. of hours / year	-	#		Task 1-4, Table 3-45: Typical time in low-power mode(s) consumption of commercial and industrial washing machines.
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Chapter 4.3.4.1 Influence of user behaviour
Off-mode: No. of hours / year	-	#	N/A	
Heat				
Consumption of heat per hour	363.375	kWh		Calculations based on Table 6-46
No. of hours / year	3,000	#	Hours per day * days per year	Calculations based on Table 6-46
Avg. Heat Power Output	363.375	kW	Total energy per year/total operating time per year	Calculations based on Table 6-46
No. of hours / year	3,000	hrs.	Hours per day * days per year	Calculations based on Table 6-46
Water use				
Water use per hour	7.01	m^3	Annual water consumption / number of hours per year	Calculations based on Table 6-46
No. of hours / year	3,000	#	Hours per day * days per year	Calculations based on Table 5-45

Use phase inputs	Value	Unit	Comment	Reference
Annual water use	21,037.5	m^3		Calculations based on Table 6-46
Auxilliary materials				
Detergent per hour	10.200	kg		Calculations based on Table 6-45

Economic input data

All economic input parameters are provided below.

Table 5-47: Economic inputs for WM5.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	13.7	years	Stakeholder input	High quality	Lifetime 41,000 hours	Task 1-4, Table 3-35: Key market segments of commercial and industrial washing machines according to spatial requirements and operator skills.
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024 (Gama Caldas et al. 2024) page 48
Economic life cycle data						
Latest Annual sales	0.00025	Mln Units / year	Previous study	Medium quality	Only estimated number of units sold (2009 figures) values available (sourced from the 2011 study)	Task 1-4, Table 3-16: Number of batch-loaded washing machines manufactured in the EU27.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Assumed purchase price	585,000	Euro/ unit	Expert judgement	Medium quality	"Estimated unit prices for WM7 Base Case of the 2011 study	Task 1-4, Table 3-25: Estimate of the unit prices of commercial and industrial laundry appliances in 2023 (based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices).
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, page 113-115 (European commission/JRC, 2018)
Installation/acquisition costs (if any)	52,650	Euro/ unit	Stakeholder input	High quality	Assumed 9 % of the purchase price for heavy duty machines	Task 1-4, Chapter 4.2.4.2 Installation costs
Fuel rate (gas, oil, wood)	0.023	Euro/ MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.2 Gas rate
Electricity rate	0.234	Euro/kWh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.1 Electricity rate
Water rate	1.91	Euro/ m^3	Literature	Medium quality	Statistics, average prices of water from EU members	Task 1-4, Chapter Water costs
Repair & maintenance costs	146,250	Euro/ unit	Stakeholder input	High quality	25 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, Chapter 4.2.4.4 Maintenance and service costs

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, page 62 (Gama Caldas et al. 2024)
Escalation rate (project annual growth of running costs)	1.33 %	%				See Table 5-48
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	
Price of auxiliary material 1: Detergent	10.3	Euro/kg detergent	Stakeholder input	High quality		Calculations based on Table 5-46

Table 5-48: Escalation rate parameters for WM5.

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	1,147,500.0	96,983.9	20.89 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	57,375.0	13,404.7	2.89 %	
Water	0.16 %	21,037,500.0	40,181.6	8.66 %	
Detergent	1.21 %	30,600.0	313,650.0	67.56 %	
Weighted average Escalation rate	1.33 %				

D1: Light duty commercial tumble dryer

Raw materials

Below, the BOM followed by the packaging used is provided for BC D1 including recycled content, dataset used, data source and quality scoring.

Table 5-49: Bill of Materials for D1.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	34.60	kg	57.5 %	3-Ferro	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel Sheet galvanised	3.50	kg	5.8 %	3-Ferro	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Cast Iron	2.40	kg	4.0 %	3-Ferro	Default	Medium quality	Manual dataset - 300-Cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2,06 % carbon content	Not available
Polypropylene (PP)	7.70	kg	12.8 %	1-BlkPlastics	Default	Medium quality	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %
Polyamide (PA)	0.40	kg	0.7 %	2-TecPlastics	Default	Medium quality	11-Nylon 6 fibre extrusion into fibre production mix, at plant 5 % loss, 3,5 MJ electricity	31-Nylon fibre, recycled, mechanical, post-consumer washing, drying, shredding, drum rotating spinning production mix, at plant Erec/ErecEOL, efficiency 90 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Acrylonitrile Butadiene Styrene (ABS)	2.10	kg	3.5 %	1-BlkPlastics	Default	Medium quality	1-Acrylonitrile Butadiene Styrene (ABS) emulsion polymerisation, bulk polymerisation or combined processes production mix, at plant	36-Recycling plastic Acrylonitrile-butadiene-styrene (ABS), waste management, technology mix
Polystyrene (PS)	0.40	kg	0.7 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate
Styropor expandable polystyrene (EPS)	0.45	kg	0.7 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate
Polyvinylchloride (PVC)	0.15	kg	0.2 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
Plastics others	2.50	kg	4.2 %	1-BlkPlastics	Default	Medium quality	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Aluminium	0.90	kg	1.5 %	4-Non-ferro	Default	Medium quality	52-Aluminium ingot mix (high purity) primary production, aluminium casting single route, at plant 2.7 g/cm^3, >99 % Al	123-Recycling of aluminium into aluminium ingot - from post-consumer collection, transport, pretreatment, remelting production mix, at plant aluminium waste, efficiency 90 %
Cu wire	2.60	kg	4.3 %	4-Non-ferro	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm^3
Glass for lamps	0.60	kg	1.0 %	7-Misc.	Default	Medium quality	72-Flat glass, uncoated cut, Pilkington process, from sand and soda ash production mix, at plant 2,500 kg/m^3	116-Recycling glass, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant glass waste, efficiency 95 %
Electronics	0.82	kg	1.3 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95-98% efficiency, scrap incineration: 11.0 MJ/kg NCV

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Total product weight	**60.20**	**kg**	**100 %**					

Table 5-50: Packaging used for D1.

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
PE-Foil	0.5	kg	7.4 %	1-BlkPlastics	Default	Medium quality	7-HDPE granulates Polymerisation of ethylene production mix, at plant 0.91-0.96 g/cm^3, 28 g/mol per repeating unit	28-High density polyethylene (HDPE), recycled washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 98 %
Wood	5	kg	73.5 %	7-Misc.	Default	Medium quality	Proxy - 284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture	Not available
Cardboard and paper	1.3	kg	19.1 %	7-Misc.	Default	Medium quality	217-Corrugated board, uncoated "virgin" Kraft Pulping Process, pulp pressing and drying production mix, at plant flute thickness 0.8- 2.8 mm, R1=0 %	238-Recycling paper and cardboard, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant paper waste, efficiency 90,9 %

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Total packaging weight	6.80	kg	100 %					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 5-51**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 5-52** provides the data points related to the manufacturing of the components of the product.

Table 5-51: Energy inputs Manufacturing for D1.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	8.87	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-52: Material inputs Manufacturing for D1.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	34.6	kg	38.1		

Material	Value	Unit	Input value ERT	Comments	Dataset used
Steel Sheet galvanised	3.5	kg		Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Polypropylene (PP)	7.7	kg	13.3	Best dataset choice from tool options	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polyamide (PA)	0.4	kg		Proxy	
Acrylonitrile Butadiene Styrene (ABS)	2.1	kg			
Styropor expandable polystyrene (EPS)	0.45	kg			
Polyvinylchloride (PVC)	0.15	kg			
Plastics others	2.5	kg			
Polystyrene (PS)	0.4	kg	0.4	Proxy	3-Blow moulding blow moulding production mix, at plant PET, HDPE and PP
Aluminium	0.9	kg	0.9	Best dataset choice from tool options	53-Aluminium sheet rolling primary production, aluminium deep- drawing single route, at plant 2.7 g/cm^3
Cu wire	2.6	kg	2.6	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
Glass for lamps	0.6	kg	0.6	Best dataset choice from tool options	71-Flat glass, tempering of glass production mix, at plant 2500 kg/m^3
Electronics (control)	0.62	m2	0.62	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h

Material	Value	Unit	Input value ERT	Comments	Dataset used
Cast Iron	2.4	kg	2.4	Proxy	42-Aluminium casting primary production, aluminium casting single route, at plant 2.7 g/cm^3

Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-53: Distribution input for D1.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	0.067	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (Table 5-55), the parameters indicated in **Table 5-54** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-54: Use phase parameters for calculation for D1.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	1,620	kWh	Stakeholder input	High quality	Updated calculation based on stakeholder input (APPLiA)
Energy consumption: Electricity	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-48: Energy Sources for heating in new commercial and industrial dryers.
Energy consumption: Heat	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-48: Energy Sources for heating in new commercial and industrial dryers.
Energy consumption for heating: Total	95 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	5 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Cycles per day	2.5	cycles/day	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Daily dried laundry	22.5	kg/day	Expert judgement	Medium quality	

Description	Value	Unit	Source	Data quality assessment	Reference
Number of working days per year	300	days/year	Expert judgement	Medium quality	
Annually dried laundry	6.75	tons/year	Stakeholder input	High quality	
Duration of the typically used drying program	2.75	hours	Previous study	Medium quality	Stakeholder input (APPLiA)

Table 5-55: Use phase input data for D1.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	2.160	kWh		Calculations based on Table 5-54. Updated calculation based on stakeholder input (APPLiA)
On-mode: No. of cycles / year	750	#	Cycles per day* Number of working days per year	Calculations based on Table 5-54. Updated calculation based on stakeholder input (APPLiA)
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.
Standby-mode: No. of hours / year	900	#	180 min per day = 3 hours	Task 1-4, Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.

Use phase inputs	Value	Unit	Comment	Reference
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Chapter 4.3.4.1 Influence of user behaviour
Off-mode: No. of hours / year	-	#	N/A	

Economic input data

All economic input parameters are provided below.

Table 5-56: Economic inputs for D1.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	10	years	Stakeholder input	High quality	Broad range of cycles per lifetime (5000-15000) - average taken	Stakeholder input (APPLiA)
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024 (European Commission/JRC, 2024) page 48
Economic life cycle data						
Latest Annual sales	0.016	mln. Units/ year	Stakeholder input	High quality	Range of estimated numbers of batch-loaded units: 7000-9000. Average number taken	Stakeholder input (APPLiA)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Assumed purchase price	1,600	Euro/ unit	Previous study	Medium quality	Estimated unit prices for D1 and D2 Base Cases of the 2011 study Average prices, extrapollation of 2011 data	Stakeholder input (APPLiA)
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication https://publications.jrc.ec.europa.eu/repository/handle/JRC114337	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, (European commission/JRC, 2018)
Installation/ acquisition costs (if any)	64	Euro/ unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, Chapter 4.2.4.2 Installation costs. Updated calculation based on stakeholder input (APPLiA)
Fuel rate (gas, oil, wood)	0.023	Euro/ MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.2 Gas rate
Electricity rate	0.234	Euro/ kWh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter "4.2.4.3.1.1 Electricity rate"
Repair & maintenance costs	48	Euro/ unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, Chapter "4.2.4.4 Maintenance and service costs". Updated calculation based on stakeholder input (APPLiA)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, page 62 (European Commission/JRC, 2024)
Escalation rate (project annual growth of running costs)	1.62 %	%				See Table 5-57
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	

Table 5-57: Escalation rate parameters for D1.

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	-	-	0 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	1,620.0	378.5	100 %	
Water	0.16 %	-	-	0 %	
Detergent	1.21 %	-	-	0 %	
Weighted average Escalation rate	1.62 %				

D2: Commercial tumble dryer

Raw materials

Below, the BOM followed by the packaging used is provided for BC D2 including recycled content, dataset used, data source and quality scoring.

Table 5-58: Bill of Materials for D2.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	32.80	kg	57.3 %	3-Ferro	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel Sheet galvanised	3.50	kg	6.1 %	3-Ferro	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Cast Iron	2.80	kg	4.9 %	3-Ferro	Default	Medium quality	Manual dataset - 300-Cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2,06 % carbon content	Not available
Polypropylene (PP)	7.20	kg	12.6 %	1-BlkPlastics	Default	Medium quality	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %
Polyamide (PA)	0.40	kg	0.7 %	2-TecPlastics	Default	Medium quality	11-Nylon 6 fibre extrusion into fibre production mix, at plant 5 % loss, 3,5 MJ electricity	31-Nylon fibre, recycled, mechanical, post-consumer washing, drying, shredding, drum rotating spinning production mix, at plant Erec/ErecEOL, efficiency 90 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Acrylonitrile Butadiene Styrene (ABS)	2.10	kg	3.7 %	1-BlkPlastics	Default	Medium quality	1-Acrylonitrile Butadiene Styrene (ABS) emulsion polymerisation, bulk polymerisation or combined processes production mix, at plant	36-Recycling plastic Acrylonitrile-butadiene-styrene (ABS), waste management, technology mix
Polystyrene (PS)	0.40	kg	0.7 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate
Styropor expandable polystyrene (EPS)	0.45	kg	0.8 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate
Polyvinylchloride (PVC)	0.15	kg	0.3 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
Plastics others	1.50	kg	2.6 %	1-BlkPlastics	Default	Medium quality	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Aluminium	0.90	kg	1.6 %	4-Non-ferro	Default	Medium quality	52-Aluminium ingot mix (high purity) primary production, aluminium casting single route, at plant 2.7 g/cm^3, >99 % Al	123-Recycling of aluminium into aluminium ingot - from post-consumer collection, transport, pretreatment, remelting production mix, at plant aluminium waste, efficiency 90 %
Cu wire	2.60	kg	4.5 %	4-Non-ferro	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm3
Glass for lamps	0.60	kg	1.0 %	7-Misc.	Default	Medium quality	72-Flat glass, uncoated cut, Pilkington process, from sand and soda ash production mix, at plant 2500 kg/m^3	116-Recycling glass, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant glass waste, efficiency 95 %
Electronics	0.76	kg	1.4 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95-98% efficiency, scrap incineration: 11.0 MJ/kg NCV

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Total product weight	**57.20**	**kg**	**100 %**					

Table 5-59: Packaging used for D2.

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
PE-Foil	0.5	kg	7.4 %	1-BlkPlastics	Default	Medium quality	7-HDPE granulates Polymerisation of ethylene production mix, at plant 0.91-0.96 g/cm^3, 28 g/mol per repeating unit	28-High density polyethylene (HDPE), recycled washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 98 %
Wood	5	kg	73.5 %	7-Misc.	Default	Medium quality	Proxy - 284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture	Not available
Cardboard and paper	1.3	kg	19.1 %	7-Misc.	Default	Medium quality	217-Corrugated board, uncoated "virgin" Kraft Pulping Process, pulp pressing and drying production mix, at plant flute thickness 0.8- 2.8 mm, R1=0 %	238-Recycling paper and cardboard, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant paper waste, efficiency 90,9 %

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Total packaging weight	6.80	kg	100 %					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 5-60**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 5-61** provides the data points related to the manufacturing of the components of the product.

Table 5-60: Energy inputs Manufacturing for D2.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	8.87	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-61: Material inputs Manufacturing for D2.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	32.8	kg	36.3	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel Sheet galvanised	3.5	kg			

Material	Value	Unit	Input value ERT	Comments	Dataset used
Polypropylene (PP)	7.2	kg	11.8	Best dataset choice from tool options	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
Polyamide (PA)	0.4	kg		Proxy	
Acrylonitrile Butadiene Styrene (ABS)	2.1	kg			
Styropor expandable polystyrene (EPS)	0.45	kg			
Polyvinylchloride (PVC)	0.15	kg			
Plastics others	1.5	kg			
Polystyrene (PS)	0.4	kg	0.4	Proxy	3-Blow moulding blow moulding production mix, at plant PET, HDPE and PP
Aluminium	0.9	kg	0.9	Best dataset choice from tool options	53-Aluminium sheet rolling primary production, aluminium deep- drawing single route, at plant 2.7 g/cm^3
Cu wire	2.6	kg	2.6	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
Glass for lamps	0.6	kg	0.6	Best dataset choice from tool options	71-Flat glass, tempering of glass production mix, at plant 2,500 kg/m^3
Electronics (control)	0.58	m2	0.58	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h
Cast Iron	2.80	kg	2.8	Proxy	42-Aluminium casting primary production, aluminium casting single route, at plant 2.7 g/cm^3

Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-62: Distribution input for D2.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	0.064	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT, the parameters indicated in **Table 5-63** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-63: Use phase parameters for calculation for D2.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	54,382.23	kWh	Stakeholder input	High quality	Updated calculation based on stakeholder input (APPLiA)
Energy consumption: Electricity	65 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-48: Energy Sources for heating in new commercial and industrial dryers.
Energy consumption: Heat	35 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-48: Energy Sources for heating in new commercial and industrial dryers.
Energy consumption for heating: Total	89 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	12 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Cycles per day	9.3	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 4-38: Typical intensity of use of the regarded dryer categories
Daily dried laundry	247	kg/day	Expert judgement	Medium quality	

Description	Value	Unit	Source	Data quality assessment	Reference
Number of working days per year	273.3	days/year	Expert judgement	Medium quality	
Annually dried laundry	86.321	tons/year	Stakeholder input	High quality	Updated calculation based on stakeholder input (APPLiA)
Duration of the typically used drying program	0.58	hours	Previous study	Medium quality	Stakeholder input (APPLiA)

Table 5-64: Use phase input data for D2.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	16.090	kWh		Updated calculation based on stakeholder input (APPLiA)
On-mode: No. of cycles / year	2,333	#	Cycles per day* Number of working days per year	Updated calculation based on stakeholder input (APPLiA)
Standby-mode: Consumption per hour	-	kWh	No data	Task 1-4, Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.
Standby-mode: No. of hours / year	-	#	No data	Task 1-4, Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Chapter 4.3.4.1 Influence of user behaviour
Off-mode: No. of hours / year	-	#	N/A	

Use phase inputs	Value	Unit	Comment	Reference
Heat				
Consumption of heat per cycle	7.220	kWh		Updated calculation based on stakeholder input (APPLiA)
No. of cycles / year	2333	#	Cycles per day* Number of working days per year	Updated calculation based on stakeholder input (APPLiA)
Avg. Heat Power Output	12.378	kW	Total energy per year/total operating time per year	Updated calculation based on stakeholder input (APPLiA)
No. of hours / year	11,360.9	hrs.	Hours per cycle * cycles per year	Updated calculation based on stakeholder input (APPLiA)

Economic input data

All economic input parameters are provided below.

Table 5-65: Economic inputs for D2.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	15	years	Stakeholder input	High quality		Stakeholder input (APPLiA)
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024, page 48 (European Commission/JRC, 2024)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Economic life cycle data						
Latest Annual sales	0.0051	mln. Units/ year	Stakeholder input	High quality		Stakeholder input (APPLiA)
Assumed purchase price	6,000	Euro/ unit	Previous study	Medium quality		Stakeholder input (APPLiA)
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication https://publications.jrc.ec.europa.eu/repository/handle/JRC114337	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, page 113-115 (European commission/JRC, 2018)
Installation/ acquisition costs (if any)	240	Euro/ unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, Chapter 4.2.4.2 Installation costs. Updated calculation based on stakeholder input (APPLiA)
Fuel rate (gas, oil, wood)	0.023	Euro/ MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.2 Gas rate
Electricity rate	0.234	Euro/ kWh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter 4.2.4.3.1.1 Electricity rate

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Repair & maintenance costs	180	Euro/ unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, Chapter 4.2.4.4 Maintenance and service costs. Updated calculation based on stakeholder input (APPLiA)
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, page 62 (European Commission/JRC, 2024)
Escalation rate (project annual growth of running costs)	1.7 %	%				See Table 5-66
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	

Table 5-66: Escalation rate parameters for D2.

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	17,731.5	1,498.6	14.59 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	37,537.3	8,770.0	85.41 %	
Water	0.16 %	-	-	0 %	
Detergent	1.21 %	-	-	0 %	
Weighted average Escalation rate	1.7 %				

D3: Commercial cabinet dryer

Raw materials

Below, the BOM followed by the packaging used is provided for BC D3 including recycled content, dataset used, data source and quality scoring.

Table 5-67: Bill of Materials for D3.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	4.35	kg	3.0 %	3-Ferro	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel Sheet galvanised	108.75	kg	74.9 %	3-Ferro	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Plastics (PP, Polyester, ABS etc.)	2.18	kg	1.5 %	1-BlkPlastics	Default	Medium quality	Proxy - 16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
EDPM-rubber	1.45	kg	1.0 %	1-BlkPlastics	Default	Medium quality	6-Ethylene propylene dien elastomer (EPDM) copolymerisation of ethylene and propylene production mix, at plant 69 % ethylene, 38 % propylene	39-Recycling of post-industrial waste EPDM rubber
Polyvinylchloride (PVC)	0.15	kg	0.1 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
Aluminium	20.30	kg	14.0 %	4-Non-ferro	Default	Medium quality	52-Aluminium ingot mix (high purity) primary production, aluminium casting single route, at plant 2.7 g/cm^3, >99 % Al	123-Recycling of aluminium into aluminium ingot - from post-consumer collection, transport, pretreatment, remelting production mix, at plant aluminium waste, efficiency 90 %
Copper	1.45	kg	1.0 %	4-Non-ferro	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm^3
Other - Assumed plastics	3.48	kg	2.4 %	7-Misc.	Default	Medium quality	16-Polypropylene (PP), petrochemical based polymerisation of bio-fossil propylene production mix, at plant petrochemical based	35-Polypropylene, recycled, post-consumer washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 90 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Electronics	1.31	kg	0.9 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95-98% efficiency, scrap incineration: 11.0 MJ/kg NCV
Total product weight	**145.15**	**kg**	**100 %**					

Table 5-68: Packaging used for D3.

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Polystyrene	1.8	kg	6.7 %	1-BlkPlastics	Default	Medium quality	17-Polystyrene production, high impact polymerisation of styrene production mix, at plant 1.05 g/cm^3	40-Recycling of post-consumer waste polypropylene (PP) collection, sorting, transport, washing, granulation, pelletisation production mix, at plant 48,9 % recycling rate

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
Wood	18.6	kg	69.1 %	7-Misc.	Default	Medium quality	Proxy - 284-Plywood box; attaching veneer layers; production mix, at plant; 5 % moisture	Not available
Cardboard and paper	6.5	kg	24.2 %	7-Misc.	Default	Medium quality	217-Corrugated board, uncoated "virgin" Kraft Pulping Process, pulp pressing and drying production mix, at plant flute thickness 0.8- 2.8 mm, R1=0 %	238-Recycling paper and cardboard, waste management, technology mix, at plant collection, sorting, transport, recycling production mix, at plant paper waste, efficiency 90,9 %
Total packaging weight	26.90	kg	100 %					

Manufacturing

The electricity consumption for the manufacturing of the product is described in Table 5-69. The value is taken from literature and has been adjusted to represent the weight of the product. Table 5-70 provides the data points related to the manufacturing of the components of the product.

Table 5-69: Energy inputs Manufacturing for D3.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	21.8	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-70: Material inputs Manufacturing for D3.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	4.35	kg	113.1	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel Sheet galvanised	108.75	kg			
Plastics (PP, Polyester, ABS etc.)	2.175	kg	7.25	Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
EDPM	1.45	kg			
Polyvinylchloride (PVC)	0.145	kg			

Material	Value	Unit	Input value ERT	Comments	Dataset used
Other - Assumed plastics	3.48	kg			
Aluminium	20.3	kg	20.3	Best dataset choice from tool options	53-Aluminium sheet rolling primary production, aluminium deep- drawing single route, at plant 2.7 g/cm^3
Copper	1.45	kg	1.45	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
Electronics (control)	0.99	m2	0.99	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h

Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-71: Distribution input for D3.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	0.172	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (**Table 5-73**), the parameters indicated in **Table 5-72** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-72: Use phase parameters for calculation for D3.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	12,6000	kWh	Stakeholder input	High quality	Updated calculation based on stakeholder input (APPLiA)
Energy consumption: Electricity	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-48: Energy Sources for heating in new commercial and industrial dryers.
Energy consumption: Heat	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-48: Energy Sources for heating in new commercial and industrial dryers.

Description	Value	Unit	Source	Data quality assessment	Reference
Energy consumption for heating: Total	95 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	5 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Cycles per day	10	cycles/day	Expert judgement	Medium quality	Updated calculation based on stakeholder input (APPLiA)
Daily dried laundry	70	kg/day	Expert judgement	Medium quality	
Number of working days per year	300	days/year	Expert judgement	Medium quality	
Annually dried laundry	21	tons/year	Stakeholder input	High quality	Updated calculation based on stakeholder input (APPLiA)
Duration of the typically used drying program	2.16	hours	Previous study	Medium quality	Task 1-4, Table 3-44: Programme selection of commercial and industrial dryer categories.

Table 5-73: Use phase input data for D3.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				

Use phase inputs	Value	Unit	Comment	Reference
On-mode: Consumption per cycle	4.2	kWh		Calculations based on Table 5-72. Updated calculation based on stakeholder input (APPLiA)
On-mode: No. of cycles / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on Table 6-73. Updated calculation based on stakeholder input (APPLiA)
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.
Standby-mode: No. of hours / year	660	#	180 min per day = 3 hours	Task 1-4, Table 4-46: Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Ideal operating conditions and user behaviour
Off-mode: No. of hours / year	-	#	N/A	

Economic input data

All economic input parameters are provided below.

Table 5-74: Economic inputs for D3.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	10	years	Stakeholder input	High quality	Broad range of cycles per lifetime (30000-80000) - average taken cycles per lifetime	Stakeholder input (APPLiA)
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024 (European Commission/JRC, 2024) page 48
Economic life cycle data						
Latest Annual sales	0.0100	mln. Units/ year	Stakeholder input	High quality	Estimated numbers of batch-loaded units for corresponding 2011 Base Case (D3): 10000 units.	Task 1-4, Table 3-17: Number of batch-loaded dryers manufactured in the EU27.
Assumed purchase price	2,000	Euro/ unit	Previous study	Medium quality	Estimated unit prices for D3 Base Case of the 2011 study Average prices, extrapolation of 2011 data	Stakeholder input (APPLiA)
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, page 113-115 (European commission/JRC, 2018)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Installation/ acquisition costs (if any)	80	Euro/ unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, 3.2.4.2 Installation costs. Updated calculation based on stakeholder input (APPLiA).
Fuel rate (gas, oil, wood)	0.023	Euro/ MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, 3.2.4.3 Gas rate
Electricity rate	0.234	Euro/ kWh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, 3.2.4.3 Electricity Rate
Repair & maintenance costs	60	Euro/ unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, Chapter "3.2.4.4 Maintenance and service costs". Updated calculation based on stakeholder input (APPLiA).
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, page 62 (European Commission/JRC, 2024)
Escalation rate (project annual growth of running costs)	1.62 %	%				See Table 5-75

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	

Table 5-75: Escalation rate parameters for D3.

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	-	-	0.00 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	12,600.0	2,943.8	100.00 %	
Water	0.16 %	-	-	0.00 %	
Detergent	1.21 %	-	-	0.00 %	
Weighted average Escalation rate	1.62 %				

D4: Industrial pass-through tumble dryer

Raw materials

Below, the BOM is provided for BC D4 including recycled content, dataset used, data source and quality scoring. There is no data available for packaging for this BC.

Table 5-76: Bill of Materials for D4.

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Stainless Steel	16.60	kg	0.6 %	3-Ferro	Default	Medium quality	85-Stainless steel cold rolled hot rolling production mix, at plant stainless steel	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Steel Sheet galvanised	2,826.6	kg	98.5 %	3-Ferro	Default	Medium quality	89-Steel hot dip galvanised steel sheet hot dip galvanisation single route, at plant 1.5 mm sheet thickness, 0.02 mm zinc thickness	128-Steel cast part alloyed electric arc furnace route, from steel scrap, secondary production single route, at plant carbon steel
Cast Iron	6.65	kg	0.2 %	3-Ferro	Default	Medium quality	Manual dataset - 300-Cast iron electric arc furnace route, from steel scrap, secondary production single route, at plant > 2,06 % carbon content	Not available

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
EDPM-rubber	3.33	kg	0.1 %	1-BlkPlastics	Default	Medium quality	6-Ethylene propylene dien elastomer (EPDM) copolymerisation of ethylene and propylene production mix, at plant 69 % ethylene, 38 % propylene	39-Recycling of post-industrial waste EPDM rubber
Polyethylene (PE)	3.33	kg	0.1 %	1-BlkPlastics	Default	Medium quality	7-HDPE granulates Polymerisation of ethylene production mix, at plant 0.91-0.96 g/cm^3, 28 g/mol per repeating unit	28-High density polyethylene (HDPE), recycled washing, drying, shredding, pelletising production mix, at plant Erec/ErecEOL, efficiency 98 %
Polyvinylchloride (PVC)	3.33	kg	0.1 %	1-BlkPlastics	Default	Medium quality	22-PVC granulates, low density polymerisation of vinyl chloride production mix, at plant 62 g/mol per repeating unit	37-Recycling plastic (PVC), waste management, technology mix, at plant
Copper	6.65	kg	0.2 %	4-Non-ferro	Default	Medium quality	61-Copper Cathode, production mix	124-Secondary Copper Cathode (including scrap LCI input) copper scrap smelting and refining single route, at plant 8.92 g/cm^3

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
Electronics	1.43	kg	0.05 %	6-Electronics	Default	Medium quality	164-Printed wiring board (PWB) (2-layer) via the subtractive method (as opposed to additive method) production mix, at plant 2-layer, 1.32 kg	195-End of life of Populated Printed wiring board (PWB) (2-layer) Recycling of copper and precious metals (Ag, Au, Pd, Pt) from electronics production mix, at plant recycling processes: 95-98% efficiency, scrap incineration: 11.0 MJ/kg NCV
Total product weight	**2,870.88**	**kg**	**100 %**					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 5-77**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 5-78** provides the data points related to the manufacturing of the components of the product.

Table 5-77: Energy inputs Manufacturing for D4.

Energy	Value	Unit	Source	Data quality assessment	Dataset used	Reference
Electricity	363.8	kWh	Literature	Medium quality	243-Electricity grid mix 1kV-60kV technology mix consumption mix, to consumer 1kV - 60kV	Yuan et al., 2016

Table 5-78: Material inputs Manufacturing for D4.

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	16.6	kg	2843.2	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel Sheet galvanised	2,826.6	kg			
Polyethylene (PE)	3.325	kg	9.98	Proxy	8-Injection moulding plastic injection moulding production mix, at plant for PP, HDPE and PE
EDPM	3.325	kg			
Polyvinylchloride (PVC)	3.325	kg			
Cast iron	6.65	kg	6.65	Proxy	53-Aluminium sheet rolling primary production, aluminium deep- drawing single route, at plant 2.7 g/cm^3
Copper	6.65	kg	6.65	Best dataset choice from tool options	65-Copper Wire Drawing wire drawing single route, at plant 8.92 g/cm^3
Electronics (control)	1.08	m2	1.08	Best dataset choice from tool options	131-Assembly line THT/SMD technology mix production mix, at plant THT/SMD (1TP,1SP,1CS,1WO,1Rf) throughput 600/h

Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 5-79: Distribution input for D4.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	2.871	Ton	N/A			Based on total weight (BOM + Packaging)
Truck distance	1,330	Km	263-Articulated lorry transport, Euro 5, Total weight 28-32 t diesel driven, Euro 5, cargo consumption mix, to consumer 28 - 32t gross weight / 22t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory + from factory to final client
Train distance	240	Km	268-Freight train, electricity traction electricity driven, cargo consumption mix, to consumer average train, gross tonne weight 1000t / 726t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory
Ship distance	270	Km	265-Barge technology mix, diesel driven, cargo consumption mix, to consumer 1500 t payload capacity	Scientific literature	High quality	Distribution distance from supplier to factory

Use phase

For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (**Table 5-81**), the parameters indicated in **Table 5-80** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 5-80: Use phase parameters for calculation for D4.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	816,000	kWh	Stakeholder input	High quality	Task 1-4, Table 3-67: Energy consumption of commercial cabinet dryers.
Energy consumption: Electricity	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-48: Energy Sources for heating in new commercial and industrial dryers.
Energy consumption: Heat	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-48: Energy Sources for heating in new commercial and industrial dryers.
Energy consumption for heating: Total	89 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Electricity consumption rest (motor etc)	11 %	%	Expert judgement	Medium quality	Task 1-4, Table 3-52: Estimated share of the average energy consumption in the different categories of commercial and industrial washing machines.
Hours per day	10	hours/day	Expert judgement	Medium quality	Task 1-4, Table 3-38: Typical intensity of use of the regarded dryer categories.
Daily dried laundry	3,400	kg/day	Expert judgement	Medium quality	
Number of working days per year	300	days/year	Expert judgement	Medium quality	
Annually dried laundry	1,020.0	tons/year	Stakeholder input	High quality	Task 1-4, Table 3-68: Energy consumption of industrial pass-through dryers.

Description	Value	Unit	Source	Data quality assessment	Reference
Duration of the typically used drying program	0.33	hours	Previous study	Medium quality	Task 1-4, Table 3-44: Programme selection of commercial and industrial dryer categories.

Table 5-81: Use phase input data for D4.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per hour	29.920	kWh		Calculations based on Table 5-80
On-mode: No. of hours / year	3,000	#	Hours per day* Number of working days per year	Calculations based on Table 5-58
Standby-mode: Consumption per hour	-	kWh	Negligible	Task 1-4, Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.
Standby-mode: No. of hours / year	-	#	Negligible	Task 1-4, Table 3-46: Typical time in low-power mode(s) consumption of commercial and industrial dryers.
Off-mode: Consumption per hour	-	kWh	N/A	Task 1-4, Ideal operating conditions and user behaviour
Off-mode: No. of hours / year	-	#	N/A	
Heat				
Consumption of heat per hour	242.080	kWh		Calculations based on Table 6-81

Use phase inputs	Value	Unit	Comment	Reference
No. of hours / year	3,000	#	Hours per day* Number of working days per year	Calculations based on Table 6-81
Avg. Heat Power Output	726.240	kW		Calculations based on Table 6-81
No. of hours / year	1,000	hrs.	Hours per day * days per year	Calculations based on Table 6-81

Economic input data

All economic input parameters are provided below.

Table 5-82: Economic inputs for D4.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial lifetime	25	years	Stakeholder input	High quality	Lifetime 50000 to 100000 hours - average taken	Task 1-4, Table 3-36: Key market segments of commercial and industrial dryers according to spatial requirements and operator skills.
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024 (European Commission/JRC, 2024) page 48
Economic life cycle data						

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Latest Annual sales	0.0012	mln. Units /year	Previous study	Medium quality	Only estimated number of units sold (2009 figures) values available (sourced from the 2011 study)	Task 1-4, Table 3-17: Number of batch-loaded dryers manufactured in the EU27.
Assumed purchase price	50,000	Euro/ unit	Previous study	Medium quality	Estimated unit prices for D7 Base Case of the 2011 study Average prices, extrapollation of 2011 data	Task 1-4, Table 3-25: Estimate of the unit prices of commercial and industrial laundry appliances in 2023 (based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices).
Number of priority parts for repair and upgrade	15	-	Literature	Medium quality	Priority parts should be identified by the Study-Team: identified based on JRC publication https://publications.jrc.ec.europa.eu/repository/handle/JRC114337	JRC technical report: Analysis and development of a scoring system for repair and upgrade of products, page 113-115 (European commission/JRC, 2018)
Installation /acquisition costs (if any)	4,500	Euro/ unit	Stakeholder input	High quality	Assumed 9 % of the purchase price for heavy duty machines	Task 1-4 3.2.4.2, Installation costs
Fuel rate (gas, oil, wood)	0.023	Euro/ MJ	Literature	Medium quality	Eurostat data: average price between 2 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, 3.2.4.3 Gas rate

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Electricity rate	0.234	Euro/ kWh	Literature	Medium quality	Eurostat data: average price between 3 different consumption bands, average price in EU27, semester 1 2024.	Task 1-4, Chapter "3.2.4.3Electricity rate"
Repair & maintenance costs	1,500	Euro/ unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, Chapter "3.2.4.4Maintenance and service costs"
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, page 62 (European Commission/JRC, 2024)
Escalation rate (project annual growth of running costs)	2.02 %	%				See Table 5-83

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Ratio efficiency STOCK: efficiency NEW, in Use Phase	0.95	-	Expert judgement	Medium quality	Definition in the tool for stock efficiency: products sold half a product lifetime ago. 10 % increase in efficiency for the past 13 years. This ratio is applicable for half the product lifetime, therefore approximately 5 %, so 0,95.	

Table 5-83: Escalation rate parameters for D4.

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Natural gas	2.15 %	764,463.2	64,610.6	75.50 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	89,760	20,970.9	24.50 %	
Water	0.16 %	-	-	0 %	
Detergent	1.21 %	-	-	0 %	
Weighted average Escalation rate	2.02 %				

Calculation of escalation rate

The escalation rate was calculated based on the data in **Table 5-84.** Below is the explanation of how the escalation rate was calculated.

Table 5-84: Overview of Eurostat datasets.

Parameter	Dataset
General inflation (HICP) and water	HICP - annual data (average index and rate of change) [prc_hicp_aind__custom_15078220]; Statistics | Eurostat
Electricity	Electricity prices for non-household consumers - bi-annual data (from 2007 onwards) [nrg_pc_205__custom_15077362]; Statistics | Eurostat Three band widths were included: Consumption less than 20 MWh - band IA, Consumption from 20 MWh to 499 MWh - band IB, Consumption from 500 MWh to 1 999 MWh - band IC
Natural gas (for heat)	Gas prices for non-household consumers - bi-annual data (from 2007 onwards) [nrg_pc_203__custom_15349990]; Statistics | Eurostat Consumption less than 1 000 GJ - band I1
Detergent	Sold production, exports and imports [ds-056120__custom_15078125]; Statistics | Eurostat

For professional detergents used in commercial and industrial laundry machines, both total volume (PRODQNT) and total value (PRODVAL) of manufacturing were available, from which the price per kg of detergent was calculated (PRODVAL divided by PRODQNT).

Per product (water, electricity, natural gas and detergent), the % increase in 2024 versus 2014 was calculated according to **Formula 1.**

Formula 1: Calculation of % increase.

$$Increase\ (\%)\ = (\frac{2024\ price^{\frac{1}{10}}}{2014\ price} - 1) \times 100\ \%$$

Subsequently, the escalation rate was calculated by **Formula 2.**

Formula 2: Calculation of % increase.

$$Escalation\ rate\ (\%)\ = (\frac{1 + \%\ increase\ product}{1 + \%\ increase\ HICP} - 1) \times 100\ \%$$

For electricity, the three escalation rates for each band were averaged to obtain one escalation rate for electricity.

The final escalation rate per product are in **Table 5-85** and per BC in **Annex V: Inputs for LCA / LCC per Base Case.**

Table 5-85: Escalation rate per product.

Parameter	Escalation rate
Water	0.16 %
Electricity	1.62 %
Natural gas (for heat)	2.15 %
Detergent	1.21

As per BC, only one escalation rate is required for the ERT, a weighted average was calculated; for this, the annual use volume for each running cost product (water, electricity, natural gas and detergent) was multiplied by the costs per unit to calculate the yearly costs for each product. For heat, the annual kWh were divided by 0.95 to compensate the natural gas volumes for the efficiency (95 %) of the natural gas boiler as modelled in the ERT. Subsequently, for each BC a weighted average of the escalation rate was calculated based on the share of yearly costs per product.

5.6. Annex VI – Results of LCA / LCC per Base Case

WM1: Light duty commercial washer extractor

Below, the life cycle impact is provided per product (**Table 5-86)**, per year of use of the product **(Table 5-87**), total impact for the EU27 for the new product (**Table 5-88**) and the impact of the stock of products in the EU27 (**Table 5-89**). The LCC per product and as EU27 total are provided in **Table 5-90**.

Table 5-86: Life cycle impact per product: WM1.

Life cycle stages--> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	13,470	13,210		51	0	n.a.			**26,731**
Metals	g	39,533	39,533		0	0	n.a.			**79,066**
Electronics	g	66	50		0	0	n.a.			**116**
Others	g	20,695	0		2,452	837,990,000	n.a.			**838,013,147**
Total weight	g	73,764	52,793		2,503	837,990,000	738			**838,119,798**
Energy consumption										
Electricity	kWh		9		0	9,868	0			**9,876**
Thermal energy	MJ		0		0	17,241	0			**17,241**

Life cycle stages--> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	2.6E+02	1.4E+01	8.5E+00	2.0E+00	7.9E+03	2.8E+00	2.7E+01	-1.2E+02	**8.1E+03**
Ozone depletion	kg CFC-11 eq	3.4E-07	4.7E-09	9.8E-11	9.5E-11	1.1E-04	3.5E-09	6.1E-09	-3.4E-09	**1.1E-04**
Human toxicity, cancer	CTUh	1.4E-05	8.0E-10	2.3E-09	1.6E-09	8.6E-06	1.4E-07	3.4E-08	-9.9E-06	**1.3E-05**
Human toxicity, non-cancer	CTUh	3.7E-06	1.1E-07	5.5E-08	3.2E-08	1.0E-04	3.8E-08	1.3E-07	-1.3E-06	**1.1E-04**
Particulate matter	disease incidence	4.3E-05	7.2E-07	2.7E-07	1.2E-07	3.9E-04	4.4E-07	1.6E-06	-1.9E-05	**4.2E-04**
Ionising radiation, human health	kBq U235 eq	1.3E+01	5.4E+00	1.5E-01	1.2E-01	2.0E+03	1.9E-01	7.4E+00	-4.7E+00	**2.1E+03**
Photochemical ozone formation, human health	kg NMVOC eq	7.5E-01	3.1E-02	3.0E-02	9.9E-03	1.5E+01	7.8E-03	4.0E-02	-3.4E-01	**1.6E+01**
Acidification	mol H+ eq	2.5E+00	4.9E-02	3.3E-02	8.0E-03	2.7E+01	2.5E-02	6.2E-02	-1.4E+00	**2.8E+01**
Eutrophication, terrestrial	mol N eq	2.5E+00	1.2E-01	1.6E-01	2.4E-02	6.1E+01	2.6E-02	1.5E-01	-1.1E+00	**6.3E+01**
Eutrophication, freshwater	kg P eq	3.1E-03	3.0E-05	5.1E-05	2.1E-05	3.5E-01	3.2E-05	3.8E-05	-8.3E-05	**3.6E-01**
Eutrophication, marine	kg N eq	2.3E-01	1.1E-02	1.4E-02	2.4E-03	9.7E+00	2.4E-03	1.4E-02	-9.3E-02	**9.9E+00**
Ecotoxicity, freshwater	CTUe	2.7E+03	1.0E+02	7.9E+01	9.4E+00	6.1E+04	2.8E+01	8.8E+01	-1.2E+03	**6.2E+04**

Life cycle stages--> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Land use	pt	7.4E+04	8.6E+01	6.6E+01	5.0E+02	7.5E+04	7.4E+02	8.3E+01	-2.1E+02	**1.5E+05**
Water use	m^3 water eq. of deprived water	7.9E+01	5.0E+00	7.9E-01	2.3E-01	1.8E+04	8.3E-01	5.9E+00	-3.0E+01	**1.8E+04**
Resource use, minerals and metals	kg Sb eq	2.5E-02	5.5E-06	5.6E-06	4.2E-07	3.3E-02	2.5E-04	5.3E-06	-1.1E-02	**4.7E-02**
Resource use, fossils	MJ	3.5E+03	2.5E+02	1.2E+02	2.0E+01	1.3E+05	3.8E+01	4.3E+02	-1.4E+03	**1.3E+05**
Additional technical information										
Primary energy consumption	MJ	3.5E+03	2.6E+02	1.2E+02	2.0E+01	1.3E+05	3.8E+01	4.3E+02	-1.4E+03	**1.3E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-87: Life cycle impact per product per year of use: WM1.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	g	1,347	1,321		5	0	n.a.			**2,673**
Metals	g	3,953	3,953		0	0	n.a.			**7,907**
Electronics	g	7	5		0	0	n.a.			**12**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Others	g	2,070	0		245	83,799,000	n.a.			**83,801,315**
Total weight	g	7,376	5,279		250	83,799,000	74			**83,811,980**
Energy consumption										
Electricity	kWh		1		0	987	0			**988**
Thermal energy	MJ		0		0	1,724	0			**1,724**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	2.6E+01	1.4E+00	8.5E-01	2.0E-01	7.9E+02	2.8E-01	2.7E+00	-1.2E+01	**8.1E+02**
Ozone depletion	kg CFC-11 eq	3.4E-08	4.7E-10	9.8E-12	9.5E-12	1.1E-05	3.5E-10	6.1E-10	-3.4E-10	**1.1E-05**
Human toxicity, cancer	CTUh	1.4E-06	8.0E-11	2.3E-10	1.6E-10	8.6E-07	1.4E-08	3.4E-09	-9.9E-07	**1.3E-06**
Human toxicity, non-cancer	CTUh	3.7E-07	1.1E-08	5.5E-09	3.2E-09	1.0E-05	3.8E-09	1.3E-08	-1.3E-07	**1.1E-05**
Particulate matter	disease incidence	4.3E-06	7.2E-08	2.7E-08	1.2E-08	3.9E-05	4.4E-08	1.6E-07	-1.9E-06	**4.2E-05**
Ionising radiation, human health	kBq U235 eq	1.3E+00	5.4E-01	1.5E-02	1.2E-02	2.0E+02	1.9E-02	7.4E-01	-4.7E-01	**2.1E+02**
Photochemical ozone formation, human health	kg NMVOC eq	7.5E-02	3.1E-03	3.0E-03	9.9E-04	1.5E+00	7.8E-04	4.0E-03	-3.4E-02	**1.6E+00**
Acidification	mol H+ eq	2.5E-01	4.9E-03	3.3E-03	8.0E-04	2.7E+00	2.5E-03	6.2E-03	-1.4E-01	**2.8E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Eutrophication, terrestrial	mol N eq	2.5E-01	1.2E-02	1.6E-02	2.4E-03	6.1E+00	2.6E-03	1.5E-02	-1.1E-01	**6.3E+00**
Eutrophication, freshwater	kg P eq	3.1E-04	3.0E-06	5.1E-06	2.1E-06	3.5E-02	3.2E-06	3.8E-06	-8.3E-06	**3.6E-02**
Eutrophication, marine	kg N eq	2.3E-02	1.1E-03	1.4E-03	2.4E-04	9.7E-01	2.4E-04	1.4E-03	-9.3E-03	**9.9E-01**
Ecotoxicity, freshwater	CTUe	2.7E+02	1.0E+01	7.9E+00	9.4E-01	6.1E+03	2.8E+00	8.8E+00	-1.2E+02	**6.2E+03**
Land use	pt	7.4E+03	8.6E+00	6.6E+00	5.0E+01	7.5E+03	7.4E+01	8.3E+00	-2.1E+01	**1.5E+04**
Water use	m^3 water eq. of deprived water	7.9E+00	5.0E-01	7.9E-02	2.3E-02	1.8E+03	8.3E-02	5.9E-01	-3.0E+00	**1.8E+03**
Resource use, minerals and metals	kg Sb eq	2.5E-03	5.5E-07	5.6E-07	4.2E-08	3.3E-03	2.5E-05	5.3E-07	-1.1E-03	**4.7E-03**
Resource use, fossils	MJ	3.5E+02	2.5E+01	1.2E+01	2.0E+00	1.3E+04	3.8E+00	4.3E+01	-1.4E+02	**1.3E+04**
Additional technical information										
Primary energy consumption	MJ	3.5E+02	2.6E+01	1.2E+01	2.0E+00	1.3E+04	3.8E+00	4.3E+01	-1.4E+02	**1.3E+04**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-88: EU total impact of new products sold in the year of study: WM1.

Life Cycle phases --> Resource use and emissions		Raw materials	Manufacturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	kt	3.27321E-07	3.21003E-07		1.2393E-09	0	n.a.			**6.49563E-07**
Metals	kt	9.60652E-07	9.60652E-07		0	0	n.a.			**1.9213E-06**
Electronics	kt	1.6038E-09	1.215E-09		0	0	n.a.			**2.8188E-09**
Others	kt	5.02889E-07	0		5.95836E-08	0.020363157	n.a.			**0.020363719**
Total weight	kt	1.79247E-06	1.28287E-06		6.08229E-08	0.020363157	1.79247E-08			**0.020366311**
Energy consumption										
Electricity	kWh		0.215541		0	239.78268	0			**239.998221**
Thermal energy	MJ		0		0	418.9492709	0			**418.9492709**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	6.4E+00	3.4E-01	2.1E-01	4.8E-02	1.9E+02	6.7E-02	6.5E-01	-2.9E+00	**2.0E+02**

Life Cycle phases --> Resource use and emissions		Raw materials	Manufacturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Ozone depletion	kg CFC-11 eq	8.3E-09	1.2E-10	2.4E-12	2.3E-12	2.6E-06	8.4E-11	1.5E-10	-8.3E-11	**2.6E-06**
Human toxicity, cancer	CTUh	3.5E-07	2.0E-11	5.5E-11	4.0E-11	2.1E-07	3.5E-09	8.2E-10	-2.4E-07	**3.2E-07**
Human toxicity, non-cancer	CTUh	8.9E-08	2.7E-09	1.3E-09	7.8E-10	2.5E-06	9.1E-10	3.2E-09	-3.2E-08	**2.6E-06**
Particulate matter	disease incidence	1.1E-06	1.8E-08	6.6E-09	2.8E-09	9.6E-06	1.1E-08	3.8E-08	-4.6E-07	**1.0E-05**
Ionising radiation, human health	kBq U235 eq	3.2E-01	1.3E-01	3.7E-03	2.9E-03	5.0E+01	4.5E-03	1.8E-01	-1.1E-01	**5.0E+01**
Photochemical ozone formation, human health	kg NMVOC eq	1.8E-02	7.4E-04	7.3E-04	2.4E-04	3.7E-01	1.9E-04	9.7E-04	-8.2E-03	**3.8E-01**
Acidification	mol H+ eq	6.0E-02	1.2E-03	8.1E-04	2.0E-04	6.6E-01	6.1E-04	1.5E-03	-3.5E-02	**6.9E-01**
Eutrophication, terrestrial	mol N eq	6.0E-02	2.9E-03	3.9E-03	5.8E-04	1.5E+00	6.3E-04	3.6E-03	-2.6E-02	**1.5E+00**
Eutrophication, freshwater	kg P eq	7.6E-05	7.4E-07	1.2E-06	5.0E-07	8.6E-03	7.7E-07	9.2E-07	-2.0E-06	**8.7E-03**
Eutrophication, marine	kg N eq	5.5E-03	2.7E-04	3.5E-04	5.8E-05	2.4E-01	5.8E-05	3.3E-04	-2.3E-03	**2.4E-01**
Ecotoxicity, freshwater	CTUe	6.6E+01	2.5E+00	1.9E+00	2.3E-01	1.5E+03	6.9E-01	2.1E+00	-2.9E+01	**1.5E+03**

Life Cycle phases --> Resource use and emissions		Raw materials	Manufacturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Land use	pt	1.8E+03	2.1E+00	1.6E+00	1.2E+01	1.8E+03	1.8E+01	2.0E+00	-5.2E+00	**3.6E+03**
Water use	m^3 water eq. of deprived water	1.9E+00	1.2E-01	1.9E-02	5.5E-03	4.4E+02	2.0E-02	1.4E-01	-7.2E-01	**4.4E+02**
Resource use, minerals and metals	kg Sb eq	6.1E-04	1.3E-07	1.4E-07	1.0E-08	8.1E-04	6.1E-06	1.3E-07	-2.8E-04	**1.2E-03**
Resource use, fossils	MJ	8.5E+01	6.2E+00	3.0E+00	5.0E-01	3.1E+03	9.2E-01	1.0E+01	-3.3E+01	**3.2E+03**
Additional technical information										
Primary energy consumption	MJ	8.5E+01	6.2E+00	3.0E+00	5.0E-01	3.1E+03	9.2E-01	1.0E+01	-3.3E+01	**3.2E+03**

Table 5-89: EU total impact of Stock of products in the year of study: WM1.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	kt	3.27E+00	3.21E+00	0.00E+00	1.24E-02	0.00E+00	n.a.	0.00E+00	0.00E+00	**6.50E+00**
Metals	kt	9.61E+00	9.61E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.92E+01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Electronics	kt	1.60E-02	1.21E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.82E-02**
Others	kt	5.03E+00	0.00E+00	0.00E+00	5.96E-01	2.04E+05	n.a.	0.00E+00	0.00E+00	**2.04E+05**
Total weight	kt	1.79E+01	1.28E+01	0.00E+00	6.08E-01	2.04E+05	1.79E-01	0.00E+00	0.00E+00	**2.04E+05**
Energy consumption										
Electricity	kWh	0.00E+00	2.16E+06	0.00E+00	0.00E+00	2.40E+09	0.00E+00	0.00E+00	0.00E+00	**2.40E+09**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.19E+09	0.00E+00	0.00E+00	0.00E+00	**4.19E+09**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	6.37E+07	3.44E+06	2.06E+06	4.82E+05	1.93E+09	6.72E+05	6.51E+06	-2.95E+07	**1.97E+09**
Ozone depletion	kg CFC-11 eq	8.32E-02	1.15E-03	2.37E-05	2.30E-05	2.56E+01	8.44E-04	1.48E-03	-8.34E-04	**2.57E+01**
Human toxicity, cancer	CTUh	3.51E+00	1.95E-04	5.49E-04	3.96E-04	2.08E+00	3.51E-02	8.19E-03	-2.40E+00	**3.23E+00**
Human toxicity, non-cancer	CTUh	8.87E-01	2.73E-02	1.33E-02	7.82E-03	2.50E+01	9.14E-03	3.22E-02	-3.16E-01	**2.57E+01**
Particulate matter	disease incidence	1.06E+01	1.75E-01	6.61E-02	2.84E-02	9.57E+01	1.07E-01	3.78E-01	-4.56E+00	**1.02E+02**
Ionising radiation, human health	kBq U235 eq	3.19E+06	1.32E+06	3.72E+04	2.92E+04	4.95E+08	4.51E+04	1.79E+06	-1.14E+06	**5.01E+08**
Photochemical ozone formation, human health	kg NMVOC eq	1.83E+05	7.42E+03	7.33E+03	2.40E+03	3.72E+06	1.90E+03	9.72E+03	-8.17E+04	**3.85E+06**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Acidification	mol H+ eq	6.03E+05	1.18E+04	8.08E+03	1.95E+03	6.55E+06	6.14E+03	1.51E+04	-3.48E+05	**6.85E+06**
Eutrophication, terrestrial	mol N eq	6.04E+05	2.93E+04	3.88E+04	5.77E+03	1.49E+07	6.34E+03	3.58E+04	-2.58E+05	**1.54E+07**
Eutrophication, freshwater	kg P eq	7.59E+02	7.38E+00	1.24E+01	5.04E+00	8.59E+04	7.66E+00	9.24E+00	-2.02E+01	**8.67E+04**
Eutrophication, marine	kg N eq	5.48E+04	2.73E+03	3.46E+03	5.80E+02	2.36E+06	5.76E+02	3.33E+03	-2.26E+04	**2.40E+06**
Ecotoxicity, freshwater	CTUe	6.62E+08	2.45E+07	1.91E+07	2.28E+06	1.47E+10	6.87E+06	2.14E+07	-2.90E+08	**1.52E+10**
Land use	pt	1.80E+10	2.08E+07	1.59E+07	1.22E+08	1.82E+10	1.80E+08	2.02E+07	-5.21E+07	**3.65E+10**
Water use	m^3 water eq. of deprived water	1.91E+07	1.21E+06	1.91E+05	5.52E+04	4.36E+09	2.03E+05	1.43E+06	-7.23E+06	**4.38E+09**
Resource use, minerals and metals	kg Sb eq	6.15E+03	1.33E+00	1.37E+00	1.02E-01	8.10E+03	6.15E+01	1.29E+00	-2.79E+03	**1.15E+04**
Resource use, fossils	MJ	8.55E+08	6.16E+07	2.97E+07	4.96E+06	3.08E+10	9.16E+06	1.05E+08	-3.32E+08	**3.16E+10**
Additional technical information										
Primary energy consumption	MJ	8.55E+08	6.22E+07	2.97E+07	4.96E+06	3.15E+10	9.17E+06	1.05E+08	-3.32E+08	**3.24E+10**

Table 5-90: LCC per product and total EU expenditure: WM1.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	2,000	EUR	49	mln. EUR/year
Installation/ acquisition costs (if any)	80	EUR	2	mln. EUR/year
Fuel (gas, oil, wood)	36	EUR/year	10	mln. EUR/year
Electricity	209	EUR/year	56	mln. EUR/year
Water	145	EUR/year	39	mln. EUR/year
Auxiliary material 1: Detergent	368	EUR/year	99	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	60	EUR	2	mln. EUR/year
Total	**973**	**EUR/year**	**255**	**mln. EUR/year**

WM2: Commercial washer extractor

Below, the life cycle impact is provided per product (**Table 5-91**), per year of use of the product (**Table 5-92**), total impact for the EU27 for the new product (**Table 5-93**) and the impact of the stock of products in the EU27 (**Table 5-94**).

Table 5-91: Life cycle impact per product: WM2.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	9,200	9,878		50	0	n.a.			**19,128**
Metals	g	196,960	196,330		0	0	n.a.			**393,290**
Electronics	g	1,848	1,400		0	0	n.a.			**3,248**
Others	g	0	0		18,000	7,839,570,000	n.a.			**7,839,588,000**
Total weight	g	208,008	207,608		18,050	7,839,570,000	2,080			**7,840,005,746**
Energy consumption										
Electricity	kWh		27		0	132,369	0			**132,396**
Thermal energy	MJ		0		0	322,638	0			**322,638**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	1.1E+03	3.2E+01	2.5E+01	1.6E+01	1.0E+05	1.1E+01	2.0E+02	-5.5E+02	**1.0E+05**
Ozone depletion	kg CFC-11 eq	1.7E-07	1.1E-08	2.9E-10	7.5E-10	1.0E-03	1.8E-09	4.6E-08	-2.0E-08	**1.0E-03**
Human toxicity, cancer	CTUh	3.7E-05	3.2E-09	6.8E-09	1.0E-08	8.5E-05	3.7E-07	2.5E-07	-2.5E-05	**9.7E-05**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Human toxicity, non-cancer	CTUh	2.4E-05	1.7E-06	1.6E-07	2.1E-07	1.0E-03	2.6E-07	9.9E-07	-1.1E-05	**1.1E-03**
Particulate matter	disease incidence	1.1E-04	3.7E-06	8.1E-07	8.7E-07	4.3E-03	1.2E-06	1.2E-05	-6.4E-05	**4.4E-03**
Ionising radiation, human health	kBq U235 eq	5.2E+01	1.2E+01	4.6E-01	9.3E-01	2.6E+04	6.4E-01	5.5E+01	-2.6E+01	**2.7E+04**
Photochemical ozone formation, human health	kg NMVOC eq	2.5E+00	9.0E-02	9.0E-02	8.3E-02	1.8E+02	2.6E-02	3.0E-01	-1.3E+00	**1.8E+02**
Acidification	mol H+ eq	7.4E+00	1.3E-01	9.9E-02	6.6E-02	3.1E+02	7.6E-02	4.6E-01	-4.3E+00	**3.2E+02**
Eutrophication, terrestrial	mol N eq	8.1E+00	3.5E-01	4.8E-01	2.0E-01	7.0E+02	8.5E-02	1.1E+00	-4.0E+00	**7.1E+02**
Eutrophication, freshwater	kg P eq	4.0E-03	7.3E-05	1.5E-04	2.6E-04	3.5E+00	4.0E-05	2.8E-04	-4.2E-04	**3.5E+00**
Eutrophication, marine	kg N eq	7.4E-01	3.2E-02	4.3E-02	2.1E-02	1.0E+02	7.7E-03	1.0E-01	-3.5E-01	**1.0E+02**
Ecotoxicity, freshwater	CTUe	1.0E+04	2.4E+02	2.3E+02	6.8E+01	6.6E+05	1.0E+02	6.6E+02	-6.0E+03	**6.6E+05**
Land use	pt	2.0E+05	2.9E+02	2.0E+02	4.6E+03	7.9E+05	2.0E+03	6.2E+02	-2.4E+03	**1.0E+06**
Water use	m^3 water eq. of deprived water	2.5E+02	1.2E+01	2.4E+00	2.3E+00	1.7E+05	2.6E+00	4.4E+01	-1.0E+02	**1.7E+05**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Resource use, minerals and metals	kg Sb eq	9.6E-02	1.5E-05	1.7E-05	4.5E-06	3.4E-01	9.6E-04	4.0E-05	-4.3E-02	**4.0E-01**
Resource use, fossils	MJ	1.2E+04	6.1E+02	3.7E+02	1.5E+02	1.6E+06	1.3E+02	3.2E+03	-5.9E+03	**1.7E+06**
Additional technical information										
Primary energy consumption	MJ	1.2E+04	6.2E+02	3.7E+02	1.5E+02	1.7E+06	1.3E+02	3.2E+03	-5.9E+03	**1.7E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-92: Life cycle impact per product per year of use: WM2.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	920	988		5	0	n.a.			**1,913**
Metals	g	19,696	19,633		0	0	n.a.			**39,329**
Electronics	g	185	140		0	0	n.a.			**325**
Others	g	0	0		1,800	783,957,000	n.a.			**783,958,800**
Total weight	g	20,801	20,761		1,805	783,957,000	208			**784,000,575**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Energy consumption										
Electricity	kWh		3		0	13,237	0			**13,240**
Thermal energy	MJ		0		0	32,264	0			**32,264**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq									
Ozone depletion	kg CFC-11 eq	1.1E+02	3.2E+00	2.5E+00	1.6E+00	1.0E+04	1.1E+00	2.0E+01	-5.5E+01	**1.0E+04**
Human toxicity, cancer	CTUh	1.7E-08	1.1E-09	2.9E-11	7.5E-11	1.0E-04	1.8E-10	4.6E-09	-2.0E-09	**1.0E-04**
Human toxicity, non-cancer	CTUh	3.7E-06	3.2E-10	6.8E-10	1.0E-09	8.5E-06	3.7E-08	2.5E-08	-2.5E-06	**9.7E-06**
Particulate matter	disease incidence	2.4E-06	1.7E-07	1.6E-08	2.1E-08	1.0E-04	2.6E-08	9.9E-08	-1.1E-06	**1.1E-04**
Ionising radiation, human health	kBq U235 eq	1.1E-05	3.7E-07	8.1E-08	8.7E-08	4.3E-04	1.2E-07	1.2E-06	-6.4E-06	**4.4E-04**
Photochemical ozone formation, human health	kg NMVOC eq	5.2E+00	1.2E+00	4.6E-02	9.3E-02	2.6E+03	6.4E-02	5.5E+00	-2.6E+00	**2.7E+03**
Acidification	mol H+ eq	2.5E-01	9.0E-03	9.0E-03	8.3E-03	1.8E+01	2.6E-03	3.0E-02	-1.3E-01	**1.8E+01**
Eutrophication, terrestrial	mol N eq	7.4E-01	1.3E-02	9.9E-03	6.6E-03	3.1E+01	7.6E-03	4.6E-02	-4.3E-01	**3.2E+01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Eutrophication, freshwater	kg P eq	8.1E-01	3.5E-02	4.8E-02	2.0E-02	7.0E+01	8.5E-03	1.1E-01	-4.0E-01	**7.1E+01**
Eutrophication, marine	kg N eq	4.0E-04	7.3E-06	1.5E-05	2.6E-05	3.5E-01	4.0E-06	2.8E-05	-4.2E-05	**3.5E-01**
Ecotoxicity, freshwater	CTUe	7.4E-02	3.2E-03	4.3E-03	2.1E-03	1.0E+01	7.7E-04	1.0E-02	-3.5E-02	**1.0E+01**
Land use	pt	1.0E+03	2.4E+01	2.3E+01	6.8E+00	6.6E+04	1.0E+01	6.6E+01	-6.0E+02	**6.6E+04**
Water use	m^3 water eq. of deprived water	2.0E+04	2.9E+01	2.0E+01	4.6E+02	7.9E+04	2.0E+02	6.2E+01	-2.4E+02	**1.0E+05**
Resource use, minerals and metals	kg Sb eq	2.5E+01	1.2E+00	2.4E-01	2.3E-01	1.7E+04	2.6E-01	4.4E+00	-1.0E+01	**1.7E+04**
Resource use, fossils	MJ	9.6E-03	1.5E-06	1.7E-06	4.5E-07	3.4E-02	9.6E-05	4.0E-06	-4.3E-03	**4.0E-02**
Additional technical information										
Primary energy consumption	MJ	1.2E+03	6.2E+01	3.7E+01	1.5E+01	1.7E+05	1.3E+01	3.2E+02	-5.9E+02	**1.7E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-93: EU total impact of new products sold in the year of study: WM2.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	kt	4.88E-01	5.24E-01	0.00E+00	2.65E-03	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.01E+00**
Metals	kt	1.04E+01	1.04E+01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.08E+01**
Electronics	kt	9.79E-02	7.42E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.72E-01**
Others	kt	0.00E+00	0.00E+00	0.00E+00	9.54E-01	4.15E+05	n.a.	0.00E+00	0.00E+00	**4.15E+05**
Total weight	kt	1.10E+01	1.10E+01	0.00E+00	9.57E-01	4.15E+05	1.10E-01	0.00E+00	0.00E+00	**4.16E+05**
Energy consumption										
Electricity	kWh	0.00E+00	1.41E+06	0.00E+00	0.00E+00	7.02E+09	0.00E+00	0.00E+00	0.00E+00	**7.02E+09**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E+10	0.00E+00	0.00E+00	0.00E+00	**1.71E+10**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	5.59E+07	1.68E+06	1.35E+06	8.22E+05	5.41E+09	5.76E+05	1.05E+07	-2.93E+07	**5.45E+09**
Ozone depletion	kg CFC-11 eq	8.93E-03	5.79E-04	1.55E-05	3.96E-05	5.42E+01	9.51E-05	2.41E-03	-1.05E-03	**5.42E+01**
Human toxicity, cancer	CTUh	1.96E+00	1.69E-04	3.58E-04	5.31E-04	4.50E+00	1.96E-02	1.33E-02	-1.34E+00	**5.15E+00**
Human toxicity, non-cancer	CTUh	1.30E+00	8.83E-02	8.69E-03	1.10E-02	5.50E+01	1.39E-02	5.23E-02	-5.89E-01	**5.59E+01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Particulate matter	disease incidence	6.00E+00	1.99E-01	4.31E-02	4.61E-02	2.30E+02	6.20E-02	6.14E-01	-3.38E+00	**2.33E+02**
Ionising radiation, human health	kBq U235 eq	2.73E+06	6.62E+05	2.43E+04	4.95E+04	1.40E+09	3.40E+04	2.91E+06	-1.38E+06	**1.41E+09**
Photochemical ozone formation, human health	kg NMVOC eq	1.33E+05	4.76E+03	4.78E+03	4.41E+03	9.51E+06	1.38E+03	1.58E+04	-6.74E+04	**9.61E+06**
Acidification	mol H+ eq	3.94E+05	6.98E+03	5.27E+03	3.52E+03	1.66E+07	4.01E+03	2.44E+04	-2.29E+05	**1.68E+07**
Eutrophication, terrestrial	mol N eq	4.31E+05	1.86E+04	2.53E+04	1.09E+04	3.71E+07	4.49E+03	5.80E+04	-2.11E+05	**3.74E+07**
Eutrophication, freshwater	kg P eq	2.10E+02	3.89E+00	8.09E+00	1.37E+01	1.84E+05	2.14E+00	1.50E+01	-2.21E+01	**1.84E+05**
Eutrophication, marine	kg N eq	3.93E+04	1.72E+03	2.26E+03	1.13E+03	5.52E+06	4.10E+02	5.40E+03	-1.88E+04	**5.55E+06**
Ecotoxicity, freshwater	CTUe	5.28E+08	1.30E+07	1.24E+07	3.59E+06	3.49E+10	5.40E+06	3.47E+07	-3.17E+08	**3.51E+10**
Land use	pt	1.04E+10	1.55E+07	1.04E+07	2.42E+08	4.21E+10	1.05E+08	3.28E+07	-1.26E+08	**5.28E+10**
Water use	m^3 water eq. of deprived water	1.33E+07	6.54E+05	1.25E+05	1.24E+05	9.26E+09	1.39E+05	2.32E+06	-5.48E+06	**9.27E+09**
Resource use, minerals and metals	kg Sb eq	5.11E+03	7.80E-01	8.92E-01	2.37E-01	1.83E+04	5.11E+01	2.10E+00	-2.27E+03	**2.12E+04**
Resource use, fossils	MJ	6.30E+08	3.26E+07	1.93E+07	8.14E+06	8.74E+10	6.63E+06	1.70E+08	-3.11E+08	**8.79E+10**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Additional technical information										
Primary energy consumption	MJ	6.30E+08	3.30E+07	1.93E+07	8.14E+06	8.93E+10	6.63E+06	1.70E+08	-3.11E+08	**8.99E+10**

Table 5-94: EU total impact of Stock of products in the year of study: WM2.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	kt	4.88E+00	5.24E+00	0.00E+00	2.65E-02	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.01E+01**
Metals	kt	1.04E+02	1.04E+02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.08E+02**
Electronics	kt	9.79E-01	7.42E-01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.72E+00**
Others	kt	0.00E+00	0.00E+00	0.00E+00	9.54E+00	4.15E+06	n.a.	0.00E+00	0.00E+00	**4.15E+06**
Total weight	kt	1.10E+02	1.10E+02	0.00E+00	9.57E+00	4.15E+06	1.10E+00	0.00E+00	0.00E+00	**4.16E+06**
Energy consumption										
Electricity	kWh	0.00E+00	1.41E+07	0.00E+00	0.00E+00	7.02E+10	0.00E+00	0.00E+00	0.00E+00	**7.02E+10**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E+11	0.00E+00	0.00E+00	0.00E+00	**1.71E+11**
PEF Impact categories	**unit**									

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Climate change, total	kg CO_2 eq	5.59E+08	1.68E+07	1.35E+07	8.22E+06	5.41E+10	5.76E+06	1.05E+08	-2.93E+08	**5.45E+10**
Ozone depletion	kg CFC-11 eq	8.93E-02	5.78E-03	1.55E-04	3.96E-04	5.42E+02	9.51E-04	2.41E-02	-1.05E-02	**5.42E+02**
Human toxicity, cancer	CTUh	1.96E+01	1.69E-03	3.58E-03	5.31E-03	4.50E+01	1.96E-01	1.33E-01	-1.34E+01	**5.15E+01**
Human toxicity, non-cancer	CTUh	1.30E+01	8.83E-01	8.69E-02	1.10E-01	5.50E+02	1.39E-01	5.23E-01	-5.89E+00	**5.59E+02**
Particulate matter	disease incidence	6.00E+01	1.99E+00	4.31E-01	4.61E-01	2.30E+03	6.20E-01	6.14E+00	-3.38E+01	**2.33E+03**
Ionising radiation, human health	kBq U235 eq	2.73E+07	6.62E+06	2.43E+05	4.95E+05	1.40E+10	3.40E+05	2.91E+07	-1.38E+07	**1.41E+10**
Photochemical ozone formation, human health	kg NMVOC eq	1.33E+06	4.76E+04	4.78E+04	4.41E+04	9.51E+07	1.38E+04	1.58E+05	-6.74E+05	**9.61E+07**
Acidification	mol H+ eq	3.94E+06	6.98E+04	5.27E+04	3.52E+04	1.66E+08	4.01E+04	2.44E+05	-2.29E+06	**1.68E+08**
Eutrophication, terrestrial	mol N eq	4.31E+06	1.86E+05	2.53E+05	1.09E+05	3.71E+08	4.49E+04	5.80E+05	-2.11E+06	**3.74E+08**
Eutrophication, freshwater	kg P eq	2.10E+03	3.89E+01	8.09E+01	1.37E+02	1.84E+06	2.14E+01	1.50E+02	-2.21E+02	**1.84E+06**
Eutrophication, marine	kg N eq	3.93E+05	1.72E+04	2.26E+04	1.13E+04	5.52E+07	4.10E+03	5.40E+04	-1.88E+05	**5.55E+07**
Ecotoxicity, freshwater	CTUe	5.28E+09	1.30E+08	1.24E+08	3.59E+07	3.49E+11	5.40E+07	3.47E+08	-3.17E+09	**3.51E+11**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Land use	pt	1.04E+11	1.55E+08	1.04E+08	2.42E+09	4.21E+11	1.05E+09	3.28E+08	-1.26E+09	**5.28E+11**
Water use	m^3 water eq. of deprived water	1.33E+08	6.54E+06	1.25E+06	1.24E+06	9.26E+10	1.39E+06	2.32E+07	-5.48E+07	**9.27E+10**
Resource use, minerals and metals	kg Sb eq	5.11E+04	7.80E+00	8.92E+00	2.37E+00	1.83E+05	5.11E+02	2.10E+01	-2.27E+04	**2.12E+05**
Resource use, fossils	MJ	6.30E+09	3.26E+08	1.93E+08	8.14E+07	8.74E+11	6.63E+07	1.70E+09	-3.11E+09	**8.79E+11**
Additional technical information										
Primary energy consumption	MJ	6.30E+09	3.30E+08	1.93E+08	8.14E+07	8.93E+11	6.63E+07	1.70E+09	-3.11E+09	**9.00E+11**

Table 5-95: LCC per product and total EU expenditure: WM2.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	9,000	EUR	477	mln. EUR/year
Installation/ acquisition costs (if any)	360	EUR	19	mln. EUR/year
Fuel (gas, oil, wood)	676	EUR/year	393	mln. EUR/year
Electricity	2,824	EUR/year	1,642	mln. EUR/year
Water	1,363	EUR/year	793	mln. EUR/year
Auxiliary material 1: Detergent	3,254	EUR/year	1,892	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	270	EUR	16	mln. EUR/year
Total	**9,081**	**EUR/year**	**5,231**	**mln. EUR/year**

WM3: Commercial washer dryer

Below, the life cycle impact is provided per product (**Table 5-96**), per year of use of the product (**Table 5-97**), total impact for the EU27 for the new product (**Table 5-98)** and the impact of the stock of products in the EU27 (**Table 5-99**).

Table 5-96: Life cycle impact per product: WM3.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	8,400	8,400		1,500	0	n.a.			**18,300**
Metals	g	362,900	362,900		0	0	n.a.			**725,800**
Electronics	g	4,580	3,470		0	0	n.a.			**8,050**
Others	g	0	0		23,500	5,405,940,000	n.a.			**5,405,963,500**
Total weight	g	375,880	374,770		25,000	5,405,940,000	3,759			**5,406,719,409**
Energy consumption										
Electricity	kWh		53		0	334,807	0			**334,860**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	1.8E+03	6.6E+01	4.5E+01	2.4E+01	1.6E+05	1.8E+01	3.9E+02	-8.2E+02	**1.6E+05**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Ozone depletion	kg CFC-11 eq	2.4E-07	2.1E-08	5.2E-10	1.0E-09	6.8E-04	2.7E-09	9.1E-08	-1.1E-08	**6.8E-04**
Human toxicity, cancer	CTUh	3.5E-05	1.6E-08	1.2E-08	1.4E-08	7.2E-05	3.5E-07	5.0E-07	-2.4E-05	**8.4E-05**
Human toxicity, non-cancer	CTUh	6.1E-05	4.3E-06	2.9E-07	3.2E-07	1.0E-03	6.5E-07	2.0E-06	-2.2E-05	**1.1E-03**
Particulate matter	disease incidence	1.7E-04	9.4E-06	1.4E-06	1.2E-06	6.0E-03	1.8E-06	2.3E-05	-8.2E-05	**6.2E-03**
Ionising radiation, human health	kBq U235 eq	5.3E+01	2.3E+01	8.1E-01	1.3E+00	6.1E+04	7.6E-01	1.1E+02	-2.0E+01	**6.1E+04**
Photochemical ozone formation, human health	kg NMVOC eq	4.1E+00	1.9E-01	1.6E-01	1.2E-01	2.8E+02	4.3E-02	5.9E-01	-1.7E+00	**2.8E+02**
Acidification	mol H+ eq	9.9E+00	3.0E-01	1.8E-01	9.4E-02	5.1E+02	1.0E-01	9.1E-01	-4.8E+00	**5.2E+02**
Eutrophication, terrestrial	mol N eq	1.4E+01	7.2E-01	8.5E-01	2.9E-01	1.1E+03	1.4E-01	2.2E+00	-5.2E+00	**1.1E+03**
Eutrophication, freshwater	kg P eq	8.7E-03	1.5E-04	2.7E-04	3.7E-04	2.4E+00	8.8E-05	5.7E-04	-6.7E-04	**2.4E+00**
Eutrophication, marine	kg N eq	1.3E+00	6.7E-02	7.6E-02	3.0E-02	1.2E+02	1.3E-02	2.0E-01	-4.7E-01	**1.3E+02**
Ecotoxicity, freshwater	CTUe	1.0E+04	4.6E+02	4.2E+02	1.5E+02	8.9E+05	1.1E+02	1.3E+03	-4.5E+03	**9.0E+05**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Land use	pt	8.6E+05	1.1E+04	3.5E+02	6.1E+03	9.4E+05	8.7E+03	1.2E+03	-5.2E+03	**1.8E+06**
Water use	m^3 water eq. of deprived water	4.4E+02	2.6E+01	4.2E+00	3.8E+00	1.5E+05	4.7E+00	8.8E+01	-9.3E+01	**1.5E+05**
Resource use, minerals and metals	kg Sb eq	2.2E-01	1.8E-03	3.0E-05	7.1E-06	2.2E-01	2.3E-03	7.9E-05	-6.2E-02	**3.8E-01**
Resource use, fossils	MJ	1.9E+04	1.2E+03	6.5E+02	3.1E+02	2.7E+06	2.0E+02	6.3E+03	-8.0E+03	**2.7E+06**
Additional technical information										
Primary energy consumption	MJ	1.9E+04	1.2E+03	6.5E+02	3.1E+02	2.8E+06	2.0E+02	6.3E+03	-8.0E+03	**2.8E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-97: Life cycle impact per product per year of use: WM3.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	840	840		150	0	n.a.			**1,830**
Metals	g	36,290	36,290		0	0	n.a.			**72,580**
Electronics	g	458	347		0	0	n.a.			**805**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Others	g	0	0		2,350	540,594,000	n.a.			**540,596,350**
Total weight	g	37,588	37,477		2,500	540,594,000	376			**540,671,941**
Energy consumption										
Electricity	kWh		5		0	33,481	0			**33,486**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	1.8E+02	6.6E+00	4.5E+00	2.4E+00	1.6E+04	1.8E+00	3.9E+01	-8.2E+01	**1.6E+04**
Ozone depletion	kg CFC-11 eq	2.4E-08	2.1E-09	5.2E-11	1.0E-10	6.8E-05	2.7E-10	9.1E-09	-1.1E-09	**6.8E-05**
Human toxicity, cancer	CTUh	3.5E-06	1.6E-09	1.2E-09	1.4E-09	7.2E-06	3.5E-08	5.0E-08	-2.4E-06	**8.4E-06**
Human toxicity, non-cancer	CTUh	6.1E-06	4.3E-07	2.9E-08	3.2E-08	1.0E-04	6.5E-08	2.0E-07	-2.2E-06	**1.1E-04**
Particulate matter	disease incidence	1.7E-05	9.4E-07	1.4E-07	1.2E-07	6.0E-04	1.8E-07	2.3E-06	-8.2E-06	**6.2E-04**
Ionising radiation, human health	kBq U235 eq	5.3E+00	2.3E+00	8.1E-02	1.3E-01	6.1E+03	7.6E-02	1.1E+01	-2.0E+00	**6.1E+03**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Photochemical ozone formation, human health	kg NMVOC eq	4.1E-01	1.9E-02	1.6E-02	1.2E-02	2.8E+01	4.3E-03	5.9E-02	-1.7E-01	**2.8E+01**
Acidification	mol H+ eq	9.9E-01	3.0E-02	1.8E-02	9.4E-03	5.1E+01	1.0E-02	9.1E-02	-4.8E-01	**5.2E+01**
Eutrophication, terrestrial	mol N eq	1.4E+00	7.2E-02	8.5E-02	2.9E-02	1.1E+02	1.4E-02	2.2E-01	-5.2E-01	**1.1E+02**
Eutrophication, freshwater	kg P eq	8.7E-04	1.5E-05	2.7E-05	3.7E-05	2.4E-01	8.8E-06	5.7E-05	-6.7E-05	**2.4E-01**
Eutrophication, marine	kg N eq	1.3E-01	6.7E-03	7.6E-03	3.0E-03	1.2E+01	1.3E-03	2.0E-02	-4.7E-02	**1.3E+01**
Ecotoxicity, freshwater	CTUe	1.0E+03	4.6E+01	4.2E+01	1.5E+01	8.9E+04	1.1E+01	1.3E+02	-4.5E+02	**9.0E+04**
Land use	pt	8.6E+04	1.1E+03	3.5E+01	6.1E+02	9.4E+04	8.7E+02	1.2E+02	-5.2E+02	**1.8E+05**
Water use	m^3 water eq. of deprived water	4.4E+01	2.6E+00	4.2E-01	3.8E-01	1.5E+04	4.7E-01	8.8E+00	-9.3E+00	**1.5E+04**
Resource use, minerals and metals	kg Sb eq	2.2E-02	1.8E-04	3.0E-06	7.1E-07	2.2E-02	2.3E-04	7.9E-06	-6.2E-03	**3.8E-02**
Resource use, fossils	MJ	1.9E+03	1.2E+02	6.5E+01	3.1E+01	2.7E+05	2.0E+01	6.3E+02	-8.0E+02	**2.7E+05**
Additional technical information										

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Primary energy consumption	MJ	1.9E+03	1.2E+02	6.5E+01	3.1E+01	2.8E+05	2.0E+01	6.3E+02	-8.0E+02	**2.8E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-98: EU total impact of new products sold in the year of study: WM3.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	kt	3.40E-03	3.40E-03	0.00E+00	6.08E-04	0.00E+00	n.a.	0.00E+00	0.00E+00	**7.41E-03**
Metals	kt	1.47E-01	1.47E-01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.94E-01**
Electronics	kt	1.86E-03	1.41E-03	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**3.26E-03**
Others	kt	0.00E+00	0.00E+00	0.00E+00	9.52E-03	2.19E+03	n.a.	0.00E+00	0.00E+00	**2.19E+03**
Total weight	kt	1.52E-01	1.52E-01	0.00E+00	1.01E-02	2.19E+03	1.52E-03	0.00E+00	0.00E+00	**2.19E+03**
Energy consumption										
Electricity	kWh	0.00E+00	2.16E+04	0.00E+00	0.00E+00	1.36E+08	0.00E+00	0.00E+00	0.00E+00	**1.36E+08**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	7.20E+05	2.66E+04	1.83E+04	9.58E+03	6.34E+07	7.46E+03	1.59E+05	-3.30E+05	**6.40E+07**
Ozone depletion	kg CFC-11 eq	9.91E-05	8.39E-06	2.10E-07	4.22E-07	2.76E-01	1.08E-06	3.70E-05	-4.55E-06	**2.76E-01**
Human toxicity, cancer	CTUh	1.43E-02	6.65E-06	4.86E-06	5.76E-06	2.92E-02	1.43E-04	2.04E-04	-9.70E-03	**3.41E-02**
Human toxicity, non-cancer	CTUh	2.46E-02	1.73E-03	1.18E-04	1.31E-04	4.15E-01	2.64E-04	7.95E-04	-9.06E-03	**4.34E-01**
Particulate matter	disease incidence	6.92E-02	3.82E-03	5.86E-04	4.77E-04	2.44E+00	7.30E-04	9.36E-03	-3.33E-02	**2.49E+00**
Ionising radiation, human health	kBq U235 eq	2.14E+04	9.50E+03	3.30E+02	5.41E+02	2.48E+07	3.09E+02	4.46E+04	-8.17E+03	**2.49E+07**
Photochemical ozone formation, human health	kg NMVOC eq	1.67E+03	7.61E+01	6.50E+01	4.73E+01	1.12E+05	1.75E+01	2.37E+02	-6.89E+02	**1.14E+05**
Acidification	mol H+ eq	4.02E+03	1.20E+02	7.15E+01	3.80E+01	2.07E+05	4.14E+01	3.70E+02	-1.94E+03	**2.09E+05**
Eutrophication, terrestrial	mol N eq	5.49E+03	2.93E+02	3.43E+02	1.18E+02	4.33E+05	5.79E+01	8.75E+02	-2.11E+03	**4.38E+05**
Eutrophication, freshwater	kg P eq	3.50E+00	6.01E-02	1.10E-01	1.48E-01	9.64E+02	3.56E-02	2.30E-01	-2.73E-01	**9.68E+02**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Eutrophication, marine	kg N eq	5.09E+02	2.71E+01	3.06E+01	1.22E+01	5.03E+04	5.36E+00	8.16E+01	-1.90E+02	**5.08E+04**
Ecotoxicity, freshwater	CTUe	4.22E+06	1.85E+05	1.69E+05	5.95E+04	3.61E+08	4.41E+04	5.27E+05	-1.81E+06	**3.64E+08**
Land use	pt	3.47E+08	4.28E+06	1.41E+05	2.49E+06	3.83E+08	3.51E+06	5.01E+05	-2.12E+06	**7.38E+08**
Water use	m^3 water eq. of deprived water	1.80E+05	1.07E+04	1.69E+03	1.53E+03	6.21E+07	1.90E+03	3.56E+04	-3.76E+04	**6.23E+07**
Resource use, minerals and metals	kg Sb eq	9.10E+01	7.31E-01	1.21E-02	2.86E-03	8.81E+01	9.17E-01	3.19E-02	-2.52E+01	**1.56E+02**
Resource use, fossils	MJ	7.59E+06	4.76E+05	2.63E+05	1.27E+05	1.08E+09	8.07E+04	2.56E+06	-3.25E+06	**1.09E+09**
Additional technical information										
Primary energy consumption	MJ	7.59E+06	4.82E+05	2.63E+05	1.27E+05	1.12E+09	8.08E+04	2.56E+06	-3.25E+06	**1.13E+09**

Table 5-99: EU total impact of Stock of products in the year of study: WM3.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	unit									
Plastics	kt	3.40E-02	3.40E-02	0.00E+00	6.07E-03	0.00E+00	n.a.	0.00E+00	0.00E+00	**7.41E-02**
Metals	kt	1.47E+00	1.47E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.94E+00**
Electronics	kt	1.86E-02	1.41E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**3.26E-02**
Others	kt	0.00E+00	0.00E+00	0.00E+00	9.52E-02	2.19E+04	n.a.	0.00E+00	0.00E+00	**2.19E+04**
Total weight	kt	1.52E+00	1.52E+00	0.00E+00	1.01E-01	2.19E+04	1.52E-02	0.00E+00	0.00E+00	**2.19E+04**
Energy consumption										
Electricity	kWh	0.00E+00	2.16E+05	0.00E+00	0.00E+00	1.36E+09	0.00E+00	0.00E+00	0.00E+00	**1.36E+09**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	7.20E+06	2.66E+05	1.83E+05	9.58E+04	6.34E+08	7.46E+04	1.59E+06	-3.30E+06	**6.40E+08**
Ozone depletion	kg CFC-11 eq	9.91E-04	8.39E-05	2.10E-06	4.22E-06	2.76E+00	1.08E-05	3.70E-04	-4.55E-05	**2.76E+00**
Human toxicity, cancer	CTUh	1.43E-01	6.65E-05	4.86E-05	5.76E-05	2.92E-01	1.43E-03	2.04E-03	-9.70E-02	**3.41E-01**
Human toxicity, non-cancer	CTUh	2.46E-01	1.73E-02	1.18E-03	1.31E-03	4.15E+00	2.64E-03	7.95E-03	-9.06E-02	**4.34E+00**
Particulate matter	disease incidence	6.92E-01	3.82E-02	5.86E-03	4.77E-03	2.44E+01	7.30E-03	9.36E-02	-3.33E-01	**2.49E+01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Ionising radiation, human health	kBq U235 eq	2.14E+05	9.50E+04	3.30E+03	5.41E+03	2.48E+08	3.09E+03	4.46E+05	-8.17E+04	**2.49E+08**
Photochemical ozone formation, human health	kg NMVOC eq	1.67E+04	7.61E+02	6.49E+02	4.73E+02	1.12E+06	1.75E+02	2.37E+03	-6.89E+03	**1.14E+06**
Acidification	mol H+ eq	4.02E+04	1.20E+03	7.15E+02	3.80E+02	2.07E+06	4.14E+02	3.70E+03	-1.94E+04	**2.09E+06**
Eutrophication, terrestrial	mol N eq	5.49E+04	2.93E+03	3.43E+03	1.18E+03	4.33E+06	5.79E+02	8.75E+03	-2.11E+04	**4.38E+06**
Eutrophication, freshwater	kg P eq	3.50E+01	6.01E-01	1.10E+00	1.48E+00	9.64E+03	3.56E-01	2.30E+00	-2.73E+00	**9.68E+03**
Eutrophication, marine	kg N eq	5.09E+03	2.71E+02	3.06E+02	1.22E+02	5.03E+05	5.36E+01	8.16E+02	-1.90E+03	**5.08E+05**
Ecotoxicity, freshwater	CTUe	4.22E+07	1.85E+06	1.69E+06	5.95E+05	3.60E+09	4.41E+05	5.27E+06	-1.81E+07	**3.64E+09**
Land use	pt	3.47E+09	4.28E+07	1.41E+06	2.49E+07	3.83E+09	3.51E+07	5.01E+06	-2.12E+07	**7.38E+09**
Water use	m^3 water eq. of deprived water	1.80E+06	1.07E+05	1.69E+04	1.53E+04	6.21E+08	1.90E+04	3.56E+05	-3.76E+05	**6.23E+08**
Resource use, minerals and metals	kg Sb eq	9.09E+02	7.31E+00	1.21E-01	2.86E-02	8.81E+02	9.17E+00	3.19E-01	-2.52E+02	**1.56E+03**
Resource use, fossils	MJ	7.59E+07	4.76E+06	2.63E+06	1.27E+06	1.08E+10	8.07E+05	2.56E+07	-3.25E+07	**1.09E+10**
Additional technical information										

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Primary energy consumption	MJ	7.59E+07	4.82E+06	2.63E+06	1.27E+06	1.12E+10	8.08E+05	2.56E+07	-3.25E+07	**1.13E+10**

Table 5-100: LCC per product and total EU expenditure: WM3.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	13,000	EUR	5	mln. EUR/year
Installation/ acquisition costs (if any)	520	EUR	0	mln. EUR/year
Fuel (gas, oil, wood)	0	EUR/year	0	mln. EUR/year
Electricity	7,191	EUR/year	32	mln. EUR/year
Water	947	EUR/year	4	mln. EUR/year
Auxiliary material 1: Detergent	2,781	EUR/year	12	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	390	EUR	0	mln. EUR/year
Total	**12,309**	**EUR/year**	**54**	**mln. EUR/year**

WM4: Commercial barrier washer

Below, the life cycle impact is provided per product (**Table 5-101**), per year of use of the product **(Table 5-102**), total impact for the EU27 for the new product (**Table 5-103**) and the impact of the stock of products in the EU27 (**Table 5-104**).

Table 5-101: Life cycle impact per product: WM4.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	90,400	90,400		51	0	n.a.			**180,851**
Metals	g	852,900	852,900		0	0	n.a.			**1,705,800**
Electronics	g	25,806	19,550		0	0	n.a.			**45,356**
Others	g	0	0		2,452	12,778,560,000	n.a.			**12,778,562,452**
Total weight	g	969,106	962,850		2,503	12,778,560,000	9,691			**12,780,504,150**
Energy consumption										
Electricity	kWh		124		0	23,610	0			**23,734**
Thermal energy	MJ		0		0	456,213	0			**456,213**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	8.3E+03	3.2E+02	1.1E+02	2.0E+00	7.1E+04	8.6E+01	8.3E+02	-3.5E+03	**7.7E+04**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Ozone depletion	kg CFC-11 eq	1.5E-06	8.4E-08	1.3E-09	9.1E-11	1.2E-03	1.6E-08	1.9E-07	-5.3E-08	**1.2E-03**
Human toxicity, cancer	CTUh	4.3E-04	1.9E-07	3.0E-08	1.6E-09	1.1E-04	4.3E-06	1.1E-06	-2.9E-04	**2.5E-04**
Human toxicity, non-cancer	CTUh	1.7E-04	2.3E-05	7.2E-07	3.3E-08	1.3E-03	1.9E-06	4.1E-06	-4.0E-05	**1.4E-03**
Particulate matter	disease incidence	1.0E-03	3.8E-05	3.6E-06	1.2E-07	3.4E-03	1.1E-05	4.8E-05	-5.6E-04	**4.0E-03**
Ionising radiation, human health	kBq U235 eq	2.7E+02	9.5E+01	2.0E+00	1.2E-01	8.0E+03	3.6E+00	2.3E+02	-8.8E+01	**8.5E+03**
Photochemical ozone formation, human health	kg NMVOC eq	2.3E+01	8.2E-01	4.0E-01	9.8E-03	1.3E+02	2.4E-01	1.2E+00	-9.8E+00	**1.5E+02**
Acidification	mol H+ eq	7.6E+01	1.3E+00	4.4E-01	8.0E-03	2.0E+02	7.8E-01	1.9E+00	-4.2E+01	**2.4E+02**
Eutrophication, terrestrial	mol N eq	7.6E+01	2.9E+00	2.1E+00	2.4E-02	4.9E+02	7.9E-01	4.6E+00	-3.1E+01	**5.5E+02**
Eutrophication, freshwater	kg P eq	4.5E-02	6.1E-04	6.7E-04	2.0E-05	4.4E+00	4.6E-04	1.2E-03	-2.5E-03	**4.5E+00**
Eutrophication, marine	kg N eq	6.9E+00	2.7E-01	1.9E-01	2.4E-03	9.2E+01	7.2E-02	4.2E-01	-2.7E+00	**9.7E+01**
Ecotoxicity, freshwater	CTUe	5.3E+04	1.9E+03	1.0E+03	9.4E+00	5.4E+05	5.5E+02	2.7E+03	-2.4E+04	**5.8E+05**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Land use	pt	1.7E+06	5.5E+04	8.6E+02	5.0E+02	6.5E+05	1.8E+04	2.6E+03	-2.9E+04	**2.4E+06**
Water use	m^3 water eq. of deprived water	2.4E+03	1.1E+02	1.0E+01	2.6E-01	2.4E+05	2.5E+01	1.8E+02	-8.0E+02	**2.5E+05**
Resource use, minerals and metals	kg Sb eq	9.5E-01	9.4E-03	7.4E-05	4.3E-07	3.9E-01	9.6E-03	1.7E-04	-3.6E-01	**1.0E+00**
Resource use, fossils	MJ	9.7E+04	5.1E+03	1.6E+03	2.0E+01	1.1E+06	1.0E+03	1.3E+04	-3.9E+04	**1.1E+06**
Additional technical information										
Primary energy consumption	MJ	9.7E+04	5.1E+03	1.6E+03	2.0E+01	1.1E+06	1.0E+03	1.3E+04	-3.9E+04	**1.2E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-102: Life cycle impact per product per year of use: WM4.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	9,040	9,040		5	0	n.a.			**18,085**
Metals	g	85,290	85,290		0	0	n.a.			**170,580**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Electronics	g	2,581	1,955		0	0	n.a.			**4,536**
Others	g	0	0		245	1,277,856,000	n.a.			**1,277,856,245**
Total weight	g	96,911	96,285		250	1,277,856,000	969			**1,278,050,415**
Energy consumption										
Electricity	kWh		12		0	2,361	0			**2,373**
Thermal energy	MJ		0		0	45,621	0			**45,621**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	8.3E+02	3.2E+01	1.1E+01	2.0E-01	7.1E+03	8.6E+00	8.3E+01	-3.5E+02	**7.7E+03**
Ozone depletion	kg CFC-11 eq	1.5E-07	8.4E-09	1.3E-10	9.1E-12	1.2E-04	1.6E-09	1.9E-08	-5.3E-09	**1.2E-04**
Human toxicity, cancer	CTUh	4.3E-05	1.9E-08	3.0E-09	1.6E-10	1.1E-05	4.3E-07	1.1E-07	-2.9E-05	**2.5E-05**
Human toxicity, non-cancer	CTUh	1.7E-05	2.3E-06	7.2E-08	3.3E-09	1.3E-04	1.9E-07	4.1E-07	-4.0E-06	**1.4E-04**
Particulate matter	disease incidence	1.0E-04	3.8E-06	3.6E-07	1.2E-08	3.4E-04	1.1E-06	4.8E-06	-5.6E-05	**4.0E-04**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Ionising radiation, human health	kBq U235 eq	2.7E+01	9.5E+00	2.0E-01	1.2E-02	8.0E+02	3.6E-01	2.3E+01	-8.8E+00	**8.5E+02**
Photochemical ozone formation, human health	kg NMVOC eq	2.3E+00	8.2E-02	4.0E-02	9.8E-04	1.3E+01	2.4E-02	1.2E-01	-9.8E-01	**1.5E+01**
Acidification	mol H+ eq	7.6E+00	1.3E-01	4.4E-02	8.0E-04	2.0E+01	7.8E-02	1.9E-01	-4.2E+00	**2.4E+01**
Eutrophication, terrestrial	mol N eq	7.6E+00	2.9E-01	2.1E-01	2.4E-03	4.9E+01	7.9E-02	4.6E-01	-3.1E+00	**5.5E+01**
Eutrophication, freshwater	kg P eq	4.5E-03	6.1E-05	6.7E-05	2.0E-06	4.4E-01	4.6E-05	1.2E-04	-2.5E-04	**4.5E-01**
Eutrophication, marine	kg N eq	6.9E-01	2.7E-02	1.9E-02	2.4E-04	9.2E+00	7.2E-03	4.2E-02	-2.7E-01	**9.7E+00**
Ecotoxicity, freshwater	CTUe	5.3E+03	1.9E+02	1.0E+02	9.4E-01	5.4E+04	5.5E+01	2.7E+02	-2.4E+03	**5.8E+04**
Land use	pt	1.7E+05	5.5E+03	8.6E+01	5.0E+01	6.5E+04	1.8E+03	2.6E+02	-2.9E+03	**2.4E+05**
Water use	m^3 water eq. of deprived water	2.4E+02	1.1E+01	1.0E+00	2.6E-02	2.4E+04	2.5E+00	1.8E+01	-8.0E+01	**2.5E+04**
Resource use, minerals and metals	kg Sb eq	9.5E-02	9.4E-04	7.4E-06	4.3E-08	3.9E-02	9.6E-04	1.7E-05	-3.6E-02	**1.0E-01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Resource use, fossils	MJ	9.7E+03	5.1E+02	1.6E+02	2.0E+00	1.1E+05	1.0E+02	1.3E+03	-3.9E+03	**1.1E+05**
Additional technical information										
Primary energy consumption	MJ	9.7E+03	5.1E+02	1.6E+02	2.0E+00	1.1E+05	1.0E+02	1.3E+03	-3.9E+03	**1.2E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-103: EU total impact of new products sold in the year of study: WM4.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	kt	1.10E-01	1.10E-01	0.00E+00	6.20E-05	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.20E-01**
Metals	kt	1.04E+00	1.04E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.07E+00**
Electronics	kt	3.14E-02	2.38E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**5.51E-02**
Others	kt	0.00E+00	0.00E+00	0.00E+00	2.98E-03	1.55E+04	n.a.	0.00E+00	0.00E+00	**1.55E+04**
Total weight	kt	1.18E+00	1.17E+00	0.00E+00	3.04E-03	1.55E+04	1.18E-02	0.00E+00	0.00E+00	**1.55E+04**
Energy consumption										
Electricity	kWh	0.00E+00	1.51E+05	0.00E+00	0.00E+00	2.87E+07	0.00E+00	0.00E+00	0.00E+00	**2.88E+07**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.54E+08	0.00E+00	0.00E+00	0.00E+00	**5.54E+08**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	1.00E+07	3.83E+05	1.36E+05	2.43E+03	8.66E+07	1.04E+05	1.00E+06	-4.24E+06	**9.40E+07**
Ozone depletion	kg CFC-11 eq	1.79E-03	1.02E-04	1.56E-06	1.11E-07	1.42E+00	1.89E-05	2.32E-04	-6.43E-05	**1.42E+00**
Human toxicity, cancer	CTUh	5.22E-01	2.28E-04	3.61E-05	1.93E-06	1.32E-01	5.22E-03	1.28E-03	-3.57E-01	**3.04E-01**
Human toxicity, non-cancer	CTUh	2.05E-01	2.82E-02	8.75E-04	4.05E-05	1.54E+00	2.33E-03	5.03E-03	-4.85E-02	**1.73E+00**
Particulate matter	disease incidence	1.27E+00	4.61E-02	4.34E-03	1.42E-04	4.11E+00	1.32E-02	5.88E-02	-6.77E-01	**4.83E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Ionising radiation, human health	kBq U235 eq	3.24E+05	1.16E+05	2.45E+03	1.44E+02	9.66E+06	4.40E+03	2.80E+05	-1.07E+05	**1.03E+07**
Photochemical ozone formation, human health	kg NMVOC eq	2.78E+04	9.96E+02	4.82E+02	1.19E+01	1.57E+05	2.88E+02	1.50E+03	-1.20E+04	**1.76E+05**
Acidification	mol H+ eq	9.29E+04	1.59E+03	5.30E+02	9.69E+00	2.49E+05	9.45E+02	2.33E+03	-5.12E+04	**2.96E+05**
Eutrophication, terrestrial	mol N eq	9.18E+04	3.58E+03	2.55E+03	2.88E+01	5.98E+05	9.54E+02	5.53E+03	-3.77E+04	**6.65E+05**
Eutrophication, freshwater	kg P eq	5.52E+01	7.40E-01	8.15E-01	2.40E-02	5.39E+03	5.60E-01	1.44E+00	-2.98E+00	**5.45E+03**
Eutrophication, marine	kg N eq	8.36E+03	3.32E+02	2.27E+02	2.89E+00	1.11E+05	8.70E+01	5.16E+02	-3.30E+03	**1.18E+05**
Ecotoxicity, freshwater	CTUe	6.47E+07	2.26E+06	1.25E+06	1.14E+04	6.57E+08	6.69E+05	3.32E+06	-2.93E+07	**7.00E+08**
Land use	pt	2.08E+09	6.64E+07	1.05E+06	6.09E+05	7.89E+08	2.14E+07	3.15E+06	-3.54E+07	**2.92E+09**
Water use	m^3 water eq. of deprived water	2.94E+06	1.29E+05	1.26E+04	3.19E+02	2.97E+08	3.07E+04	2.24E+05	-9.67E+05	**2.99E+08**
Resource use, minerals and metals	kg Sb eq	1.15E+03	1.15E+01	8.98E-02	5.27E-04	4.76E+02	1.16E+01	2.01E-01	-4.35E+02	**1.22E+03**
Resource use, fossils	MJ	1.18E+08	6.15E+06	1.95E+06	2.49E+04	1.30E+09	1.24E+06	1.61E+07	-4.69E+07	**1.39E+09**
Additional technical information										

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Primary energy consumption	MJ	1.18E+08	6.19E+06	1.95E+06	2.49E+04	1.31E+09	1.24E+06	1.61E+07	-4.69E+07	**1.40E+09**

Table 5-104: EU total impact of Stock of products in the year of study: WM4.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	kt	1.10E+00	1.10E+00	0.00E+00	6.20E-04	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.20E+00**
Metals	kt	1.04E+01	1.04E+01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.07E+01**
Electronics	kt	3.14E-01	2.38E-01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**5.51E-01**
Others	kt	0.00E+00	0.00E+00	0.00E+00	2.98E-02	1.55E+05	n.a.	0.00E+00	0.00E+00	**1.55E+05**
Total weight	kt	1.18E+01	1.17E+01	0.00E+00	3.04E-02	1.55E+05	1.18E-01	0.00E+00	0.00E+00	**1.55E+05**
Energy consumption										
Electricity	kWh	0.00E+00	1.51E+06	0.00E+00	0.00E+00	2.87E+08	0.00E+00	0.00E+00	0.00E+00	**2.88E+08**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.54E+09	0.00E+00	0.00E+00	0.00E+00	**5.54E+09**
PEF Impact categories	**unit**									

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Climate change, total	kg CO_2 eq	1.00E+08	3.83E+06	1.36E+06	2.43E+04	8.66E+08	1.04E+06	1.00E+07	-4.24E+07	**9.40E+08**
Ozone depletion	kg CFC-11 eq	1.79E-02	1.02E-03	1.56E-05	1.11E-06	1.42E+01	1.89E-04	2.32E-03	-6.43E-04	**1.42E+01**
Human toxicity, cancer	CTUh	5.22E+00	2.28E-03	3.61E-04	1.93E-05	1.32E+00	5.22E-02	1.28E-02	-3.57E+00	**3.04E+00**
Human toxicity, non-cancer	CTUh	2.05E+00	2.82E-01	8.75E-03	4.05E-04	1.54E+01	2.33E-02	5.03E-02	-4.85E-01	**1.73E+01**
Particulate matter	disease incidence	1.27E+01	4.61E-01	4.34E-02	1.42E-03	4.11E+01	1.32E-01	5.88E-01	-6.77E+00	**4.83E+01**
Ionising radiation, human health	kBq U235 eq	3.24E+06	1.16E+06	2.45E+04	1.44E+03	9.66E+07	4.40E+04	2.80E+06	-1.07E+06	**1.03E+08**
Photochemical ozone formation, human health	kg NMVOC eq	2.78E+05	9.96E+03	4.82E+03	1.19E+02	1.57E+06	2.88E+03	1.50E+04	-1.20E+05	**1.76E+06**
Acidification	mol H+ eq	9.29E+05	1.59E+04	5.30E+03	9.69E+01	2.49E+06	9.45E+03	2.33E+04	-5.12E+05	**2.96E+06**
Eutrophication, terrestrial	mol N eq	9.18E+05	3.58E+04	2.55E+04	2.88E+02	5.98E+06	9.54E+03	5.53E+04	-3.77E+05	**6.65E+06**
Eutrophication, freshwater	kg P eq	5.52E+02	7.40E+00	8.15E+00	2.40E-01	5.39E+04	5.60E+00	1.44E+01	-2.98E+01	**5.45E+04**
Eutrophication, marine	kg N eq	8.36E+04	3.32E+03	2.27E+03	2.89E+01	1.11E+06	8.70E+02	5.16E+03	-3.30E+04	**1.18E+06**
Ecotoxicity, freshwater	CTUe	6.47E+08	2.26E+07	1.25E+07	1.14E+05	6.57E+09	6.69E+06	3.32E+07	-2.93E+08	**7.00E+09**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Land use	pt	2.08E+10	6.64E+08	1.05E+07	6.09E+06	7.89E+09	2.14E+08	3.15E+07	-3.54E+08	**2.92E+10**
Water use	m^3 water eq. of deprived water	2.94E+07	1.29E+06	1.26E+05	3.19E+03	2.97E+09	3.07E+05	2.24E+06	-9.67E+06	**2.99E+09**
Resource use, minerals and metals	kg Sb eq	1.15E+04	1.15E+02	8.98E-01	5.27E-03	4.76E+03	1.16E+02	2.01E+00	-4.35E+03	**1.22E+04**
Resource use, fossils	MJ	1.18E+09	6.15E+07	1.95E+07	2.49E+05	1.30E+10	1.24E+07	1.61E+08	-4.69E+08	**1.39E+10**
Additional technical information										
Primary energy consumption	MJ	2.1E+04	1.2E+02	3.8E+01	5.6E-01	5.3E+04	2.1E+02	3.3E+02	-9.9E+02	**7.4E+04**

Table 5-105: LCC per product and total EU expenditure: WM4.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	35,000	EUR	43	mln. EUR/year
Installation/ acquisition costs (if any)	1,400	EUR	2	mln. EUR/year
Fuel (gas, oil, wood)	947	EUR/year	13	mln. EUR/year
Electricity	499	EUR/year	7	mln. EUR/year

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Water	2,201	EUR/year	30	mln. EUR/year
Auxiliary material 1: Detergent	4,861	EUR/year	65	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	8,750	EUR	12	mln. EUR/year
Total	**13,023**	**EUR/year**	**171**	**mln. EUR/year**

WM5: Industrial continuous tunnel washer

Below, the life cycle impact is provided per product (**Table 5-106**), per year of use of the product (**Table 5-107**), total impact for the EU27 for the new product (**Table 5-108**) and the impact of the stock of products in the EU27 (**Table 5-109**).

Table 5-106: Life cycle impact per product: WM5.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	360,000	360,000		0	0	n.a.			**720,000**
Metals	g	11,640,000	11,640,000		0	0	n.a.			**23,280,000**
Electronics	g	51,427	38,960		0	0	n.a.			**90,387**
Others	g	0	0		0	288,632,970,000	n.a.			**288,632,970,000**
Total weight	g	12,051,427	12,038,960		0	288,632,970,000	120,514			**288,657,180,901**
Energy consumption										
Electricity	kWh									
Thermal energy	MJ		1,536		0	786,038	0			**787,573**
PEF Impact categories	unit		0		0	56,594,700	0			**56,594,700**
Climate change, total	kg CO_2 eq									
Ozone depletion	kg CFC-11 eq									

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Human toxicity, cancer	CTUh	8.5E+04	1.0E+03	1.3E+03	0.0E+00	5.1E+06	8.6E+02	1.3E+04	-5.3E+04	**5.1E+06**
Human toxicity, non-cancer	CTUh	1.4E-06	4.7E-07	1.5E-08	0.0E+00	4.3E-02	1.9E-08	3.1E-06	-1.8E-07	**4.3E-02**
Particulate matter	disease incidence	6.7E-03	-4.8E-07	3.6E-07	0.0E+00	3.3E-03	6.7E-05	1.7E-05	-4.6E-03	**5.5E-03**
Ionising radiation, human health	kBq U235 eq	1.3E-03	5.0E-05	8.7E-06	0.0E+00	3.7E-02	1.3E-05	6.6E-05	-6.3E-04	**3.8E-02**
Photochemical ozone formation, human health	kg NMVOC eq	1.3E-02	1.8E-04	4.3E-05	0.0E+00	1.3E-01	1.3E-04	7.9E-04	-8.7E-03	**1.4E-01**
Acidification	mol H+ eq	1.5E+03	5.3E+02	2.4E+01	0.0E+00	3.1E+05	2.0E+01	3.8E+03	-7.0E+02	**3.1E+05**
Eutrophication, terrestrial	mol N eq	2.4E+02	3.4E+00	4.8E+00	0.0E+00	6.1E+03	2.4E+00	2.0E+01	-1.5E+02	**6.2E+03**
Eutrophication, freshwater	kg P eq	9.8E+02	5.3E+00	5.3E+00	0.0E+00	8.8E+03	9.9E+00	3.1E+01	-6.5E+02	**9.2E+03**
Eutrophication, marine	kg N eq	7.6E+02	1.5E+01	2.5E+01	0.0E+00	2.1E+04	7.7E+00	7.3E+01	-4.7E+02	**2.1E+04**
Ecotoxicity, freshwater	CTUe	1.3E-01	3.1E-03	8.1E-03	0.0E+00	1.5E+02	1.4E-03	1.9E-02	-3.8E-02	**1.5E+02**
Land use	pt	6.7E+01	1.4E+00	2.3E+00	0.0E+00	3.7E+03	6.8E-01	6.8E+00	-4.1E+01	**3.8E+03**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Water use	m^3 water eq. of deprived water	4.0E+05	1.0E+04	1.2E+04	0.0E+00	2.0E+07	4.1E+03	4.4E+04	-2.3E+05	**2.0E+07**
Resource use, minerals and metals	kg Sb eq	1.4E+07	1.3E+04	1.0E+04	0.0E+00	2.7E+07	1.4E+05	4.2E+04	-1.2E+05	**4.0E+07**
Resource use, fossils	MJ	2.0E+04	5.6E+02	1.2E+02	0.0E+00	6.1E+06	2.1E+02	3.0E+03	-1.1E+04	**6.1E+06**
Additional technical information										
Primary energy consumption	MJ	9.5E+05	2.4E+04	1.9E+04	0.0E+00	7.8E+07	9.7E+03	2.1E+05	-5.7E+05	**7.8E+07**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-107: Life cycle impact per product per year of use: WM5.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	g	26,277	26,277		0	0	n.a.			**52,555**
Metals	g	849,635	849,635		0	0	n.a.			**1,699,270**
Electronics	g	3,754	2,844		0	0	n.a.			**6,598**
Others	g	0	0		0	21,068,100,000	n.a.			**21,068,100,000**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Total weight	g	879,666	878,756		0	21,068,100,000	8,797			**21,069,867,219**
Energy consumption										
Electricity	kWh		112		0	57,375	0			**57,487**
Thermal energy	MJ		0		0	4,131,000	0			**4,131,000**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	6.2E+03	7.6E+01	9.8E+01	0.0E+00	3.7E+05	6.3E+01	9.7E+02	-3.9E+03	**3.7E+05**
Ozone depletion	kg CFC-11 eq	1.0E-07	3.4E-08	1.1E-09	0.0E+00	3.2E-03	1.4E-09	2.3E-07	-1.3E-08	**3.2E-03**
Human toxicity, cancer	CTUh	4.9E-04	-3.5E-08	2.6E-08	0.0E+00	2.4E-04	4.9E-06	1.3E-06	-3.4E-04	**4.0E-04**
Human toxicity, non-cancer	CTUh	9.2E-05	3.7E-06	6.3E-07	0.0E+00	2.7E-03	9.5E-07	4.9E-06	-4.6E-05	**2.7E-03**
Particulate matter	disease incidence	9.7E-04	1.3E-05	3.1E-06	0.0E+00	9.8E-03	9.8E-06	5.7E-05	-6.3E-04	**1.0E-02**
Ionising radiation, human health	kBq U235 eq	1.1E+02	3.9E+01	1.8E+00	0.0E+00	2.3E+04	1.5E+00	2.7E+02	-5.1E+01	**2.3E+04**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Photochemical ozone formation, human health	kg NMVOC eq	1.7E+01	2.5E-01	3.5E-01	0.0E+00	4.5E+02	1.8E-01	1.4E+00	-1.1E+01	**4.6E+02**
Acidification	mol H+ eq	7.2E+01	3.9E-01	3.8E-01	0.0E+00	6.4E+02	7.2E-01	2.3E+00	-4.8E+01	**6.7E+02**
Eutrophication, terrestrial	mol N eq	5.5E+01	1.1E+00	1.8E+00	0.0E+00	1.5E+03	5.6E-01	5.3E+00	-3.4E+01	**1.6E+03**
Eutrophication, freshwater	kg P eq	9.7E-03	2.3E-04	5.9E-04	0.0E+00	1.1E+01	1.0E-04	1.4E-03	-2.7E-03	**1.1E+01**
Eutrophication, marine	kg N eq	4.9E+00	1.0E-01	1.6E-01	0.0E+00	2.7E+02	5.0E-02	5.0E-01	-3.0E+00	**2.7E+02**
Ecotoxicity, freshwater	CTUe	2.9E+04	7.6E+02	9.1E+02	0.0E+00	1.5E+06	3.0E+02	3.2E+03	-1.7E+04	**1.5E+06**
Land use	pt	9.9E+05	9.6E+02	7.6E+02	0.0E+00	1.9E+06	9.9E+03	3.1E+03	-8.4E+03	**2.9E+06**
Water use	m^3 water eq. of deprived water	1.5E+03	4.1E+01	9.1E+00	0.0E+00	4.4E+05	1.5E+01	2.2E+02	-8.2E+02	**4.4E+05**
Resource use, minerals and metals	kg Sb eq	7.0E-01	5.5E-05	6.5E-05	0.0E+00	1.4E+00	7.0E-03	1.9E-04	-4.0E-01	**1.8E+00**
Resource use, fossils	MJ	6.9E+04	1.7E+03	1.4E+03	0.0E+00	5.7E+06	7.1E+02	1.6E+04	-4.2E+04	**5.7E+06**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Additional technical information										
Primary energy consumption	MJ	6.9E+04	1.8E+03	1.4E+03	0.0E+00	5.7E+06	7.1E+02	1.6E+04	-4.2E+04	**5.7E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-108: EU total impact of new products sold in the year of study: WM5.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	kt	9.00E-02	9.00E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.80E-01**
Metals	kt	2.91E+00	2.91E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**5.82E+00**
Electronics	kt	1.29E-02	9.74E-03	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.26E-02**
Others	kt	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.22E+04	n.a.	0.00E+00	0.00E+00	**7.22E+04**
Total weight	kt	3.01E+00	3.01E+00	0.00E+00	0.00E+00	7.22E+04	3.01E-02	0.00E+00	0.00E+00	**7.22E+04**
Energy consumption										
Electricity	kWh	0.00E+00	3.84E+05	0.00E+00	0.00E+00	1.97E+08	0.00E+00	0.00E+00	0.00E+00	**1.97E+08**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E+10	0.00E+00	0.00E+00	0.00E+00	**1.41E+10**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	2.13E+07	2.60E+05	3.36E+05	0.00E+00	1.27E+09	2.15E+05	3.31E+06	-1.32E+07	**1.28E+09**
Ozone depletion	kg CFC-11 eq	3.57E-04	1.16E-04	3.86E-06	0.00E+00	1.09E+01	4.74E-06	7.79E-04	-4.60E-05	**1.09E+01**
Human toxicity, cancer	CTUh	1.68E+00	-1.21E-04	8.94E-05	0.00E+00	8.33E-01	1.68E-02	4.29E-03	-1.15E+00	**1.38E+00**
Human toxicity, non-cancer	CTUh	3.15E-01	1.25E-02	2.17E-03	0.00E+00	9.22E+00	3.27E-03	1.66E-02	-1.58E-01	**9.42E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Particulate matter	disease incidence	3.32E+00	4.58E-02	1.08E-02	0.00E+00	3.35E+01	3.37E-02	1.96E-01	-2.17E+00	**3.49E+01**
Ionising radiation, human health	kBq U235 eq	3.79E+05	1.32E+05	6.06E+03	0.00E+00	7.73E+07	5.12E+03	9.38E+05	-1.75E+05	**7.85E+07**
Photochemical ozone formation, human health	kg NMVOC eq	5.98E+04	8.60E+02	1.19E+03	0.00E+00	1.53E+06	6.06E+02	4.95E+03	-3.76E+04	**1.56E+06**
Acidification	mol H+ eq	2.46E+05	1.32E+03	1.31E+03	0.00E+00	2.19E+06	2.47E+03	7.73E+03	-1.63E+05	**2.29E+06**
Eutrophication, terrestrial	mol N eq	1.89E+05	3.70E+03	6.31E+03	0.00E+00	5.26E+06	1.93E+03	1.82E+04	-1.18E+05	**5.36E+06**
Eutrophication, freshwater	kg P eq	3.33E+01	7.84E-01	2.02E+00	0.00E+00	3.86E+04	3.41E-01	4.82E+00	-9.40E+00	**3.86E+04**
Eutrophication, marine	kg N eq	1.67E+04	3.42E+02	5.63E+02	0.00E+00	9.33E+05	1.70E+02	1.70E+03	-1.03E+04	**9.42E+05**
Ecotoxicity, freshwater	CTUe	9.92E+07	2.61E+06	3.11E+06	0.00E+00	4.99E+09	1.02E+06	1.10E+07	-5.75E+07	**5.05E+09**
Land use	pt	3.38E+09	3.30E+06	2.59E+06	0.00E+00	6.64E+09	3.39E+07	1.05E+07	-2.89E+07	**1.00E+10**
Water use	m^3 water eq. of deprived water	5.00E+06	1.39E+05	3.12E+04	0.00E+00	1.51E+09	5.14E+04	7.47E+05	-2.80E+06	**1.52E+09**
Resource use, minerals and metals	kg Sb eq	2.41E+03	1.88E-01	2.23E-01	0.00E+00	4.93E+03	2.41E+01	6.67E-01	-1.37E+03	**6.00E+03**
Resource use, fossils	MJ	2.37E+08	5.89E+06	4.83E+06	0.00E+00	1.94E+10	2.43E+06	5.34E+07	-1.44E+08	**1.96E+10**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Additional technical information										
Primary energy consumption	MJ	2.37E+08	5.99E+06	4.83E+06	0.00E+00	1.95E+10	2.43E+06	5.34E+07	-1.44E+08	**1.96E+10**

Table 5-109: EU total impact of Stock of products in the year of study: WM5.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	kt	1.23E+00	1.23E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.46E+00**
Metals	kt	3.98E+01	3.98E+01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**7.95E+01**
Electronics	kt	1.76E-01	1.33E-01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**3.09E-01**
Others	kt	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.86E+05	n.a.	0.00E+00	0.00E+00	**9.86E+05**
Total weight	kt	4.12E+01	4.11E+01	0.00E+00	0.00E+00	9.86E+05	4.12E-01	0.00E+00	0.00E+00	**9.86E+05**
Energy consumption										
Electricity	kWh	0.00E+00	5.25E+06	0.00E+00	0.00E+00	2.69E+09	0.00E+00	0.00E+00	0.00E+00	**2.69E+09**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E+11	0.00E+00	0.00E+00	0.00E+00	**1.93E+11**
PEF Impact categories	**unit**									

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Climate change, total	kg CO_2 eq	2.91E+08	3.55E+06	4.59E+06	0.00E+00	1.74E+10	2.94E+06	4.53E+07	-1.81E+08	**1.75E+10**
Ozone depletion	kg CFC-11 eq	4.88E-03	1.59E-03	5.27E-05	0.00E+00	1.48E+02	6.47E-05	1.06E-02	-6.28E-04	**1.48E+02**
Human toxicity, cancer	CTUh	2.29E+01	-1.65E-03	1.22E-03	0.00E+00	1.14E+01	2.29E-01	5.86E-02	-1.57E+01	**1.89E+01**
Human toxicity, non-cancer	CTUh	4.30E+00	1.71E-01	2.97E-02	0.00E+00	1.26E+02	4.47E-02	2.27E-01	-2.16E+00	**1.29E+02**
Particulate matter	disease incidence	4.54E+01	6.26E-01	1.47E-01	0.00E+00	4.58E+02	4.60E-01	2.68E+00	-2.96E+01	**4.78E+02**
Ionising radiation, human health	kBq U235 eq	5.18E+06	1.81E+06	8.29E+04	0.00E+00	1.06E+09	6.99E+04	1.28E+07	-2.39E+06	**1.07E+09**
Photochemical ozone formation, human health	kg NMVOC eq	8.17E+05	1.18E+04	1.63E+04	0.00E+00	2.09E+07	8.28E+03	6.77E+04	-5.14E+05	**2.13E+07**
Acidification	mol H+ eq	3.36E+06	1.80E+04	1.80E+04	0.00E+00	3.00E+07	3.38E+04	1.06E+05	-2.23E+06	**3.13E+07**
Eutrophication, terrestrial	mol N eq	2.59E+06	5.05E+04	8.63E+04	0.00E+00	7.18E+07	2.64E+04	2.49E+05	-1.61E+06	**7.32E+07**
Eutrophication, freshwater	kg P eq	4.56E+02	1.07E+01	2.76E+01	0.00E+00	5.27E+05	4.66E+00	6.58E+01	-1.29E+02	**5.28E+05**
Eutrophication, marine	kg N eq	2.28E+05	4.67E+03	7.69E+03	0.00E+00	1.27E+07	2.33E+03	2.33E+04	-1.41E+05	**1.29E+07**
Ecotoxicity, freshwater	CTUe	1.36E+09	3.57E+07	4.25E+07	0.00E+00	6.81E+10	1.39E+07	1.51E+08	-7.85E+08	**6.90E+10**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Land use	pt	4.62E+10	4.51E+07	3.55E+07	0.00E+00	9.07E+10	4.63E+08	1.43E+08	-3.95E+08	**1.37E+11**
Water use	m^3 water eq. of deprived water	6.84E+07	1.90E+06	4.26E+05	0.00E+00	2.07E+10	7.03E+05	1.02E+07	-3.83E+07	**2.07E+10**
Resource use, minerals and metals	kg Sb eq	3.29E+04	2.56E+00	3.04E+00	0.00E+00	6.74E+04	3.29E+02	9.12E+00	-1.87E+04	**8.20E+04**
Resource use, fossils	MJ	3.24E+09	8.05E+07	6.60E+07	0.00E+00	2.65E+11	3.32E+07	7.30E+08	-1.96E+09	**2.67E+11**
Additional technical information										
Primary energy consumption	MJ	3.24E+09	8.19E+07	6.60E+07	0.00E+00	2.66E+11	3.32E+07	7.30E+08	-1.96E+09	**2.69E+11**

Table 5-110: LCC per product and total EU expenditure: WM5.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	585,000	EUR	146	mln. EUR/year
Installation/ acquisition costs (if any)	52,650	EUR	13	mln. EUR/year
Fuel (gas, oil, wood)	84,420	EUR/year	325	mln. EUR/year
Electricity	11,929	EUR/year	46	mln. EUR/year
Water	35,702	EUR/year	137	mln. EUR/year

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Auxiliary material 1: Detergent	280,042	EUR/year	1,077	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	146,250	EUR	41	mln. EUR/year
Total	**469,312**	**EUR/year**	**1,785**	**mln. EUR/year**

D1: Light duty commercial tumble dryer

Below, the life cycle impact is provided per product (**Table 5-111**), per year of use of the product (**Table 5-112**), total impact for the EU27 for the new product (**Table 5-113**) and the impact of the stock of products in the EU27 (**Table 5-114)**.

Table 5-111: Life cycle impact per product: D1.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	13,700	13,700		51	0	n.a.			**27,451**
Metals	g	44,600	44,600		0	0	n.a.			**89,200**
Electronics	g	818	620		0	0	n.a.			**1,438**
Others	g	0	0		5,000	0	n.a.			**5,000**
Total weight	g	59,118	58,920		5,051	0	591			**123,681**
Energy consumption										
Electricity	kWh		9		0	16,227	0			**16,236**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq									
Ozone depletion	kg CFC-11 eq									
Human toxicity, cancer	CTUh	4.2E+02	1.6E+01	7.4E+00	3.9E+00	6.8E+03	4.3E+00	4.7E+01	-1.9E+02	**7.1E+03**
Human toxicity, non-cancer	CTUh	2.3E-07	5.6E-09	8.5E-11	1.9E-10	2.5E-06	2.3E-09	1.1E-08	-1.9E-09	**2.8E-06**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Particulate matter	disease incidence	2.4E-05	4.8E-09	2.0E-09	3.2E-09	1.1E-06	2.4E-07	6.1E-08	-1.7E-05	**9.1E-06**
Ionising radiation, human health	kBq U235 eq	7.9E-06	7.3E-07	4.8E-08	6.5E-08	2.3E-05	8.6E-08	2.4E-07	-2.3E-06	**3.0E-05**
Photochemical ozone formation, human health	kg NMVOC eq	5.8E-05	1.4E-06	2.4E-07	2.4E-07	2.2E-04	5.9E-07	2.8E-06	-3.1E-05	**2.5E-04**
Acidification	mol H+ eq	1.0E+01	6.4E+00	1.3E-01	2.4E-01	2.9E+03	1.6E-01	1.3E+01	-3.8E+00	**2.9E+03**
Eutrophication, terrestrial	mol N eq	1.2E+00	3.6E-02	2.6E-02	2.0E-02	1.1E+01	1.2E-02	7.0E-02	-5.5E-01	**1.2E+01**
Eutrophication, freshwater	kg P eq	4.1E+00	5.8E-02	2.9E-02	1.6E-02	2.1E+01	4.2E-02	1.1E-01	-2.4E+00	**2.3E+01**
Eutrophication, marine	kg N eq	4.0E+00	1.4E-01	1.4E-01	4.8E-02	4.2E+01	4.1E-02	2.6E-01	-1.7E+00	**4.4E+01**
Ecotoxicity, freshwater	CTUe	3.1E-03	3.4E-05	4.5E-05	4.1E-05	1.4E-02	3.1E-05	6.8E-05	-1.4E-04	**1.7E-02**
Land use	pt	3.6E-01	1.3E-02	1.2E-02	4.8E-03	3.9E+00	3.7E-03	2.4E-02	-1.5E-01	**4.2E+00**
Water use	m^3 water eq. of deprived water	2.8E+03	9.1E+01	6.9E+01	1.7E+01	3.1E+04	2.9E+01	1.6E+02	-1.1E+03	**3.3E+04**
Resource use, minerals and metals	kg Sb eq	1.5E+05	1.0E+02	5.7E+01	1.0E+03	2.9E+04	1.5E+03	1.5E+02	-1.0E+03	**1.8E+05**
Resource use, fossils	MJ	1.2E+02	5.7E+00	6.9E-01	4.8E-01	2.3E+03	1.3E+00	1.1E+01	-4.3E+01	**2.4E+03**
Additional technical information										

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Primary energy consumption	MJ	5.1E+03	2.9E+02	1.1E+02	3.8E+01	1.2E+05	5.4E+01	7.6E+02	-2.1E+03	**1.3E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-112: Life cycle impact per product per year of use: D1.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	g	1,370	1,370		5	0	n.a.			**2,745**
Metals	g	4,460	4,460		0	0	n.a.			**8,920**
Electronics	g	82	62		0	0	n.a.			**144**
Others	g	0	0		500	0	n.a.			**500**
Total weight	g	5,912	5,892		505	0	59			**12,368**
Energy consumption										
Electricity	kWh		1		0	1,623	0			**1,624**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	**unit**									

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Climate change, total	kg CO_2 eq									
Ozone depletion	kg CFC-11 eq									
Human toxicity, cancer	CTUh	4.2E+01	1.6E+00	7.4E-01	3.9E-01	6.8E+02	4.3E-01	4.7E+00	-1.9E+01	**7.1E+02**
Human toxicity, non-cancer	CTUh	2.3E-08	5.6E-10	8.5E-12	1.9E-11	2.5E-07	2.3E-10	1.1E-09	-1.9E-10	**2.8E-07**
Particulate matter	disease incidence	2.4E-06	4.8E-10	2.0E-10	3.2E-10	1.1E-07	2.4E-08	6.1E-09	-1.7E-06	**9.1E-07**
Ionising radiation, human health	kBq U235 eq	7.9E-07	7.3E-08	4.8E-09	6.5E-09	2.3E-06	8.6E-09	2.4E-08	-2.3E-07	**3.0E-06**
Photochemical ozone formation, human health	kg NMVOC eq	5.8E-06	1.4E-07	2.4E-08	2.4E-08	2.2E-05	5.9E-08	2.8E-07	-3.1E-06	**2.5E-05**
Acidification	mol H+ eq	1.0E+00	6.4E-01	1.3E-02	2.4E-02	2.9E+02	1.6E-02	1.3E+00	-3.8E-01	**2.9E+02**
Eutrophication, terrestrial	mol N eq	1.2E-01	3.6E-03	2.6E-03	2.0E-03	1.1E+00	1.2E-03	7.0E-03	-5.5E-02	**1.2E+00**
Eutrophication, freshwater	kg P eq	4.1E-01	5.8E-03	2.9E-03	1.6E-03	2.1E+00	4.2E-03	1.1E-02	-2.4E-01	**2.3E+00**
Eutrophication, marine	kg N eq	4.0E-01	1.4E-02	1.4E-02	4.8E-03	4.2E+00	4.1E-03	2.6E-02	-1.7E-01	**4.4E+00**
Ecotoxicity, freshwater	CTUe	3.1E-04	3.4E-06	4.5E-06	4.1E-06	1.4E-03	3.1E-06	6.8E-06	-1.4E-05	**1.7E-03**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Land use	pt	3.6E-02	1.3E-03	1.2E-03	4.8E-04	3.9E-01	3.7E-04	2.4E-03	-1.5E-02	**4.2E-01**
Water use	m^3 water eq. of deprived water	2.8E+02	9.1E+00	6.9E+00	1.7E+00	3.1E+03	2.9E+00	1.6E+01	-1.1E+02	**3.3E+03**
Resource use, minerals and metals	kg Sb eq	1.5E+04	1.0E+01	5.7E+00	1.0E+02	2.9E+03	1.5E+02	1.5E+01	-1.0E+02	**1.8E+04**
Resource use, fossils	MJ	1.2E+01	5.7E-01	6.9E-02	4.8E-02	2.3E+02	1.3E-01	1.1E+00	-4.3E+00	**2.4E+02**
Additional technical information										
Primary energy consumption	MJ	5.1E+02	2.9E+01	1.1E+01	3.8E+00	1.2E+04	5.4E+00	7.6E+01	-2.1E+02	**1.3E+04**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-113: EU total impact of new products sold in the year of study: D1.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	kt	2.19E-01	2.19E-01	0.00E+00	8.16E-04	0.00E+00	n.a.	0.00E+00	0.00E+00	**4.39E-01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Metals	kt	7.14E-01	7.14E-01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.43E+00**
Electronics	kt	1.31E-02	9.92E-03	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.30E-02**
Others	kt	0.00E+00	0.00E+00	0.00E+00	8.00E-02	0.00E+00	n.a.	0.00E+00	0.00E+00	**8.00E-02**
Total weight	kt	9.46E-01	9.43E-01	0.00E+00	8.08E-02	0.00E+00	9.46E-03	0.00E+00	0.00E+00	**1.98E+00**
Energy consumption										
Electricity	kWh	0.00E+00	1.42E+05	0.00E+00	0.00E+00	2.60E+08	0.00E+00	0.00E+00	0.00E+00	**2.60E+08**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	6.65E+06	2.53E+05	1.19E+05	6.31E+04	1.09E+08	6.90E+04	7.55E+05	-3.11E+06	**1.14E+08**
Ozone depletion	kg CFC-11 eq	3.62E-03	8.99E-05	1.37E-06	3.00E-06	4.04E-02	3.71E-05	1.76E-04	-3.03E-05	**4.43E-02**
Human toxicity, cancer	CTUh	3.88E-01	7.61E-05	3.16E-05	5.16E-05	1.81E-02	3.88E-03	9.69E-04	-2.66E-01	**1.45E-01**
Human toxicity, non-cancer	CTUh	1.27E-01	1.17E-02	7.68E-04	1.04E-03	3.64E-01	1.38E-03	3.78E-03	-3.62E-02	**4.73E-01**
Particulate matter	disease incidence	9.22E-01	2.19E-02	3.81E-03	3.78E-03	3.47E+00	9.44E-03	4.44E-02	-5.02E-01	**3.97E+00**
Ionising radiation, human health	kBq U235 eq	1.60E+05	1.03E+05	2.15E+03	3.83E+03	4.62E+07	2.63E+03	2.12E+05	-6.11E+04	**4.66E+07**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Photochemical ozone formation, human health	kg NMVOC eq	1.93E+04	5.73E+02	4.22E+02	3.17E+02	1.78E+05	1.98E+02	1.13E+03	-8.79E+03	**1.91E+05**
Acidification	mol H+ eq	6.58E+04	9.31E+02	4.65E+02	2.58E+02	3.31E+05	6.67E+02	1.75E+03	-3.79E+04	**3.63E+05**
Eutrophication, terrestrial	mol N eq	6.32E+04	2.16E+03	2.23E+03	7.64E+02	6.65E+05	6.54E+02	4.16E+03	-2.77E+04	**7.11E+05**
Eutrophication, freshwater	kg P eq	4.96E+01	5.52E-01	7.15E-01	6.57E-01	2.22E+02	5.02E-01	1.09E+00	-2.19E+00	**2.73E+02**
Eutrophication, marine	kg N eq	5.78E+03	2.01E+02	1.99E+02	7.68E+01	6.28E+04	5.98E+01	3.87E+02	-2.42E+03	**6.71E+04**
Ecotoxicity, freshwater	CTUe	4.47E+07	1.45E+06	1.10E+06	2.73E+05	4.95E+08	4.62E+05	2.50E+06	-1.78E+07	**5.28E+08**
Land use	pt	2.33E+09	1.62E+06	9.18E+05	1.64E+07	4.68E+08	2.34E+07	2.38E+06	-1.65E+07	**2.83E+09**
Water use	m^3 water eq. of deprived water	1.96E+06	9.09E+04	1.10E+04	7.64E+03	3.71E+07	2.05E+04	1.69E+05	-6.85E+05	**3.87E+07**
Resource use, minerals and metals	kg Sb eq	7.89E+02	9.10E-02	7.88E-02	1.34E-02	2.77E+01	7.89E+00	1.51E-01	-3.19E+02	**5.06E+02**
Resource use, fossils	MJ	8.21E+07	4.59E+06	1.71E+06	6.03E+05	1.89E+09	8.67E+05	1.21E+07	-3.41E+07	**1.96E+09**
Additional technical information										
Primary energy consumption	MJ	8.21E+07	4.63E+06	1.71E+06	6.03E+05	1.96E+09	8.67E+05	1.21E+07	-3.41E+07	**2.03E+09**

Table 5-114: EU total impact of Stock of products in the year of study: D1.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	kt	2.19E+00	2.19E+00	0.00E+00	8.16E-03	0.00E+00	n.a.	0.00E+00	0.00E+00	**4.39E+00**
Metals	kt	7.14E+00	7.14E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.43E+01**
Electronics	kt	1.31E-01	9.92E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.30E-01**
Others	kt	0.00E+00	0.00E+00	0.00E+00	8.00E-01	0.00E+00	n.a.	0.00E+00	0.00E+00	**8.00E-01**
Total weight	kt	9.46E+00	9.43E+00	0.00E+00	8.08E-01	0.00E+00	9.46E-02	0.00E+00	0.00E+00	**1.98E+01**
Energy consumption										
Electricity	kWh	0.00E+00	1.42E+06	0.00E+00	0.00E+00	2.60E+09	0.00E+00	0.00E+00	0.00E+00	**2.60E+09**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	6.65E+07	2.53E+06	1.19E+06	6.31E+05	1.09E+09	6.90E+05	7.55E+06	-3.11E+07	**1.14E+09**
Ozone depletion	kg CFC-11 eq	3.62E-02	8.99E-04	1.37E-05	3.00E-05	4.04E-01	3.71E-04	1.76E-03	-3.03E-04	**4.43E-01**
Human toxicity, cancer	CTUh	3.88E+00	7.61E-04	3.16E-04	5.16E-04	1.81E-01	3.88E-02	9.69E-03	-2.65E+00	**1.45E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Human toxicity, non-cancer	CTUh	1.27E+00	1.17E-01	7.68E-03	1.04E-02	3.64E+00	1.38E-02	3.78E-02	-3.62E-01	**4.73E+00**
Particulate matter	disease incidence	9.22E+00	2.19E-01	3.81E-02	3.78E-02	3.47E+01	9.44E-02	4.44E-01	-5.02E+00	**3.97E+01**
Ionising radiation, human health	kBq U235 eq	1.60E+06	1.03E+06	2.15E+04	3.83E+04	4.62E+08	2.63E+04	2.12E+06	-6.11E+05	**4.66E+08**
Photochemical ozone formation, human health	kg NMVOC eq	1.93E+05	5.73E+03	4.22E+03	3.17E+03	1.78E+06	1.98E+03	1.13E+04	-8.79E+04	**1.91E+06**
Acidification	mol H+ eq	6.58E+05	9.31E+03	4.65E+03	2.58E+03	3.31E+06	6.67E+03	1.75E+04	-3.79E+05	**3.63E+06**
Eutrophication, terrestrial	mol N eq	6.32E+05	2.16E+04	2.23E+04	7.64E+03	6.65E+06	6.54E+03	4.16E+04	-2.77E+05	**7.11E+06**
Eutrophication, freshwater	kg P eq	4.96E+02	5.52E+00	7.15E+00	6.57E+00	2.22E+03	5.02E+00	1.09E+01	-2.19E+01	**2.73E+03**
Eutrophication, marine	kg N eq	5.78E+04	2.01E+03	1.99E+03	7.68E+02	6.28E+05	5.98E+02	3.87E+03	-2.42E+04	**6.71E+05**
Ecotoxicity, freshwater	CTUe	4.47E+08	1.45E+07	1.10E+07	2.73E+06	4.95E+09	4.62E+06	2.50E+07	-1.78E+08	**5.28E+09**
Land use	pt	2.33E+10	1.62E+07	9.18E+06	1.64E+08	4.68E+09	2.34E+08	2.38E+07	-1.65E+08	**2.83E+10**
Water use	m^3 water eq. of deprived water	1.96E+07	9.09E+05	1.10E+05	7.64E+04	3.71E+08	2.05E+05	1.69E+06	-6.85E+06	**3.87E+08**
Resource use, minerals and metals	kg Sb eq	7.89E+03	9.10E-01	7.88E-01	1.34E-01	2.77E+02	7.89E+01	1.51E+00	-3.19E+03	**5.06E+03**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Resource use, fossils	MJ	8.21E+08	4.59E+07	1.71E+07	6.03E+06	1.89E+10	8.67E+06	1.21E+08	-3.41E+08	**1.96E+10**
Additional technical information										
Primary energy consumption	MJ	8.21E+08	4.63E+07	1.71E+07	6.03E+06	1.96E+10	8.67E+06	1.21E+08	-3.41E+08	**2.05E+10**

Table 5-115: LCC per product and total EU expenditure: D1.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	1,600	EUR	26	mln. EUR/year
Installation/ acquisition costs (if any)	64	EUR	1	mln. EUR/year
Fuel (gas, oil, wood)	0	EUR/year	0	mln. EUR/year
Electricity	353	EUR/year	61	mln. EUR/year
Water	0	EUR/year	0	mln. EUR/year
Auxiliary material 1: Detergent	0	EUR/year	0	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	48	EUR	1	mln. EUR/year
Total	**524**	**EUR/year**	**88**	**mln. EUR/year**

D2: Commercial tumble dryer

Below, the life cycle impact is provided per product (**Table 5-116**), per year of use of the product (**Table 5-117**), total impact for the EU27 for the new product (**Table 5-118**) and the impact of the stock of products in the EU27 (**Table 5-119**).

Table 5-116: Life cycle impact per product: D2.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	g	12,200	12,200		51	0	n.a.			**24,451**
Metals	g	43,200	43,200		0	0	n.a.			**86,400**
Electronics	g	766	620		0	0	n.a.			**1,386**
Others	g	0	0		6,300	0	n.a.			**6,300**
Total weight	g	56,166	56,020		6,351	0	562			**119,098**
Energy consumption										
Electricity	kWh		9		0	563,060	0			**563,069**
Thermal energy	MJ		0		0	957,499	0			**957,499**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	3.9E+02	1.5E+01	7.1E+00	5.4E+00	3.0E+05	4.1E+00	4.5E+01	-1.8E+02	**3.0E+05**
Ozone depletion	kg CFC-11 eq	1.9E-07	5.3E-09	8.2E-11	2.6E-10	9.1E-05	2.0E-09	1.0E-08	-1.9E-09	**9.2E-05**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Human toxicity, cancer	CTUh	2.3E-05	4.8E-09	1.9E-09	3.6E-09	4.5E-05	2.3E-07	5.8E-08	-1.6E-05	**5.3E-05**
Human toxicity, non-cancer	CTUh	7.6E-06	7.3E-07	4.6E-08	7.3E-08	8.4E-04	8.3E-08	2.3E-07	-2.2E-06	**8.5E-04**
Particulate matter	disease incidence	5.5E-05	1.3E-06	2.3E-07	3.1E-07	7.8E-03	5.6E-07	2.6E-06	-3.0E-05	**7.9E-03**
Ionising radiation, human health	kBq U235 eq	9.7E+00	6.1E+00	1.3E-01	3.3E-01	1.0E+05	1.6E-01	1.3E+01	-3.7E+00	**1.0E+05**
Photochemical ozone formation, human health	kg NMVOC eq	1.1E+00	3.4E-02	2.5E-02	2.9E-02	4.3E+02	1.2E-02	6.7E-02	-5.2E-01	**4.3E+02**
Acidification	mol H+ eq	3.9E+00	5.6E-02	2.8E-02	2.3E-02	7.5E+02	3.9E-02	1.0E-01	-2.2E+00	**7.6E+02**
Eutrophication, terrestrial	mol N eq	3.7E+00	1.3E-01	1.3E-01	7.1E-02	1.5E+03	3.8E-02	2.5E-01	-1.6E+00	**1.5E+03**
Eutrophication, freshwater	kg P eq	2.8E-03	3.3E-05	4.3E-05	8.9E-05	8.4E-01	2.8E-05	6.5E-05	-1.3E-04	**8.4E-01**
Eutrophication, marine	kg N eq	3.4E-01	1.2E-02	1.2E-02	7.4E-03	1.5E+02	3.5E-03	2.3E-02	-1.4E-01	**1.5E+02**
Ecotoxicity, freshwater	CTUe	2.6E+03	8.8E+01	6.6E+01	2.5E+01	1.1E+06	2.7E+01	1.5E+02	-1.1E+03	**1.1E+06**
Land use	pt	1.5E+05	9.6E+01	5.5E+01	1.6E+03	1.0E+06	1.5E+03	1.4E+02	-9.7E+02	**1.2E+06**
Water use	m^3 water eq. of deprived water	1.1E+02	5.4E+00	6.6E-01	7.8E-01	8.1E+04	1.2E+00	1.0E+01	-4.1E+01	**8.2E+04**
Resource use, minerals and metals	kg Sb eq	4.7E-02	5.4E-06	4.7E-06	1.5E-06	1.8E-01	4.7E-04	9.0E-06	-1.9E-02	**2.1E-01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Resource use, fossils	MJ	4.8E+03	2.7E+02	1.0E+02	5.6E+01	5.1E+06	5.1E+01	7.2E+02	-2.0E+03	**5.1E+06**
Additional technical information										
Primary energy consumption	MJ	4.8E+03	2.8E+02	1.0E+02	5.6E+01	5.2E+06	5.1E+01	7.2E+02	-2.0E+03	**5.2E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-117: Life cycle impact per product per year of use: D2.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	g	813	813		3	0	n.a.			**1,630**
Metals	g	2,880	2,880		0	0	n.a.			**5,760**
Electronics	g	51	41		0	0	n.a.			**92**
Others	g	0	0		420	0	n.a.			**420**
Total weight	g	3,744	3,735		423	0	37			**7,940**
Energy consumption										
Electricity	kWh		1		0	37,537	0			**37,538**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Thermal energy	MJ		0		0	63,833	0			**63,833**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	2.6E+01	1.0E+00	4.7E-01	3.6E-01	2.0E+04	2.7E-01	3.0E+00	-1.2E+01	**2.0E+04**
Ozone depletion	kg CFC-11 eq	1.3E-08	3.5E-10	5.4E-12	1.8E-11	6.1E-06	1.3E-10	7.0E-10	-1.2E-10	**6.1E-06**
Human toxicity, cancer	CTUh	1.5E-06	3.2E-10	1.3E-10	2.4E-10	3.0E-06	1.5E-08	3.8E-09	-1.0E-06	**3.5E-06**
Human toxicity, non-cancer	CTUh	5.1E-07	4.8E-08	3.1E-09	4.9E-09	5.6E-05	5.5E-09	1.5E-08	-1.4E-07	**5.7E-05**
Particulate matter	disease incidence	3.6E-06	8.8E-08	1.5E-08	2.0E-08	5.2E-04	3.7E-08	1.8E-07	-2.0E-06	**5.2E-04**
Ionising radiation, human health	kBq U235 eq	6.5E-01	4.1E-01	8.5E-03	2.2E-02	6.8E+03	1.1E-02	8.4E-01	-2.5E-01	**6.8E+03**
Photochemical ozone formation, human health	kg NMVOC eq	7.6E-02	2.3E-03	1.7E-03	1.9E-03	2.9E+01	7.8E-04	4.5E-03	-3.5E-02	**2.9E+01**
Acidification	mol H+ eq	2.6E-01	3.7E-03	1.9E-03	1.5E-03	5.0E+01	2.6E-03	7.0E-03	-1.5E-01	**5.0E+01**
Eutrophication, terrestrial	mol N eq	2.5E-01	8.6E-03	8.9E-03	4.8E-03	1.0E+02	2.6E-03	1.7E-02	-1.1E-01	**1.0E+02**
Eutrophication, freshwater	kg P eq	1.8E-04	2.2E-06	2.8E-06	5.9E-06	5.6E-02	1.9E-06	4.3E-06	-8.7E-06	**5.6E-02**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Eutrophication, marine	kg N eq	2.3E-02	8.0E-04	7.9E-04	4.9E-04	9.8E+00	2.3E-04	1.5E-03	-9.6E-03	**9.8E+00**
Ecotoxicity, freshwater	CTUe	1.8E+02	5.8E+00	4.4E+00	1.7E+00	7.4E+04	1.8E+00	9.9E+00	-7.1E+01	**7.4E+04**
Land use	pt	9.7E+03	6.4E+00	3.7E+00	1.1E+02	6.9E+04	9.7E+01	9.4E+00	-6.4E+01	**7.9E+04**
Water use	m^3 water eq. of deprived water	7.7E+00	3.6E-01	4.4E-02	5.2E-02	5.4E+03	8.0E-02	6.7E-01	-2.7E+00	**5.4E+03**
Resource use, minerals and metals	kg Sb eq	3.2E-03	3.6E-07	3.1E-07	1.0E-07	1.2E-02	3.2E-05	6.0E-07	-1.3E-03	**1.4E-02**
Resource use, fossils	MJ	3.2E+02	1.8E+01	6.8E+00	3.7E+00	3.4E+05	3.4E+00	4.8E+01	-1.3E+02	**3.4E+05**
Additional technical information										
Primary energy consumption	MJ	3.2E+02	1.8E+01	6.8E+00	3.7E+00	3.5E+05	3.4E+00	4.8E+01	-1.3E+02	**3.5E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-118: EU total impact of new products sold in the year of study: D2.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	**unit**									
Plastics	kt	6.22E-01	6.22E-01	0.00E+00	2.60E-03	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.25E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Metals	kt	2.20E+00	2.20E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**4.41E+00**
Electronics	kt	3.90E-02	3.16E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**7.07E-02**
Others	kt	0.00E+00	0.00E+00	0.00E+00	3.21E-01	0.00E+00	n.a.	0.00E+00	0.00E+00	**3.21E-01**
Total weight	kt	2.86E+00	2.86E+00	0.00E+00	3.24E-01	0.00E+00	2.86E-02	0.00E+00	0.00E+00	**6.07E+00**
Energy consumption										
Electricity	kWh	0.00E+00	4.52E+05	0.00E+00	0.00E+00	2.87E+10	0.00E+00	0.00E+00	0.00E+00	**2.87E+10**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.88E+10	0.00E+00	0.00E+00	0.00E+00	**4.88E+10**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	2.00E+07	7.67E+05	3.62E+05	2.78E+05	1.52E+10	2.08E+05	2.29E+06	-9.42E+06	**1.52E+10**
Ozone depletion	kg CFC-11 eq	9.94E-03	2.71E-04	4.16E-06	1.35E-05	4.66E+00	1.02E-04	5.34E-04	-9.48E-05	**4.67E+00**
Human toxicity, cancer	CTUh	1.17E+00	2.45E-04	9.63E-05	1.84E-04	2.30E+00	1.17E-02	2.94E-03	-8.02E-01	**2.69E+00**
Human toxicity, non-cancer	CTUh	3.87E-01	3.71E-02	2.34E-03	3.75E-03	4.29E+01	4.24E-03	1.15E-02	-1.10E-01	**4.33E+01**
Particulate matter	disease incidence	2.78E+00	6.74E-02	1.16E-02	1.56E-02	3.99E+02	2.85E-02	1.35E-01	-1.52E+00	**4.01E+02**
Ionising radiation, human health	kBq U235 eq	4.97E+05	3.10E+05	6.53E+03	1.68E+04	5.17E+09	8.07E+03	6.44E+05	-1.88E+05	**5.17E+09**
Photochemical ozone formation, human health	kg NMVOC eq	5.78E+04	1.75E+03	1.29E+03	1.48E+03	2.18E+07	5.95E+02	3.43E+03	-2.66E+04	**2.19E+07**
Acidification	mol H+ eq	1.98E+05	2.84E+03	1.42E+03	1.18E+03	3.85E+07	2.01E+03	5.33E+03	-1.15E+05	**3.85E+07**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Eutrophication, terrestrial	mol N eq	1.89E+05	6.59E+03	6.80E+03	3.64E+03	7.77E+07	1.96E+03	1.26E+04	-8.37E+04	**7.78E+07**
Eutrophication, freshwater	kg P eq	1.41E+02	1.67E+00	2.18E+00	4.52E+00	4.28E+04	1.43E+00	3.31E+00	-6.65E+00	**4.30E+04**
Eutrophication, marine	kg N eq	1.73E+04	6.14E+02	6.06E+02	3.77E+02	7.46E+06	1.79E+02	1.18E+03	-7.33E+03	**7.48E+06**
Ecotoxicity, freshwater	CTUe	1.35E+08	4.47E+06	3.35E+06	1.26E+06	5.63E+10	1.40E+06	7.60E+06	-5.45E+07	**5.64E+10**
Land use	pt	7.44E+09	4.88E+06	2.79E+06	8.05E+07	5.26E+10	7.45E+07	7.22E+06	-4.93E+07	**6.01E+10**
Water use	m^3 water eq. of deprived water	5.86E+06	2.75E+05	3.36E+04	4.00E+04	4.15E+09	6.14E+04	5.14E+05	-2.08E+06	**4.16E+09**
Resource use, minerals and metals	kg Sb eq	2.42E+03	2.75E-01	2.40E-01	7.85E-02	9.17E+03	2.42E+01	4.60E-01	-9.66E+02	**1.06E+04**
Resource use, fossils	MJ	2.46E+08	1.39E+07	5.20E+06	2.83E+06	2.58E+11	2.60E+06	3.69E+07	-1.03E+08	**2.58E+11**
Additional technical information										
Primary energy consumption	MJ	2.46E+08	1.40E+07	5.20E+06	2.83E+06	2.66E+11	2.60E+06	3.69E+07	-1.03E+08	**2.66E+11**

Table 5-119: EU total impact of Stock of products in the year of study: D2.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	unit									
Plastics	kt	9.28E+00	9.28E+00	0.00E+00	3.88E-02	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.86E+01**
Metals	kt	3.29E+01	3.29E+01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**6.57E+01**
Electronics	kt	5.82E-01	4.72E-01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.05E+00**
Others	kt	0.00E+00	0.00E+00	0.00E+00	4.79E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**4.79E+00**
Total weight	kt	4.27E+01	4.26E+01	0.00E+00	4.83E+00	0.00E+00	4.27E-01	0.00E+00	0.00E+00	**9.06E+01**
Energy consumption										
Electricity	kWh	0.00E+00	6.75E+06	0.00E+00	0.00E+00	4.28E+11	0.00E+00	0.00E+00	0.00E+00	**4.28E+11**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.28E+11	0.00E+00	0.00E+00	0.00E+00	**7.28E+11**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	2.99E+08	1.14E+07	5.40E+06	4.14E+06	2.27E+11	3.10E+06	3.42E+07	-1.40E+08	**2.27E+11**
Ozone depletion	kg CFC-11 eq	1.48E-01	4.04E-03	6.20E-05	2.01E-04	6.95E+01	1.52E-03	7.96E-03	-1.41E-03	**6.96E+01**
Human toxicity, cancer	CTUh	1.75E+01	3.65E-03	1.44E-03	2.75E-03	3.43E+01	1.75E-01	4.39E-02	-1.20E+01	**4.00E+01**
Human toxicity, non-cancer	CTUh	5.77E+00	5.53E-01	3.49E-02	5.59E-02	6.40E+02	6.33E-02	1.71E-01	-1.64E+00	**6.45E+02**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Particulate matter	disease incidence	4.15E+01	1.00E+00	1.73E-01	2.32E-01	5.95E+03	4.25E-01	2.01E+00	-2.26E+01	**5.98E+03**
Ionising radiation, human health	kBq U235 eq	7.41E+06	4.62E+06	9.74E+04	2.50E+05	7.71E+10	1.20E+05	9.60E+06	-2.81E+06	**7.71E+10**
Photochemical ozone formation, human health	kg NMVOC eq	8.61E+05	2.61E+04	1.92E+04	2.21E+04	3.25E+08	8.88E+03	5.11E+04	-3.97E+05	**3.26E+08**
Acidification	mol H+ eq	2.95E+06	4.23E+04	2.11E+04	1.76E+04	5.73E+08	3.00E+04	7.95E+04	-1.71E+06	**5.75E+08**
Eutrophication, terrestrial	mol N eq	2.82E+06	9.83E+04	1.01E+05	5.42E+04	1.16E+09	2.92E+04	1.88E+05	-1.25E+06	**1.16E+09**
Eutrophication, freshwater	kg P eq	2.11E+03	2.49E+01	3.24E+01	6.74E+01	6.38E+05	2.13E+01	4.94E+01	-9.92E+01	**6.41E+05**
Eutrophication, marine	kg N eq	2.58E+05	9.16E+03	9.04E+03	5.62E+03	1.11E+08	2.67E+03	1.76E+04	-1.09E+05	**1.12E+08**
Ecotoxicity, freshwater	CTUe	2.01E+09	6.66E+07	4.99E+07	1.88E+07	8.39E+11	2.08E+07	1.13E+08	-8.13E+08	**8.40E+11**
Land use	pt	1.11E+11	7.28E+07	4.17E+07	1.20E+09	7.84E+11	1.11E+09	1.08E+08	-7.35E+08	**8.97E+11**
Water use	m^3 water eq. of deprived water	8.74E+07	4.10E+06	5.00E+05	5.96E+05	6.19E+10	9.15E+05	7.66E+06	-3.10E+07	**6.20E+10**
Resource use, minerals and metals	kg Sb eq	3.61E+04	4.09E+00	3.58E+00	1.17E+00	1.37E+05	3.61E+02	6.85E+00	-1.44E+04	**1.59E+05**
Resource use, fossils	MJ	3.67E+09	2.07E+08	7.76E+07	4.22E+07	3.85E+12	3.88E+07	5.50E+08	-1.54E+09	**3.85E+12**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Additional technical information										
Primary energy consumption	MJ	3.67E+09	2.09E+08	7.76E+07	4.22E+07	3.97E+12	3.88E+07	5.50E+08	-1.54E+09	**3.97E+12**

Table 5-120: LCC per product and total EU expenditure: D2.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	6,000	EUR	306	mln. EUR/year
Installation/ acquisition costs (if any)	240	EUR	12	mln. EUR/year
Fuel (gas, oil, wood)	1,328	EUR/year	1,117	mln. EUR/year
Electricity	7,947	EUR/year	6,680	mln. EUR/year
Water	0	EUR/year	0	mln. EUR/year
Auxiliary material 1: Detergent	0	EUR/year	0	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	180	EUR	10	mln. EUR/year

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Total	**9,703**	**EUR/year**	**8,125**	**mln. EUR/year**

D3: Commercial cabinet dryer

Below, the life cycle impact is provided per product (**Table 5-121**), per year of use of the product (**Table 5-122**), total impact for the EU27 for the new product (**Table 5-123**) and the impact of the stock of products in the EU27 (**Table 5-124**).

Table 5-121: Life cycle impact per product: D3.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	**unit**									
Plastics	g	7,260	7,250		1,800	0	n.a.			**16,310**
Metals	g	134,850	135,450		0	0	n.a.			**270,300**
Electronics	g	1,307	990		0	0	n.a.			**2,297**
Others	g	0	0		25,100	0	n.a.			**25,100**
Total weight	g	143,417	143,690		26,900	0	1,434			**315,441**
Energy consumption										
Electricity	kWh		22		0	126,020	0			**126,042**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	**unit**									
Climate change, total	kg CO_2 eq	6.4E+02	2.6E+01	1.9E+01	2.6E+01	5.3E+04	6.7E+00	1.5E+02	-3.4E+02	**5.3E+04**
Ozone depletion	kg CFC-11 eq	1.7E-07	8.9E-09	2.2E-10	1.1E-09	2.0E-05	1.8E-09	3.3E-08	-2.8E-08	**2.0E-05**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Human toxicity, cancer	CTUh	3.2E-06	2.7E-09	5.1E-09	1.5E-08	8.8E-06	3.2E-08	1.8E-07	-2.2E-06	**1.0E-05**
Human toxicity, non-cancer	CTUh	1.8E-05	1.2E-06	1.2E-07	3.5E-07	1.8E-04	1.9E-07	7.2E-07	-8.9E-06	**1.9E-04**
Particulate matter	disease incidence	4.4E-05	2.8E-06	6.1E-07	1.3E-06	1.7E-03	4.6E-07	8.4E-06	-2.3E-05	**1.7E-03**
Ionising radiation, human health	kBq U235 eq	4.9E+01	1.0E+01	3.4E-01	1.4E+00	2.2E+04	5.9E-01	3.9E+01	-3.2E+01	**2.3E+04**
Photochemical ozone formation, human health	kg NMVOC eq	1.3E+00	7.0E-02	6.8E-02	1.3E-01	8.6E+01	1.4E-02	2.2E-01	-6.0E-01	**8.8E+01**
Acidification	mol H+ eq	2.5E+00	1.0E-01	7.5E-02	1.0E-01	1.6E+02	2.6E-02	3.4E-01	-1.2E+00	**1.6E+02**
Eutrophication, terrestrial	mol N eq	4.2E+00	2.7E-01	3.6E-01	3.1E-01	3.2E+02	4.5E-02	8.0E-01	-1.9E+00	**3.3E+02**
Eutrophication, freshwater	kg P eq	3.0E-03	5.8E-05	1.1E-04	3.9E-04	1.1E-01	3.1E-05	2.0E-04	-2.6E-04	**1.1E-01**
Eutrophication, marine	kg N eq	4.0E-01	2.5E-02	3.2E-02	3.2E-02	3.0E+01	4.2E-03	7.5E-02	-1.7E-01	**3.1E+01**
Ecotoxicity, freshwater	CTUe	1.0E+04	1.5E+02	1.8E+02	1.7E+02	2.4E+05	1.1E+02	4.8E+02	-6.9E+03	**2.5E+05**
Land use	pt	8.2E+04	2.5E+02	1.5E+02	6.6E+03	2.3E+05	8.2E+02	4.5E+02	-1.6E+03	**3.2E+05**
Water use	m^3 water eq. of deprived water	1.5E+02	9.5E+00	1.8E+00	4.1E+00	1.8E+04	1.6E+00	3.1E+01	-6.4E+01	**1.8E+04**
Resource use, minerals and metals	kg Sb eq	4.1E-02	1.2E-05	1.3E-05	7.7E-06	1.3E-02	4.1E-04	2.9E-05	-1.6E-02	**3.9E-02**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Resource use, fossils	MJ	7.2E+03	5.0E+02	2.7E+02	3.5E+02	9.2E+05	7.7E+01	2.3E+03	-3.6E+03	**9.3E+05**
Additional technical information										
Primary energy consumption	MJ	7.2E+03	5.1E+02	2.7E+02	3.5E+02	9.5E+05	7.8E+01	2.3E+03	-3.6E+03	**9.6E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-122: Life cycle impact per product per year of use: D3.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distribution	Packaging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	unit									
Plastics	g	726	725		180	0	n.a.			**1,631**
Metals	g	13,485	13,545		0	0	n.a.			**27,030**
Electronics	g	131	99		0	0	n.a.			**230**
Others	g	0	0		2,510	0	n.a.			**2,510**
Total weight	g	14,342	14,369		2,690	0	143			**31,544**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distribution	Packaging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Energy consumption										
Electricity	kWh		2		0	12,602	0			**12,604**
Thermal energy	MJ		0		0	0	0			0
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	6.4E+01	2.6E+00	1.9E+00	2.6E+00	5.3E+03	6.7E-01	1.5E+01	-3.4E+01	**5.3E+03**
Ozone depletion	kg CFC-11 eq	1.7E-08	8.9E-10	2.2E-11	1.1E-10	2.0E-06	1.8E-10	3.3E-09	-2.8E-09	**2.0E-06**
Human toxicity, cancer	CTUh	3.2E-07	2.7E-10	5.1E-10	1.5E-09	8.8E-07	3.2E-09	1.8E-08	-2.2E-07	**1.0E-06**
Human toxicity, non-cancer	CTUh	1.8E-06	1.2E-07	1.2E-08	3.5E-08	1.8E-05	1.9E-08	7.2E-08	-8.9E-07	**1.9E-05**
Particulate matter	disease incidence	4.4E-06	2.8E-07	6.1E-08	1.3E-07	1.7E-04	4.6E-08	8.4E-07	-2.3E-06	**1.7E-04**
Ionising radiation, human health	kBq U235 eq	4.9E+00	1.0E+00	3.4E-02	1.4E-01	2.2E+03	5.9E-02	3.9E+00	-3.2E+00	**2.3E+03**
Photochemical ozone formation, human health	kg NMVOC eq	1.3E-01	7.0E-03	6.8E-03	1.3E-02	8.6E+00	1.4E-03	2.2E-02	-6.0E-02	**8.8E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distribution	Packaging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Acidification	mol H+ eq	2.5E-01	1.0E-02	7.5E-03	1.0E-02	1.6E+01	2.6E-03	3.4E-02	-1.2E-01	**1.6E+01**
Eutrophication, terrestrial	mol N eq	4.2E-01	2.7E-02	3.6E-02	3.1E-02	3.2E+01	4.5E-03	8.0E-02	-1.9E-01	**3.3E+01**
Eutrophication, freshwater	kg P eq	3.0E-04	5.8E-06	1.1E-05	3.9E-05	1.1E-02	3.1E-06	2.0E-05	-2.6E-05	**1.1E-02**
Eutrophication, marine	kg N eq	4.0E-02	2.5E-03	3.2E-03	3.2E-03	3.0E+00	4.2E-04	7.5E-03	-1.7E-02	**3.1E+00**
Ecotoxicity, freshwater	CTUe	1.0E+03	1.5E+01	1.8E+01	1.7E+01	2.4E+04	1.1E+01	4.8E+01	-6.9E+02	**2.5E+04**
Land use	pt	8.2E+03	2.5E+01	1.5E+01	6.6E+02	2.3E+04	8.2E+01	4.5E+01	-1.6E+02	**3.2E+04**
Water use	m^3 water eq. of deprived water	1.5E+01	9.5E-01	1.8E-01	4.1E-01	1.8E+03	1.6E-01	3.1E+00	-6.4E+00	**1.8E+03**
Resource use, minerals and metals	kg Sb eq	4.1E-03	1.2E-06	1.3E-06	7.7E-07	1.3E-03	4.1E-05	2.9E-06	-1.6E-03	**3.9E-03**
Resource use, fossils	MJ	7.2E+02	5.0E+01	2.7E+01	3.5E+01	9.2E+04	7.7E+00	2.3E+02	-3.6E+02	**9.3E+04**
Additional technical information										
Primary energy consumption	MJ	7.2E+02	5.1E+01	2.7E+01	3.5E+01	9.5E+04	7.8E+00	2.3E+02	-3.6E+02	**9.6E+04**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-123: EU total impact of new products sold in the year of study: D3.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	unit									
Plastics	kt	7.26E-02	7.25E-02	0.00E+00	1.80E-02	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.63E-01**
Metals	kt	1.35E+00	1.35E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.70E+00**
Electronics	kt	1.31E-02	9.90E-03	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.30E-02**
Others	kt	0.00E+00	0.00E+00	0.00E+00	2.51E-01	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.51E-01**
Total weight	kt	1.43E+00	1.44E+00	0.00E+00	2.69E-01	0.00E+00	1.43E-02	0.00E+00	0.00E+00	**3.15E+00**
Energy consumption										
Electricity	kWh	0.00E+00	2.18E+05	0.00E+00	0.00E+00	1.26E+09	0.00E+00	0.00E+00	0.00E+00	**1.26E+09**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	6.40E+06	2.61E+05	1.91E+05	2.57E+05	5.28E+08	6.66E+04	1.46E+06	-3.37E+06	**5.33E+08**
Ozone depletion	kg CFC-11 eq	1.74E-03	8.94E-05	2.19E-06	1.12E-05	1.96E-01	1.83E-05	3.26E-04	-2.76E-04	**1.98E-01**
Human toxicity, cancer	CTUh	3.23E-02	2.71E-05	5.08E-05	1.53E-04	8.77E-02	3.23E-04	1.80E-03	-2.17E-02	**1.01E-01**
Human toxicity, non-cancer	CTUh	1.77E-01	1.19E-02	1.23E-03	3.52E-03	1.77E+00	1.89E-03	7.17E-03	-8.88E-02	**1.88E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Particulate matter	disease incidence	4.35E-01	2.79E-02	6.11E-03	1.26E-02	1.68E+01	4.63E-03	8.37E-02	-2.25E-01	**1.72E+01**
Ionising radiation, human health	kBq U235 eq	4.90E+05	1.02E+05	3.44E+03	1.44E+04	2.24E+08	5.92E+03	3.94E+05	-3.21E+05	**2.25E+08**
Photochemical ozone formation, human health	kg NMVOC eq	1.30E+04	7.01E+02	6.78E+02	1.26E+03	8.65E+05	1.37E+02	2.18E+03	-6.04E+03	**8.76E+05**
Acidification	mol H+ eq	2.48E+04	1.01E+03	7.46E+02	1.01E+03	1.61E+06	2.58E+02	3.37E+03	-1.22E+04	**1.63E+06**
Eutrophication, terrestrial	mol N eq	4.22E+04	2.66E+03	3.58E+03	3.13E+03	3.23E+06	4.49E+02	8.03E+03	-1.89E+04	**3.27E+06**
Eutrophication, freshwater	kg P eq	3.02E+01	5.84E-01	1.15E+00	3.94E+00	1.08E+03	3.07E-01	2.04E+00	-2.60E+00	**1.11E+03**
Eutrophication, marine	kg N eq	3.96E+03	2.47E+02	3.20E+02	3.24E+02	3.05E+05	4.21E+01	7.48E+02	-1.73E+03	**3.09E+05**
Ecotoxicity, freshwater	CTUe	1.04E+08	1.50E+06	1.76E+06	1.65E+06	2.40E+09	1.06E+06	4.77E+06	-6.88E+07	**2.45E+09**
Land use	pt	8.18E+08	2.52E+06	1.47E+06	6.59E+07	2.27E+09	8.21E+06	4.48E+06	-1.58E+07	**3.16E+09**
Water use	m^3 water eq. of deprived water	1.50E+06	9.54E+04	1.77E+04	4.13E+04	1.80E+08	1.60E+04	3.14E+05	-6.40E+05	**1.82E+08**
Resource use, minerals and metals	kg Sb eq	4.13E+02	1.17E-01	1.26E-01	7.69E-02	1.34E+02	4.13E+00	2.88E-01	-1.63E+02	**3.89E+02**
Resource use, fossils	MJ	7.25E+07	5.01E+06	2.74E+06	3.51E+06	9.18E+09	7.75E+05	2.35E+07	-3.62E+07	**9.25E+09**
Additional technical information										
Primary energy consumption	MJ	4.7E+02	5.1E+00	2.7E+00	3.5E+00	1.7E+04	4.8E+00	2.4E+01	-3.8E+01	**1.8E+04**

Table 5-124: EU total impact of Stock of products in the year of study: D3.

Lice cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	unit									
Plastics	kt	7.26E-01	7.25E-01	0.00E+00	1.80E-01	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.63E+00**
Metals	kt	1.35E+01	1.35E+01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.70E+01**
Electronics	kt	1.31E-01	9.90E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.30E-01**
Others	kt	0.00E+00	0.00E+00	0.00E+00	2.51E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.51E+00**
Total weight	kt	1.43E+01	1.44E+01	0.00E+00	2.69E+00	0.00E+00	1.43E-01	0.00E+00	0.00E+00	**3.15E+01**
Energy consumption										
Electricity	kWh	0.00E+00	2.18E+06	0.00E+00	0.00E+00	1.26E+10	0.00E+00	0.00E+00	0.00E+00	**1.26E+10**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	6.40E+07	2.61E+06	1.91E+06	2.57E+06	5.28E+09	6.66E+05	1.46E+07	-3.37E+07	**5.33E+09**
Ozone depletion	kg CFC-11 eq	1.74E-02	8.94E-04	2.19E-05	1.12E-04	1.96E+00	1.83E-04	3.26E-03	-2.76E-03	**1.98E+00**
Human toxicity, cancer	CTUh	3.23E-01	2.71E-04	5.08E-04	1.53E-03	8.76E-01	3.23E-03	1.80E-02	-2.17E-01	**1.01E+00**
Human toxicity, non-cancer	CTUh	1.77E+00	1.19E-01	1.23E-02	3.52E-02	1.77E+01	1.89E-02	7.17E-02	-8.88E-01	**1.88E+01**
Particulate matter	disease incidence	4.35E+00	2.79E-01	6.11E-02	1.26E-01	1.68E+02	4.63E-02	8.37E-01	-2.25E+00	**1.72E+02**

Lice cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Ionising radiation, human health	kBq U235 eq	4.90E+06	1.02E+06	3.44E+04	1.44E+05	2.24E+09	5.92E+04	3.94E+06	-3.21E+06	**2.25E+09**
Photochemical ozone formation, human health	kg NMVOC eq	1.30E+05	7.01E+03	6.78E+03	1.26E+04	8.64E+06	1.37E+03	2.18E+04	-6.04E+04	**8.76E+06**
Acidification	mol H+ eq	2.48E+05	1.01E+04	7.46E+03	1.01E+04	1.61E+07	2.58E+03	3.37E+04	-1.22E+05	**1.63E+07**
Eutrophication, terrestrial	mol N eq	4.22E+05	2.66E+04	3.58E+04	3.13E+04	3.23E+07	4.49E+03	8.03E+04	-1.89E+05	**3.27E+07**
Eutrophication, freshwater	kg P eq	3.02E+02	5.84E+00	1.15E+01	3.94E+01	1.08E+04	3.07E+00	2.04E+01	-2.60E+01	**1.11E+04**
Eutrophication, marine	kg N eq	3.96E+04	2.47E+03	3.20E+03	3.24E+03	3.05E+06	4.21E+02	7.48E+03	-1.73E+04	**3.09E+06**
Ecotoxicity, freshwater	CTUe	1.04E+09	1.50E+07	1.76E+07	1.65E+07	2.40E+10	1.06E+07	4.77E+07	-6.88E+08	**2.45E+10**
Land use	pt	8.18E+09	2.52E+07	1.47E+07	6.59E+08	2.27E+10	8.21E+07	4.48E+07	-1.58E+08	**3.16E+10**
Water use	m^3 water eq. of deprived water	1.50E+07	9.54E+05	1.77E+05	4.13E+05	1.80E+09	1.60E+05	3.14E+06	-6.40E+06	**1.82E+09**
Resource use, minerals and metals	kg Sb eq	4.13E+03	1.17E+00	1.26E+00	7.69E-01	1.34E+03	4.13E+01	2.88E+00	-1.63E+03	**3.89E+03**
Resource use, fossils	MJ	7.25E+08	5.01E+07	2.74E+07	3.51E+07	9.18E+10	7.75E+06	2.35E+08	-3.62E+08	**9.25E+10**
Additional technical information										

Lice cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Primary energy consumption	MJ	7.25E+08	5.07E+07	2.74E+07	3.51E+07	9.53E+10	7.75E+06	2.35E+08	-3.62E+08	**9.61E+10**

Table 5-125: LCC per product and total EU expenditure: D3.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	2,000	EUR	20	mln. EUR/year
Installation/ acquisition costs (if any)	80	EUR	1	mln. EUR/year
Fuel (gas, oil, wood)	0	EUR/year	0	mln. EUR/year
Electricity	3,225	EUR/year	295	mln. EUR/year
Water	0	EUR/year	0	mln. EUR/year
Auxiliary material 1: Detergent	0	EUR/year	0	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	60	EUR	1	mln. EUR/year
Total	**3,439**	**EUR/year**	**316**	**mln. EUR/year**

D4: Industrial pass-through tumble dryer

Below, the life cycle impact is provided per product (**Table 5-126**), per year of use of the product (**Table 5-127**), total impact for the EU27 for the new product (**Table 5-128**) and the impact of the stock of products in the EU27 (

Table 5-129).

Table 5-126: Life cycle impact per product: D4.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	unit									
Plastics	g	9,990	9,980		0	0	n.a.			**19,970**
Metals	g	2,856,500	2,856,500		0	0	n.a.			**5,713,000**
Electronics	g	1,426	1,080		0	0	n.a.			**2,506**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	2,867,916	2,867,560		0	0	28,679			**5,764,155**
Energy consumption										
Electricity	kWh		364		0	2,244,000	0			**2,244,364**
Thermal energy	MJ		0		0	68,801,684	0			**68,801,684**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	8.2E+03	1.2E+02	3.2E+02	0.0E+00	5.4E+06	8.3E+01	3.5E+03	-5.5E+03	**5.4E+06**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Ozone depletion	kg CFC-11 eq	2.7E-08	7.7E-08	3.7E-09	0.0E+00	6.2E-04	1.0E-09	8.2E-07	1.3E-09	**6.2E-04**
Human toxicity, cancer	CTUh	1.4E-05	-2.4E-07	8.5E-08	0.0E+00	5.8E-04	1.4E-07	4.5E-06	-9.4E-06	**5.9E-04**
Human toxicity, non-cancer	CTUh	3.1E-04	2.9E-06	2.1E-06	0.0E+00	6.9E-03	3.1E-06	1.7E-05	-2.0E-04	**7.0E-03**
Particulate matter	disease incidence	6.0E-04	3.7E-05	1.0E-05	0.0E+00	5.2E-02	6.4E-06	2.1E-04	-4.0E-04	**5.3E-02**
Ionising radiation, human health	kBq U235 eq	9.7E+01	8.7E+01	5.7E+00	0.0E+00	4.8E+05	1.8E+00	9.9E+02	-6.0E+01	**4.8E+05**
Photochemical ozone formation, human health	kg NMVOC eq	1.4E+01	5.6E-01	1.1E+00	0.0E+00	4.5E+03	1.5E-01	5.2E+00	-9.3E+00	**4.5E+03**
Acidification	mol H+ eq	2.2E+01	8.4E-01	1.2E+00	0.0E+00	5.5E+03	2.3E-01	8.1E+00	-1.4E+01	**5.5E+03**
Eutrophication, terrestrial	mol N eq	4.2E+01	2.7E+00	6.0E+00	0.0E+00	1.1E+04	4.5E-01	1.9E+01	-2.8E+01	**1.2E+04**
Eutrophication, freshwater	kg P eq	9.4E-03	5.5E-04	1.9E-03	0.0E+00	2.8E+01	1.0E-04	5.1E-03	-5.0E-03	**2.8E+01**
Eutrophication, marine	kg N eq	3.9E+00	2.5E-01	5.3E-01	0.0E+00	1.3E+03	4.1E-02	1.8E+00	-2.5E+00	**1.3E+03**
Ecotoxicity, freshwater	CTUe	1.6E+04	1.7E+03	2.9E+03	0.0E+00	6.4E+06	1.7E+02	1.2E+04	-9.6E+03	**6.4E+06**
Land use	pt	3.8E+05	2.9E+03	2.5E+03	0.0E+00	5.2E+06	3.8E+03	1.1E+04	-6.3E+03	**5.5E+06**
Water use	m^3 water eq. of deprived water	3.5E+02	1.0E+02	3.0E+01	0.0E+00	3.9E+05	4.5E+00	7.9E+02	-1.7E+02	**3.9E+05**
Resource use, minerals and metals	kg Sb eq	5.6E-01	1.6E-04	2.1E-04	0.0E+00	8.8E+00	5.6E-03	7.0E-04	-3.5E-01	**9.1E+00**
Resource use, fossils	MJ	7.5E+04	3.7E+03	4.6E+03	0.0E+00	8.5E+07	7.8E+02	5.6E+04	-4.9E+04	**8.5E+07**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Additional technical information										
Primary energy consumption	MJ	7.5E+04	3.8E+03	4.6E+03	0.0E+00	8.6E+07	7.8E+02	5.6E+04	-4.9E+04	**8.6E+07**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-127: Life cycle impact per product per year of use: D4.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	unit									
Plastics	g	400	399		0	0	n.a.			**799**
Metals	g	114,260	114,260		0	0	n.a.			**228,520**
Electronics	g	57	43		0	0	n.a.			**100**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	114,717	114,702		0	0	1,147			**230,566**
Energy consumption										
Electricity	kWh		15		0	89,760	0			**89,775**
Thermal energy	MJ		0		0	2,752,067	0			**2,752,067**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	3.3E+02	4.9E+00	1.3E+01	0.0E+00	2.2E+05	3.3E+00	1.4E+02	-2.2E+02	**2.2E+05**
Ozone depletion	kg CFC-11 eq	1.1E-09	3.1E-09	1.5E-10	0.0E+00	2.5E-05	4.2E-11	3.3E-08	5.2E-11	**2.5E-05**
Human toxicity, cancer	CTUh	5.5E-07	-9.5E-09	3.4E-09	0.0E+00	2.3E-05	5.4E-09	1.8E-07	-3.7E-07	**2.4E-05**
Human toxicity, non-cancer	CTUh	1.2E-05	1.2E-07	8.2E-08	0.0E+00	2.8E-04	1.2E-07	7.0E-07	-8.1E-06	**2.8E-04**
Particulate matter	disease incidence	2.4E-05	1.5E-06	4.1E-07	0.0E+00	2.1E-03	2.5E-07	8.3E-06	-1.6E-05	**2.1E-03**
Ionising radiation, human health	kBq U235 eq	3.9E+00	3.5E+00	2.3E-01	0.0E+00	1.9E+04	7.4E-02	4.0E+01	-2.4E+00	**1.9E+04**
Photochemical ozone formation, human health	kg NMVOC eq	5.7E-01	2.2E-02	4.5E-02	0.0E+00	1.8E+02	5.9E-03	2.1E-01	-3.7E-01	**1.8E+02**
Acidification	mol H+ eq	8.8E-01	3.4E-02	5.0E-02	0.0E+00	2.2E+02	9.1E-03	3.3E-01	-5.8E-01	**2.2E+02**
Eutrophication, terrestrial	mol N eq	1.7E+00	1.1E-01	2.4E-01	0.0E+00	4.6E+02	1.8E-02	7.7E-01	-1.1E+00	**4.6E+02**
Eutrophication, freshwater	kg P eq	3.8E-04	2.2E-05	7.7E-05	0.0E+00	1.1E+00	4.0E-06	2.0E-04	-2.0E-04	**1.1E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Eutrophication, marine	kg N eq	1.6E-01	9.9E-03	2.1E-02	0.0E+00	5.1E+01	1.7E-03	7.2E-02	-1.0E-01	**5.1E+01**
Ecotoxicity, freshwater	CTUe	6.3E+02	6.7E+01	1.2E+02	0.0E+00	2.5E+05	6.9E+00	4.6E+02	-3.8E+02	**2.6E+05**
Land use	pt	1.5E+04	1.1E+02	9.8E+01	0.0E+00	2.1E+05	1.5E+02	4.4E+02	-2.5E+02	**2.2E+05**
Water use	m^3 water eq. of deprived water	1.4E+01	4.0E+00	1.2E+00	0.0E+00	1.5E+04	1.8E-01	3.1E+01	-6.9E+00	**1.5E+04**
Resource use, minerals and metals	kg Sb eq	2.2E-02	6.6E-06	8.4E-06	0.0E+00	3.5E-01	2.2E-04	2.8E-05	-1.4E-02	**3.6E-01**
Resource use, fossils	MJ	3.0E+03	1.5E+02	1.8E+02	0.0E+00	3.4E+06	3.1E+01	2.2E+03	-2.0E+03	**3.4E+06**
Additional technical information										
Primary energy consumption	MJ	3.0E+03	1.5E+02	1.8E+02	0.0E+00	3.4E+06	3.1E+01	2.2E+03	-2.0E+03	**3.4E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 5-128: EU total impact of new products sold in the year of study: D4.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Materials	unit									
Plastics	kt	1.20E-02	1.20E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**2.40E-02**
Metals	kt	3.43E+00	3.43E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**6.86E+00**
Electronics	kt	1.71E-03	1.30E-03	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**3.01E-03**
Others	kt	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**0.00E+00**
Total weight	kt	3.44E+00	3.44E+00	0.00E+00	0.00E+00	0.00E+00	3.44E-02	0.00E+00	0.00E+00	**6.92E+00**
Energy consumption										
Electricity	kWh	0.00E+00	4.37E+05	0.00E+00	0.00E+00	2.69E+09	0.00E+00	0.00E+00	0.00E+00	**2.69E+09**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.26E+10	0.00E+00	0.00E+00	0.00E+00	**8.26E+10**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	9.85E+06	1.47E+05	3.82E+05	0.00E+00	6.49E+09	1.00E+05	4.18E+06	-6.59E+06	**6.50E+09**
Ozone depletion	kg CFC-11 eq	3.23E-05	9.28E-05	4.39E-06	0.00E+00	7.45E-01	1.25E-06	9.84E-04	1.57E-06	**7.46E-01**
Human toxicity, cancer	CTUh	1.65E-02	-2.84E-04	1.02E-04	0.00E+00	7.01E-01	1.62E-04	5.42E-03	-1.12E-02	**7.11E-01**
Human toxicity, non-cancer	CTUh	3.67E-01	3.51E-03	2.47E-03	0.00E+00	8.29E+00	3.70E-03	2.10E-02	-2.44E-01	**8.45E+00**
Particulate matter	disease incidence	7.18E-01	4.45E-02	1.22E-02	0.00E+00	6.26E+01	7.62E-03	2.48E-01	-4.79E-01	**6.32E+01**
Ionising radiation, human health	kBq U235 eq	1.16E+05	1.05E+05	6.89E+03	0.00E+00	5.75E+08	2.21E+03	1.19E+06	-7.18E+04	**5.77E+08**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EOL		Total
								Impacts	Credits	
Photochemical ozone formation, human health	kg NMVOC eq	1.70E+04	6.70E+02	1.36E+03	0.00E+00	5.43E+06	1.76E+02	6.26E+03	-1.12E+04	**5.44E+06**
Acidification	mol H+ eq	2.64E+04	1.01E+03	1.50E+03	0.00E+00	6.56E+06	2.74E+02	9.76E+03	-1.73E+04	**6.58E+06**
Eutrophication, terrestrial	mol N eq	5.04E+04	3.21E+03	7.18E+03	0.00E+00	1.38E+07	5.36E+02	2.30E+04	-3.31E+04	**1.38E+07**
Eutrophication, freshwater	kg P eq	1.13E+01	6.63E-01	2.30E+00	0.00E+00	3.32E+04	1.20E-01	6.08E+00	-5.98E+00	**3.32E+04**
Eutrophication, marine	kg N eq	4.67E+03	2.96E+02	6.40E+02	0.00E+00	1.53E+06	4.96E+01	2.15E+03	-3.06E+03	**1.54E+06**
Ecotoxicity, freshwater	CTUe	1.88E+07	2.01E+06	3.53E+06	0.00E+00	7.63E+09	2.08E+05	1.39E+07	-1.15E+07	**7.66E+09**
Land use	pt	4.55E+08	3.44E+06	2.95E+06	0.00E+00	6.18E+09	4.59E+06	1.33E+07	-7.60E+06	**6.65E+09**
Water use	m^3 water eq. of deprived water	4.22E+05	1.21E+05	3.54E+04	0.00E+00	4.63E+08	5.42E+03	9.43E+05	-2.08E+05	**4.64E+08**
Resource use, minerals and metals	kg Sb eq	6.68E+02	1.97E-01	2.53E-01	0.00E+00	1.06E+04	6.69E+00	8.43E-01	-4.21E+02	**1.09E+04**
Resource use, fossils	MJ	8.94E+07	4.46E+06	5.49E+06	0.00E+00	1.02E+11	9.39E+05	6.75E+07	-5.91E+07	**1.02E+11**
Additional technical information										
Primary energy consumption	MJ	8.94E+07	4.58E+06	5.49E+06	0.00E+00	1.03E+11	9.40E+05	6.75E+07	-5.91E+07	**1.03E+11**

Table 5-129: EU total impact of Stock of products in the year of study: D4.

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packaging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Materials	unit									
Plastics	kt	2.67E-01	2.67E-01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**5.34E-01**
Metals	kt	7.63E+01	7.63E+01	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**1.53E+02**
Electronics	kt	3.81E-02	2.89E-02	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**6.70E-02**
Others	kt	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	n.a.	0.00E+00	0.00E+00	**0.00E+00**
Total weight	kt	7.66E+01	7.66E+01	0.00E+00	0.00E+00	0.00E+00	7.66E-01	0.00E+00	0.00E+00	**1.54E+02**
Energy consumption										
Electricity	kWh	0.00E+00	9.72E+06	0.00E+00	0.00E+00	6.00E+10	0.00E+00	0.00E+00	0.00E+00	**6.00E+10**
Thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E+12	0.00E+00	0.00E+00	0.00E+00	**1.84E+12**
PEF Impact categories	unit									

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packaging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Climate change, total	kg CO_2 eq	2.19E+08	3.28E+06	8.51E+06	0.00E+00	1.45E+11	2.23E+06	9.32E+07	-1.47E+08	**1.45E+11**
Ozone depletion	kg CFC-11 eq	7.19E-04	2.07E-03	9.77E-05	0.00E+00	1.66E+01	2.78E-05	2.19E-02	3.51E-05	**1.66E+01**
Human toxicity, cancer	CTUh	3.68E-01	-6.33E-03	2.26E-03	0.00E+00	1.56E+01	3.62E-03	1.21E-01	-2.51E-01	**1.58E+01**
Human toxicity, non-cancer	CTUh	8.17E+00	7.81E-02	5.49E-02	0.00E+00	1.85E+02	8.25E-02	4.67E-01	-5.44E+00	**1.88E+02**
Particulate matter	disease incidence	1.60E+01	9.90E-01	2.73E-01	0.00E+00	1.39E+03	1.70E-01	5.52E+00	-1.07E+01	**1.41E+03**
Ionising radiation, human health	kBq U235 eq	2.59E+06	2.34E+06	1.54E+05	0.00E+00	1.28E+10	4.93E+04	2.64E+07	-1.60E+06	**1.28E+10**
Photochemical ozone formation, human health	kg NMVOC eq	3.78E+05	1.49E+04	3.02E+04	0.00E+00	1.21E+08	3.93E+03	1.39E+05	-2.50E+05	**1.21E+08**
Acidification	mol H+ eq	5.87E+05	2.25E+04	3.33E+04	0.00E+00	1.46E+08	6.10E+03	2.17E+05	-3.86E+05	**1.47E+08**
Eutrophication, terrestrial	mol N eq	1.12E+06	7.14E+04	1.60E+05	0.00E+00	3.07E+08	1.19E+04	5.13E+05	-7.37E+05	**3.08E+08**
Eutrophication, freshwater	kg P eq	2.52E+02	1.48E+01	5.11E+01	0.00E+00	7.40E+05	2.66E+00	1.35E+02	-1.33E+02	**7.40E+05**
Eutrophication, marine	kg N eq	1.04E+05	6.59E+03	1.43E+04	0.00E+00	3.42E+07	1.10E+03	4.79E+04	-6.81E+04	**3.43E+07**
Ecotoxicity, freshwater	CTUe	4.19E+08	4.48E+07	7.87E+07	0.00E+00	1.70E+11	4.63E+06	3.10E+08	-2.57E+08	**1.71E+11**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packaging	Use	Maintenance & Repair	EOL Impacts	EOL Credits	Total
Land use	pt	1.01E+10	7.67E+07	6.57E+07	0.00E+00	1.38E+11	1.02E+08	2.95E+08	-1.69E+08	**1.48E+11**
Water use	m^3 water eq. of deprived water	9.39E+06	2.69E+06	7.89E+05	0.00E+00	1.03E+10	1.21E+05	2.10E+07	-4.63E+06	**1.03E+10**
Resource use, minerals and metals	kg Sb eq	1.49E+04	4.39E+00	5.64E+00	0.00E+00	2.36E+05	1.49E+02	1.88E+01	-9.37E+03	**2.42E+05**
Resource use, fossils	MJ	1.99E+09	9.94E+07	1.22E+08	0.00E+00	2.28E+12	2.09E+07	1.50E+09	-1.32E+09	**2.28E+12**
Additional technical information										
Primary energy consumption	MJ	1.99E+09	1.02E+08	1.22E+08	0.00E+00	2.29E+12	2.09E+07	1.50E+09	-1.32E+09	**2.29E+12**

Table 5-130: LCC per product and total EU expenditure: D4.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	50,000	EUR	60	mln. EUR/year
Installation/ acquisition costs (if any)	4,500	EUR	5	mln. EUR/year
Fuel (gas, oil, wood)	56,033	EUR/year	1,692	mln. EUR/year

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Electricity	18,593	EUR/year	561	mln. EUR/year
Water	0	EUR/year	0	mln. EUR/year
Auxiliary material 1: Detergent	0	EUR/year	0	mln. EUR/year
Auxiliary material 2	0	EUR/year	0	mln. EUR/year
Auxiliary material 3	0	EUR/year	0	mln. EUR/year
Auxiliary material 4	0	EUR/year	0	mln. EUR/year
Auxiliary material 5	0	EUR/year	0	mln. EUR/year
Repair & maintenance costs	9,000	EUR	11	mln. EUR/year
Total	**77,166**	**EUR/year**	**2,329**	**mln. EUR/year**

5.7. Annex VII: Results of sensitivity analysis WM5

Scenario #	Product aspect	Life cycle stage	Modelling change	Effect on LCA (per product)	Effect on LCA (per product per year of use)	Effect on LCC (product)	Effect on LCC (EU27 total)
S1	Energy reduction	Use phase	-10 % energy use (same division between electricity and heat as in original data)	Per impact category: - Use phase: reduction between 0.08 % (Ozone depletion) and 8 % (Resource use, fossils) - Total impact for all life cycles: reduction between 0.08 % (Ozone depletion) and 7.8 % (Resource use, fossils) - Reduction for climate change of 7.9 % / 7.6 % for Use phase and Total impact respectively.	Per impact category: - Use phase: reduction between 0.08 % (Ozone depletion) and 8 % (Resource use, fossils) - Total impact for all life cycles: reduction between 0.08 % (Ozone depletion) and 7.8 % (Resource use, fossils) - Reduction for climate change of 7.9 % / 7.6 % for Use phase and Total impact respectively.	2.0 % reduction of costs / year	2.1 % reduction of costs / year
S2	Water reduction	Use phase	-10 % water use	Per impact category: '- Use phase: reduction between 0.37 % (Resource use, fossils) and 7.94 % (Water use); increased impact for Land use (+0.21 %) - Total impact for all life cycles: reduction between 0.21 % (Resource use, minerals and metals) and 7.90 % (Water use); increased impact for Land use (+0.14 %) - Reduction for climate change of 0.48 % / 0.46 % Use phase and Total impact respectively.	Per impact category: '- Use phase: reduction between 0.37 % (Resource use, fossils) and 7.94 % (Water use); increased impact for Land use (+0.21 %) - Total impact for all life cycles: reduction between 0.21 % (Resource use, minerals and metals) and 7.90 % (Water use); increased impact for Land use (+0.14 %) - Reduction for climate change of 0.48 % / 0.46 % Use phase and Total impact respectively.	0.76 % reduction of costs / year	0.77 % reduction of costs / year

Scenario #	Product aspect	Life cycle stage	Modelling change	Effect on LCA (per product)	Effect on LCA (per product per year of use)	Effect on LCC (product)	Effect on LCC (EU27 total)
S3	Detergent reduction	Use phase	-10 % detergent use	Per impact category: '- Use phase: Reduction between 1.6 % (Resource use, fossils) and 9.34 % (Land use) in the across all impact categories. - Total impact for all life cycles: Reduction between 1.6 % (Resource use, fossil) and 9 % (Ozone depletion; -6.2 % for Land use) across all impact categories. - Reduction for climate change of 1.64 % / 1.59 % Use phase and Total impact respectively.	Per impact category: '- Use phase: Reduction between 1.6 % (Resource use, fossils) and 9.34 % (Land use) in the across all impact categories. - Total impact for all life cycles: Reduction between 1.6 % (Resource use, fossil) and 9 % (Ozone depletion; -6.2 % for Land use) across all impact categories. - Reduction for climate change of 1.64 % / 1.59 % Use phase and Total impact respectively.	Reduction of 3.93 % of costs / year	Reduction of 3.97 % of costs / year

Scenario #	Product aspect	Life cycle stage	Modelling change	Effect on LCA (per product)	Effect on LCA (per product per year of use)	Effect on LCC (product)	Effect on LCC (EU27 total)
S4	Resource use and resource efficiency + Recycled content	Manufacturing + EOL	R1 at: - Stainless steel: 10 % - Electronics: 10 % *Materials that contribute >10 % for at least 2 impact categories in Raw Materials life cycle*	Raw materials impact: '- Reduction of the impact of electronics of ~ 5 % across all impact categories - Reduction of the impact of stainless steel of 0.84-1.91 % across impact categories. *Increased of impact for Ionising radiation (7.89 %) and 28.1 % (Ozone depletion), see sensitivity analysis S11* Per impact category: - Reduction between 0.06 % (Land use) and 4.03 % (Acidification) in Raw Materials & Maintenance and Repair phases - Total impact for all life cycles: Reduction between 0.02 % (Land use) and 2.5 % (Human toicity, non-cancer) - Reduction for climate change of 3.57 % / 0.14 % for Raw Materials & Maintenance and Repair phases / Total impact respectively.	Per impact category: - Reduction between 0.06 % (Land use) and 4.03 % (Acidification) in Raw Materials & Maintenance and Repair phases - Total impact for all life cycles: Reduction between 0.02 % (Land use) and 2.5 % (Human toicity, non-cancer) - Reduction for climate change of 3.57 % / 0.14 % for Raw Materials & Maintenance and Repair phases / Total impact respectively.	No change in costs	No change in costs

Scenario #	Product aspect	Life cycle stage	Modelling change	Effect on LCA (per product)	Effect on LCA (per product per year of use)	Effect on LCC (product)	Effect on LCC (EU27 total)
S5	Resource use and resource efficiency (Lighter product)	Manufacturing + EOL	10 % less weight for all BOM inputs and Manufacturing (except for electricity in assembly)	Per impact category: - Reduction in all impact categories of 10 % for life cycles Raw Materials, End-of-life impacts, End-of-life credits, 9.26-10 % reduction for Maintenance and Repair; reduction between 3.81 % (Climate change) and 12.2 % (Human toxicity, cancer) for Manufacturing & Assembly '- Total reduction for all life cycles: maxium 4.87 % (Resource use, minerals and metals)	Per impact category: - Reduction in all impact categories of 10 % for life cycles Raw Materials, End-of-life impacts, End-of-life credits, 9.26-10 % reduction for Maintenance and Repair; reduction between 3.81 % (Climate change) and 12.2 % (Human toxicity, cancer) for Manufacturing & Assembly '- Total reduction for all life cycles: maxium 4.87 % (Resource use, minerals and metals)	No change in costs	No change in costs
S6	Repairability	Maintenance and Repair	% of spare parts at 20 %	Per impact category: - Increase of 1900 % for Maintenance & Repair, 18.1 % increase of End-of-life (impacts and credits); - Total impact for all life cycles between 0.003 % (Ozone depletion) and 9.16 % (Resource use, minerals and metals) across impact categories; increase of 0.6 % for climate change	Per impact category: - Increase of 1900 % for Maintenance & Repair, 18.1 % increase of End-of-life (impacts and credits); - Total impact for all life cycles between 0.003 % (Ozone depletion) and 9.16 % (Resource use, minerals and metals) across impact categories; increase of 0.6 % for climate change	No change in costs	No change in costs

Scenario #	Product aspect	Life cycle stage	Modelling change	Effect on LCA (per product)	Effect on LCA (per product per year of use)	Effect on LCC (product)	Effect on LCC (EU27 total)
S7	Recyclability	EOL	R2 at: - Stainless steel: 100 % - Electronics: 65 % *Materials that contribute >10 % for at least 2 impact categories to the Raw Materials life cycle; increase by 15 % points*	Per impact category: - Increase of 15-17 % of impact of End-of-Life (impacts and credits) and 26.3 % (Land use) for End-of-Life credits - Total impact for all life cycles: maximum reduction of 14.0 % (Human toxicity, cancer)	Per impact category: - Increase of 15-17 % of impact of End-of-Life (impacts and credits) and 26.3 % (Land use) for End-of-Life credits - Total impact for all life cycles: maximum reduction of 14.0 % (Human toxicity, cancer)	No change in costs	No change in costs
S8	Dataset stainless steel recycling	EOL	Different secondary stainless steel dataset (2 options, with a different environmental impact)	Per impact category: - Reduction in End-of-Life impacts between 71.1 % (Photochemical Ozone formation, Human health) and 97.7 % (Human toxicity, cancer) across all impact categories - Total impact for all life cycles: maximum reduction of 0.95 % (Ionising radiation, human health); 0.21 % reduction for Climate change	Per impact category: - Reduction in End-of-Life impacts between 71.1 % (Photochemical Ozone formation, Human health) and 97.7 % (Human toxicity, cancer) across all impact categories - Total impact for all life cycles: maximum reduction of 0.95 % (Ionising radiation, human health); 0.21 % reduction for Climate change	No change in costs	No change in costs

Scenario #	Product aspect	Life cycle stage	Modelling change	Effect on LCA (per product)	Effect on LCA (per product per year of use)	Effect on LCC (product)	Effect on LCC (EU27 total)
S9	Dataset heat boiler	Use phase	Heat input with a condensing boiler instead of non-condensing boiler	Per impact category: - Heat impact: reduction between 7.9 %-23.8 % for all impact categories - Use phase: reduction of maximum of 7.6 % (Photochemical ozone formation, human health) - Total impact for all life cycle stages: reduction of maximum 6.9 % (Photochemical ozone formation, human health) and 6.6 % reduction for Climate change	Per impact category: - Heat impact: reduction between 7.9 %-23.8 % for all impact categories - Use phase: reduction of maximum of 7.6 % (Photochemical ozone formation, human health) - Total impact for all life cycle stages: reduction of maximum 6.9 % (Photochemical ozone formation, human health) and 6.6 % reduction for Climate change	No change in costs	No change in costs

5.8. Annex VIII: Substances of Concern

5.8.1. Introduction of Task

5.8.1.1. Objectives of this Task

This part of the Commercial and industrial laundry appliances preparatory study focuses on identifying 'Substances of Concern' (SoC). These substances identified in accordance with Article 2(27) (a–d) of the ESPR, namely any substance that:

(a) Appears in the Regulation on the registration, evaluation, authorisation and restriction of chemicals (REACH) (EC No 1907/2006) Annex XIV (Substances of Very High Concern, SVHC) Candidate List.

(b) Falls under one or more hazard classes in Annex VI of the Classification, Labelling and Packaging of chemicals (CLP) Regulation (EC No 1272/2008):

(i) carcinogenicity categories 1 and 2;
(ii) germ cell mutagenicity categories 1 and 2;
(iii) reproductive toxicity categories 1 and 2;
(iv) endocrine disruption for human health categories 1 and 2;
(v) endocrine disruption for the environment categories 1 and 2;
(vi) persistent, mobile and toxic or very persistent, very mobile properties;
(vii) persistent, bioaccumulative and toxic or very persistent, very bioaccumulative properties;
(viii) respiratory sensitisation category 1;
(ix) skin sensitisation category 1;
(x) hazardous to the aquatic environment — categories chronic 1 to 4;
(xi) hazardous to the ozone layer;
(xii) specific target organ toxicity — repeated exposure categories 1 and 2;
(xiii) specific target organ toxicity — single exposure categories 1 and 2.

(c) Is regulated as a Persistent Organic Pollutant (EU 2019/1021).

(d) Negatively affects the reuse or recycling of materials in the product.

When such substances are present, information requirements are by default imposed (Art. 7(5) of ESPR legislation) and can require reporting of substance identity, location, concentration, safe-use instructions, and end-of-life guidance. For substances meeting criterion (d), performance requirements, such as maximum concentration limits or bans, may also be needed to safeguard circularity. Exemptions on information requirements could be justifiable in case there is solid evidence for issues around technical feasibility or relevance of tracking substances of concern, the existence of analytical methods to detect and quantify them, and/or the need to protect confidential business information. This report examines stakeholder perspectives and the information they have provided and assesses whether the available data are sufficient to define information or performance requirements beyond existing obligations.

5.8.1.2. End-of-life context of Commercial and industrial laundry appliances

To contextualize this Task, the end-of-life treatment of Commercial and industrial laundry appliances is described. At the end of their useful life, heavy-duty commercial and industrial dryers are typically returned to the manufacturer, where reusable components are salvaged and the remaining structure (over 60% stainless steel) is disassembled and sold to metal recyclers. Because approximately 95% of materials in commercial and industrial laundry appliances can be recycled, with plastics constituting less than 10% of the total weight (all large plastic parts are ISO 1043-marked), these machines rarely end up in landfills. Light duty commercial dryers may be dismantled by certified scrap dealers. In the EU, non-recyclable plastics are sent for controlled incineration, though exports of used equipment to regions without strict recycling controls may result in uncertain disposal practices. Ultimately, most commercial washers and dryers are either refurbished or recycled for scrap, driven by the high value of recovered stainless steel.

5.8.1.3. Reading guide

The report is structured in four parts to guide the reader through identifying and assessing the SoC in the Commercial and industrial laundry appliances product group. The first section covers the stakeholder consultation, which outlines how input from manufacturers, recyclers, and national representatives shaped the SoC inventory. Afterward, the existing regulatory requirements are discussed. This section reviews REACH, CLP, Persistent Organic Pollutants (POP) Regulation, Waste Framework Directive (WFD), Waste Electrical and Electronic Equipment (WEEE) Directive, and Restriction of Hazardous Substances (RoHS) obligations so that ESPR proposals align with, rather than duplicate, current reporting duties. Next, SoC in the product group presents the identified substances and highlights any recycling challenges. Finally, the section on information and performance requirements translates these findings into recommendations for the product group.

5.8.2. Stakeholder consultation

As a jumping-off point for the SoC work, a stakeholder consultation was conducted to gather information. It aimed to support the creation of a SoC inventory and to identify specific requirements and potential exemptions for certain substances. The consultation was conducted from end-April to end-May 2025. A questionnaire originally developed by the JRC was modified to help identify both Intentionally Added Substances (IAS) and Non-Intentionally Added Substances (NIAS) and ask for other inputs. The consultation was made available to stakeholders registered on the platform used for previous consultations: https://ecodesign-washing-machines.eu/ewm/. The stakeholders engaged in this consultation include manufacturers, industry organisations for both manufacturing and recycling, as well as national representatives.

5.8.2.1. Stakeholder perspectives and feedback

The consultation provided stakeholders perspectives, specifically from industry representatives and manufacturers. No specific substance-based information was obtained. A summary of these perspectives is provided here.

As a general note, a risk-based, targeted framework for substances or materials in waste electrical and electronic equipment (WEEE) would be recommendable for identification of substances that potentially hinder recycling. This should first be identified across product groups, which can be organised by collection categories and waste streams. Waste-treatment operators must be involved so that information requirements are practical and useful.

Reporting or restrictions would apply only to substances present in a given product group, using a 0.1 % w/w threshold familiar from REACH Art 33(1). New obligations under a delegated act of the ESPR should be introduced only when a concrete circular-economy problem exists and is not already addressed by existing legislation.

Considering the SoC under the art 2(27)(a-d) the following perspectives are shared. The REACH Candidate List should remain the single, central reference for mandatory information on substances of concern, with updates limited to once per year to avoid continual re-evaluation of complex supply chains. Substances covered only by harmonised classification should be exempt from ESPR reporting unless evidence shows they undermine the goals of Art. 5 (1) of ESPR on the listed product aspects addressed by Ecodesign requirements. Likewise, substances already restricted under the POP regulation, and those lacking defined criteria with regards to substances falling under art 2(27)d should generally be excluded until specific recycling or reuse issues are proven.

The current data collection approach, followed in the consultation, demands extensive data collection across the entire supply chain (potentially involving changes to contractual agreement) to identify substances of concern, a process that would realistically take years and imposes an excessive burden on industry, especially SMEs. This is further complicated by the need to analyse recycled materials for hundreds of legacy substances from before RoHS and REACH existed and the absence of Safety Data Sheets for articles. Moreover, there is no comprehensive substance list for Art 2(27)(d) substances making effective screening impossible without clear criteria.

Concerning Intentionally Added Substances (IAS), companies of complex focus on IAS, because reliable supply-chain information exists only for those, whereas Non-Intentionally Added Substances (NIAS) require full analytical testing and cannot be declared unless listed in specific substance inventories. As a result, ecodesign requirements should target IAS on a risk-based basis, and existing chemical regulations (REACH, RoHS, POPs) suffice to manage NIAS without additional ESPR mandates.

Stakeholders note that overlapping EU frameworks (REACH, RoHS, WEEE, WFD/SCIP, ESPR, PPWR, Battery Regulation, Green Claims, EU Taxonomy, and CSRD) create inconsistent requirements, legal uncertainty, and redundant work without adding value. Under RoHS (Directive 2011/65/EU), Art. 6 mandates reviewing substance bans based on their impact on waste-EEE reuse and recycling, and potential releases during treatment. And, the WEEE (Directive 2012/19/EU) already requires manufacturers, via Art. 15, to supply recyclers

with substance information through the I4R platform, with ongoing consultations questioning if changes are needed. Meanwhile, the Waste Framework Directive (2008/98/EC) and SCIP database require SCIP notifications under Article 9(1)(i), but known SCIP shortcomings must be addressed to prevent duplicating RoHS, WEEE, and WFD requirements.

Finally, it is noted that without a third-party testing for all SoCs it would not be possible to ensure that compliance, which means a high-risk of non-compliance with developed Ecodesign requirements related to SoCs.

From the recyclers point of view additional perspectives were obtained on the following three points:

- Regulatory frameworks typically identify Substances of Concern for products being newly introduced to the market, giving manufacturers time to adapt their designs. However, recyclers encounter these products only at the end of their lifecycle (often more than a decade later). By that time, regulatory requirements may have evolved significantly, creating a disconnect between the substance restrictions applied during product design and those applicable during recycling. This regulatory lag and its changes over time complicates compliance and processing.
- The DPP, while potentially useful for tracking substances during a product's active life, has limited practical value at end-of-life. This is mainly due to the high-speed, high-volume processing typical in WEEE recycling, the poor physical condition of discarded products that often renders identifiers like QR codes or tags unreadable, and regulatory discrepancies between the time of manufacture and the time of waste processing, where different substance thresholds may apply.
- Analytical testing for presence of SoC in WEEE (or its waste fraction) is only effective if supported by a harmonised, mandatory methodology across all Member States that is also practical for ongoing use in industrial settings. Without such standardisation, recyclers face the risk of inconsistent outcomes, with varying methods leading to different results and potential competitive imbalances occurring between operators. Additionally, lengthy testing processes that delay results for days or weeks are not feasible in fast-paced recycling operations, where materials must be processed and forwarded quickly to meet operational demands.

Further perspectives from manufacturers and industry representatives on the draft proposals outlined in this annex were obtained. The views and perspectives listed below have not resulted in changes to these proposals, but are included for future reference:

- Consider redefining SoC as meaning Art. 2(27) (a)(b), (c) **and** (d) instead of the current meaning of Art. 2(27) (a)(b), (c) **or** (d). Others suggested to consider the Art. 2(27) (a)(b), (c) and (d) approach, while also switching the meaning of Art. 2(27)d from negatively affecting to impeding recycling and reuse. The proposals on redefining the SoC definition could also be supported by a case-by-case assessment for managing the SoC in the product group.
- Stakeholders note that a workable definition for hindering recycling is missing for ESPR. The recyclability and reusability of products depend not only on material properties but also on collection, sorting, processing, and the specific recycling method used. Since different recycling techniques (mechanical, thermomechanical, chemical) have varying

tolerances to substances, one substance may be problematic in one process but acceptable in another. Furthermore, to support technological progress, legislation must remain adaptable and open to innovation, allowing product design and new recycling and reuse capabilities to evolve together. The presence of SoC should not automatically rule out alternative resource-saving strategies such as Rethink, Repair, or Refurbish, as long as they provide clear benefits in minimising resource use and do not pose unacceptable risks.

- Furthermore, a regularly updated substance specific threshold for Art. 2(27) (d) substances (negatively affecting recycling and reuse) is preferred, as recycling technologies advance and waste handling requirements shift.
- Information requirements (including for the DDP) should rely on existing frameworks like REACH and Safety Data Sheets, focusing only on relevant substances above set thresholds to ensure practicality and usefulness without adding redundant reporting burdens.
- The manufacturer or importer should be able to choose how to obtain information for DPPs related to SoC when information requirements apply (for example, through supplier questionnaires, Safety Data Sheet reviews, material risk assessments, or analytical testing). However, analytical testing, certificates, or audits should not be mandatory, as requiring them would conflict with the principle of presumption of compliance, which assumes that products placed on the EU market comply with relevant regulations.
- A 5-year roll-out period for adherence to information is needed, as shorter timelines are impractical. This is because contracts with non-EU suppliers must be renegotiated to obtain the necessary SoC information for inclusion in the DPP, and new suppliers may need to be identified. However, market surveillance authorities should have the option to extend the roll-out period if the manufacturer or importer provides a justified reason.

5.8.3. Existing regulatory requirements on provision of SoC information

In the consultation, stakeholders noted that several existing laws already require information sharing on SoC for waste treatment. This section therefore examines legislative requirements beyond the ESPR, highlighting obligations that apply to this product group and identifying any existing thresholds for communicating SoC information (if present).

5.8.3.1. Relevant regulations

REACH regulation

Under Art. 33(1) of the REACH regulation (EC No 1907/2006), any supplier of an article containing a Candidate List SVHC at a concentration above 0.1 % w/w must provide, at or before the time of supply, sufficient information (at minimum the substance's name) to allow safe use of the article by their professional recipients. Furthermore, upon request by a consumer, the supplier must supply the same information free of charge within 45 days of that request. This information requirement applies to SoC that fall under ESPR Art. 2(27)(a).

Continuing from the requirements discussed above, in accordance with Art. 31, any supplier of a substance or mixture is required to provide a Safety Data Sheet (SDS) free of charge if the substance or mixture is classified as hazardous, identified as a PBT substance, identified as a very Persistent and very Bioaccumulative (vPvB) substance, included on the Candidate List of SVHCs, or subject to EU workplace exposure limits. If a non-classified mixture contains hazardous substances above certain thresholds—1 % w/w for non-gaseous substances or 0.2 % v/v for gases (general hazards), and 0.1 % w/w for PBT/vPvB or Candidate List substances, the supplier must supply an SDS upon the recipient's request.

CLP regulation

Under the CLP regulation (EC No 1272/2008), any substance or mixture classified as hazardous must bear, before being placed on the EU market, a label showing at minimum the product identifier; supplier name, address and phone number; hazard pictograms; a signal word; hazard statements; precautionary statements; and (where applicable) supplemental information (Art. 17–25). Labels must be applied and positioned in accordance with the general rules in Art. 31 and 32, and specific rules for outer, inner and single packaging in Art. 33. Moreover, suppliers are required to assemble and keep available all the information used for classification and labelling for at least ten years after the substance or mixture was last supplied, and to provide it on request (Art. 49).

POPs regulations

For Persistent Organic Pollutants (POPs) placed on the EU market as articles, POPs regulation (EU 2019/1021) sets specific concentration limits in Annex I (as amended by Delegated regulation (EU 2020/784). Concentration thresholds are substances specific and articles containing POPs at or above that concentration may not be marketed and must be reported or managed in accordance with the regulation unless they are derogated. A cumulative limit on the concentration (amount of mg/kg) in mixtures or articles is set or a specific limit if it on their presence in substances. This type of restrictions is associated with SoC's that fall under ESPR Art. 2(27)(c). POP Regulation does not place obligations on suppliers of articles on sharing information to downstream parties.

Waste Framework Directive

The SCIP (Substances of Concern In articles as such or in complex objects (Products)) database, established by ECHA under Art. 9(2) of the Waste Framework Directive (2008/98/EC), serves to collect and disseminate detailed information on Candidate List SVHCs present in articles and complex products throughout their entire lifecycle to drive substitution of hazardous substances, prevent the generation of contaminated waste, enhance transparency for waste operators.

Establishing the SCIP database allows for transferring Art. 33(1) REACH information, that would otherwise not reach waste treatment operators. It is however noted in an evaluation of SCIP for ECHA (PWC, 2022) that: "While the reliability and quality of the information is not in question, its accessibility and practical use cases for waste operators and consumers remain limited for the moment, according to the consulted stakeholder organisations. Equally, some

Companies are uncertain about the usefulness of the information they provide to SCIP for other stakeholders".

WEEE directive

When placing new Commercial and industrial laundry appliances on the market, producers provide waste treatment operators with detailed information on preparation for reuse and treatment in accordance with Article 15(1) of the WEEE Directive (2012/19/EU). This information shall identify each component and material and indicate the location of any hazardous substances, to the extent necessary for reuse, treatment, and recycling. Thereby enabling proper preparation for reuse and environmentally sound treatment of WEEE. To support this process, the I4R platform has been established. No specific threshold for sharing information is mentioned in the directive.

RoHs directive

The RoHS Directive (2011/65/EU) aims to restrict the use of hazardous substances in electrical and electronic equipment (EEE) in order to protect human health and the environment, including ensuring the environmentally sound recovery and disposal of waste EEE. In support of these objectives Art. 6 requires the Commission to review and, if necessary, amend the list of restricted substances. This review process must align with other chemicals legislation, particularly REACH (and its Annexes XIV and XVII). When evaluating substances (including those with very small or nanoscale structures), the Commission must consider whether they could negatively affect EEE waste management (such as by impeding reuse or recycling) or give rise to uncontrolled releases or hazardous by-products during waste treatment. Furthermore, the assessment must take into account potential risks to workers handling EEE waste and identify whether alternative substances or technologies with fewer adverse effects are feasible.

5.8.3.2. Summary existing regulation

The following existing information requirements are present in legislation:

- REACH requires suppliers to disclose any Candidate List SVHCs (Annex XIV) above 0.1 % w/w and provide Safety Data Sheets for hazardous or PBT/vPvB substances;
- CLP requires clear hazard labelling and record-keeping for classification data;
- POPs above specific limits are banned, though POP rules do not mandate downstream information sharing;
- the Waste Framework Directive's SCIP database collects SVHC data to aid waste operators;
- WEEE compels producers to supply end-of-life guidance on components and hazardous-substance locations to recyclers (supported by the I4R platform); and
- RoHS restricts certain hazardous substances included in Annex II outright, with periodic reviews aligned with REACH to safeguard recyclability and worker safety.

5.8.4. Substances of Concern in the product group

Without stakeholder input it is not possible to establish a clear picture of the substances present in the product group.

The consultation for the commercial and industrial product group indicated the presence of a range of SVHCs (Art. 2(27(a)). Many of these substances also met the CLP hazard classifications included in Art. 2(27)(b), while 27(c) POPs were not identified. Specifically, there were brominated flame retardants and lead present in the commercial and industrial in various (electronic) components. It can be reasonably expected these types of substances can occur in the Commercial and industrial laundry appliances product group too, as there is some overlap in regard to materials used. However, none of these substances is expected to hinder recycling and re-use, as these substances are well known to the waste treatment operators. In the case of the brominated flame retardants, Art. 8 and the Annex of the WEEE directive already restrict their use. Lead could create issues when part of the brass or copper alloys but is generally diluted in the recycling to minimise the impact of these impurities. The exemptions in RoHS Annex III on the application of lead, allowing for higher thresholds, are also no longer present since 21 July 2024. These observations suggest Art. 2(27)(a-b) substances can be present, but it does not suggest strong evidence on substances that should separately be considered from the perspective of negatively impacting reuse or recycling in that product group. It is reasonable to expect a similar picture to emerge for this product group if more data should be available.

5.8.5. Considerations on information and performance requirements

5.8.5.1. Information requirements

Article 7 of the ESPR mandates that any product containing a Substance of Concern must be accompanied by standardised information covering: the exact name or numerical identifier of each substance; its precise location within the product; the concentration (or concentration range/maximum value) at the product, component, or spare-part level; clear instructions for safe use; and guidance on environmentally sound end-of-life treatment. Drawing on stakeholder consultations, literature, and draft JRC guidance, this section explores the specific concentration thresholds, exemptions, and implementation timeline to be applied to information requirements for Commercial and industrial laundry appliances.

5.8.5.2. Threshold for information requirements

The tracking thresholds proposed in the section are based on draft JRC guidance and trigger the information requirement obligation. If a SoC falls into multiple categories (for example, Article 2(27)(a) and 2(27)(b)), the most conservative (i.e. lowest) threshold should be applied. All included thresholds for tracking in this section apply to the IAS in the final product (including components and spare parts.

Art. 2(27)(a) substances

No specific SVHC are identified in the consultation for this product group. However, if they are present, it is likely that they fall under Annex XIV candidate list SVHCs based on the SoC identified in the commercial and industrial laundry product group. Therefore the 0.1 % w/w threshold and REACH Art. 33(1) disclosure requirements should guide threshold-setting.

Since their component producers should be able to access Safety Data Sheets that flag any substances or mixtures above the 0.1 % w/w threshold, this information could be made available at the component level to the manufacturers. Similarly, stakeholders expressed a desire to minimize duplication and ensure alignment with existing legislation.

Art. 2(27)(b) substances

For Substances of Concern (SoCs) falling under Article 2(27)(b) in products classified as articles, a generic concentration threshold equal to the cut-off values in Table 1.5.1 of Section 1.5.3 ("General guidance for compiling safety data sheets") of the Globally Harmonised System (GHS) is recommended. These cut-offs define the minimum concentration at which a hazardous constituent must be disclosed in any GHS-compliant Safety Data Sheet worldwide. Where a relevant hazard class or category is absent from Table 1.5.1 but appears in Annex I of the CLP Regulation with a generic concentration limit (GCL) for mixtures, the lowest GCL that would classify the mixture into the most severe category of that hazard class should be adopted as a conservative proxy. Additionally, for the following hazard classes (introduced in 2022) the GCLs from the Delegated regulation (EU) 2023/707 are suggested:

- (iv) endocrine disruption for human health categories 1 and 2 (Table 3.11.2),
- (v) endocrine disruption for the environment categories 1 and 2 (Table 4.2.2),
- (vi) persistent, mobile and toxic or very persistent, very mobile properties (PMT or vPvM, Art. 4 (4)(3)),
- (vii) persistent, bioaccumulative and toxic or very persistent, very bioaccumulative properties (PBT or vPvB, Art. 4 (3)(3)).

Art. 2(27)(c) substances

For persistent organic pollutants (POPs) covered by Article 2(27)(c), a 0.1 % w/w threshold is likewise proposed based on the guidance, treating them as SVHCs on the REACH Candidate List. This harmonised threshold streamlines compliance, ensures consistent notification criteria across both SVHCs and restricted POPs.

Art. 2(27)(d) substances

A generic threshold of 0.1 % w/w is likewise proposed for SoC that fall under Article 2(27)(d), namely those substances whose presence can negatively affect reuse and recycling. In the absence of data identifying which substances most adversely affect circularity within this product group, it is not feasible to establish specific limits related to substance groups of even specific substances. Without any information requirement, future data collection on these SoCs would remain severely constrained. Adopting the 0.1 % w/w threshold used for SVHCs

and POPs provides a clear, uniform obligation, which covers the complete BOM, including all components and spare parts.

5.8.5.3. Information requirement exemptions and timelines

Currently it is not possible to determine substance specific exemptions based on the stakeholder feedback obtained through the consultation. However, stakeholders expressed concerns about the difficulty of gathering information for both IAS and NIAS across the full life cycle. They cited the duration and scope of data collection, the need to adjust contractual relations, and the challenge of identifying NIAS at different stages of the life cycle. From this perspective, one could argue that information requirements should be limited to SoC that are present in the final product (including components and spare parts) and its full BOM, while all other SoC would be exempt.

Regarding the SoC that must still be tracked under the information requirement, several approaches are possible, each with its own level of ambition and associated administrative burden. For example, from highest to lowest burden:

- Highly ambitious scenario: All SoC listed in Art. 2(27)(a–d) present in the product would fall under the information requirement with the proposed thresholds (see previous chapter), with no further exemptions.
- Intermediate scenario: All Art. 2(27)(a–d) SoC would still be tracked, but companies could justify substance-specific exemptions. Supporting evidence demonstrating, issues with technical infeasibility, lack of analytical methods to detect or quantify, irrelevance in the specific product, or the need to protect confidential business information) would be made available for audit. Where needed this should be supported with scientific evidence to substantiate the claims.
- Limited scenario: All Art. 2(27)(a–c) SoC would be tracked, but companies could justify broader exemptions for groups of substances, hazard classes or categories, etc, within the flexibilities offered by the legal text. Supporting evidence demonstrating, issues with technical infeasibility, lack of analytical methods to detect or quantify, irrelevance in the specific product, or the need to protect confidential business information) would be made available for audit. Where needed this should be supported with scientific evidence to substantiate the claims.
- For Art. 2(27)(d) SoC, a targeted follow-up study with recyclers would need to identify which substances pose recycling challenges for this product group. Any problematic SoC could then be added to the delegated act as an amended to remove their exemption. A variant of this approach could also target specific groups of substances or exempt certain hazard classes based on product characteristics, current recycling practices and the operational conditions.

Given the complexity of the products (each containing numerous subcomponents and sub-subcomponent) a five-year implementation period after adoption of the delegated act would be warranted for each of the scenarios. This timeline would allow for:

- Year 1: Preliminary identification of substances present.

- Years 2–3: Collection of necessary information and initiation of contractual negotiations.
- Years 4–5: Receipt of supplier data, management of any supplier non-compliance, organisation of information in accordance with Article 7(a) of the ESPR and sharing via a Digital Product Passport and/or existing information channels (for instance technical product information).

That said, before choosing an exemption approach for the information requirements under Art. 7 of the ESPR, the impacts of each scenario and the proposed timeline must be assessed further in the impact assessment.

5.8.5.4. Performance requirements

The consultation has not identified any substances that stand out as particularly problematic with respect to the existing information. Recycling of this product group is governed by the WEEE and RoHS Directives, and an established recycling procedure is already in place. Neither manufacturers nor recyclers have indicated any specific substances to consider either. Therefore, at this stage, there is no basis for imposing specific performance requirements in line with Art. 6 of ESPR.

5.8.6. Conclusions

This SoC identification task, guided by the criteria outlined in ESPR Art. 2(27), focused on stakeholder consultation, reviewing end-of-life processes and relevant EU regulations, including REACH, CLP, POP, WFD/SCIP, WEEE, and RoHS. The goal was to assess which substances in Commercial and industrial laundry appliances might require additional scrutiny. Stakeholder consultations provided insights into the challenges of data collection, the overlap with existing regulations, and the information available to waste treatment operators through the SCIP and I4R platforms. Additionally, recyclers expressed concerns on the lag-time between design and recycling, the challenges of using a DPP in their operational conditions, and the need for harmonised methodologies for testing for the presence of SoC.

Nevertheless, the ESPR nonetheless requires manufacturers of Commercial and industrial laundry appliances to adhere to information requirements for all SoCs present in their products, resulting in tracking obligations concerning their identity, location, concentration, safe-use instructions, and end-of-life treatment. To meet these obligations with minimal duplication and maximum alignment, the following thresholds (based on draft JRC guidance) are recommended:

- A 0.1 % w/w threshold for SVHCs (Art. 2(27)(a)) and POPs (Art. 2(27)(c)) in line with REACH Art. 33(1),
- UN Globally Harmonised System (GHS) generic concentration limits (or, where absent, the lowest CLP GCLs) for hazard-classed substances under Art. 2(27)(b), supplemented by the latest endocrine-disruptor and PMT/PBT criteria, and
- A uniform 0.1 % w/w cutoff for SoCs affecting circularity (Art. 2(27)(d)), pending more granular data.

Because full-life-cycle IAS and NIAS data collection is time- and resource-intensive, the scope is limited to product-specific IAS present in the final product, including its components and spare parts. Three implementation scenarios are proposed:

- Ambitious: covering all SoCs without exemptions,
- Intermediate: case-by-case exemptions for substances based on solid justification, and
- Limited: tracking only Art. 2(27)(a–c) substances with broader approach towards exemptions within the flexibilities offered by the legal text, coupled with a targeted study to identify additional Art. 2(27)(d) candidates for selected regulation trough amending the delegative act.

A five-year roll-out is recommended across all scenarios to allow for supplier engagement, data gathering, and Digital Product Passport integration. An assessment of feasibility and administrative burden should be undertaken as part of the impact assessment.

Finally, performance requirements under Art. 6 of the ESPR need not be imposed at this stage: current WEEE/RoHS recycling frameworks are working satisfactorily, and stakeholder feedback has not identified any specific performance gaps. As new research or recyclability insights emerge, revisiting performance criteria should be considered.

5.9. Annex IX: Stakeholder meeting 2: meeting minutes

Meeting Minutes

Second stakeholder meeting of the Preparatory Study on Professional laundry appliances

Project	Preparatory study and impact assessment support study on professional laundry appliances
Event	Second stakeholder meeting of the Preparatory Study on Professional laundry appliances
Date & time	10th of April 2024, 10:00 – 16:00
Location	Hybrid: "BRE2", Av. d'Auderghem 19, 1040 Brussels & Online
Participants	**Partner/Institution**

Consortium Partners

VITO

Oeko-Institut Consult GmbH

Trinomics BV

Ecomatters

Fraunhofer ISI

European Commission - DG Env

Stakeholders

APPLiA

Electrolux Professional AB

ETCT European Textile Care Technology

ETSA European Textile Care Association

European Electronics Recyclers Association

FEICA

Girbau S.A.

Herbert Kannegiesser GmbH

JENSEN GmbH

Miele & Cie / Laboratoriy & Testing

Miele & Cie. KG

Netherlands Enterprise Agency

Ali Group srl - Grandimpianti ILE (online)

Alliance Laundry CZ (online)

APPLiA Italia - Efcem Italia (online)

BAM (online)

German Federal Ministry for Environment and Transport – BMUV (online)

German Federal Ministry for Economic Affairs and Climate Action – BMWK (online)

European Association of Chemicals Industry – Cefic (online)

Compliance & Risks (online)

Danish Energy Agency (online)

German Association of Textile Cleaning – Deutscher

Textilreinigungsverband e.V. (online)

Electrolux Professional (online)

Belgian Federal Public Service Economy (online)

French Ministry of Energy (online)

IMESA S.p.A. (online)

JENSEN-GROUP (online)

Onnera Laundry Barcelona, S.A. (online)

Opeque Ltd (online)

Swedish Energy Agency (online)

Swiss Federal Office of Energy – BFE (online)

Tony Preto (online)

Topten (online)

Wewash GmbH (online)

wfk - Cleaning Technology Institute (online)

Agenda:

Time	Topic	Presenter	Institution
09:45	Registration & coffee		
10:00	**1. Introduction to the meeting. Brief Tour de table**	Andreas Köhler	Oeko-Institut
10:15	**2. Task 1 - Scope: Presentation of the revised categories of Laundry Appliances**	Yifaat Baron	Oeko-Institut
10:45	Coffee break		
11:00	**3. Task 5 - Life-cycle assessment:** Presentation of the results	Mieke de Jager	Ecomatters
11:30	**Task 5 - Life-cycle assessment:** Discussion		
12:30	Lunch		

Time	Topic	Presenter	Institution
14:00	**4. Task 6 - Design options:** Presentation of first ideas + discussion	Andreas Köhler	Oeko-Institut
15:00	Coffee break		
15:15	**5. Task 7 – Policy options:** Presentation of principles	Antoine Durand	Fraunhofer ISI
15:30	**6. Conclusions of the main meeting - Final observations by participants**		
15:45	End of meeting		

1. Introduction to the meeting. Brief Tour de table

Please find the content of the presentations made during the workshop attached as an annex to this minutes.

2. Task 1 - Scope: Presentation of the revised categories of Laundry Appliances – Yifaat Baron (Oeko-Institut)

Oeko-Institut presented the revised categorisation and a few related aspects. The following points were raised in the discussion that followed:

- A few of the participants raised the point that a future regulation must include definitions for the terms "semi-professional", "industrial", "professional", "commercial" in the context of laundry appliances, as these are undefined.
- Oeko-Institut stated that clarifying the scope of each of these terms has been in the focus of the study from the beginning. Professional is to be understood as an "umbrella term" reflecting all appliances which are not household ones (i.e., not domestic). However, it has not been possible to define the other terms in a clear manner, without overlaps between each other. Each of the technical categorisations that were proposed were proven to be non-exclusive for one of the terms. Stakeholders were encouraged to contribute definitions and characteristics that would help developing clear definitions. The appropriation of commercial and industrial appliances is different, however other clear differences have not become apparent. Though industrial appliances are said to operate in a process, where different units are connected and where the textiles are transferred from one unit to the next automatically, this is not always the case and would also not allow a clear differentiation.
- One of the stakeholders representing manufacturers said that they could send definitions and explained that:
    - Commercial is where machines are being used for financial gain.
    - Industrial is where machines are used in a factory environment. Differences in size and cost were also mentioned.
    - Professional is generally used to define a person's responsibility within a particular work – the term is thus not recognized in this context.
- A representative of a national authority explained that market surveillance needs very clear technical characteristics for differentiation. Reference to the Low-Voltage Directive and Machinery Regulation are useful. However, definitions of the products that are in scope should be based on technical characteristics that can be assessed from the machine itself, not on the targeted market, because the targeted market cannot be controlled by Market

Surveillance authorities. Lifetime or number of cycles are not practical. Professional could be replaced by commercial, but technical aspects are also needed.

- Oeko questioned how changing from professional to commercial would affect industrial appliances not under the tunnel machine categorisations.
- It was suggested by a stakeholder representing the users of non-household machines to align terminology in legislation with standards and a slide with analysis of some categories ("who treats the laundry" and "why the laundry is treated") was shown, among others commenting that the annual load of the different categories is significantly different, i.e., between household, commercial and industrial.
- Stakeholders representing manufacturers of industrial machines contended that the border between commercial and industrial is clearly defined based on the 40 kg load threshold which is also given in the standards of industrial machines.
- Stakeholders representing manufacturers of commercial machines however don't agree with this threshold, explaining that they sell machines that are over 40 kg, sometimes also to industry.
- A reference was made to the higher durability and repairability of commercial and industrial machines as opposed to domestic machines, with industrial machines explained to be even more robust with the components being easier to replace.
- Oeko-Institut raised the question to what degree it was important to make the differentiation in terms of differences in performance in the context of the Ecodesign for Sustainable Products Regulation (ESPR) requirements. Perhaps if it was clearer why it is important to differentiate between commercial and industrial it would help define the terms.
- Stakeholders representing manufacturers of industrial machines out forward the difference that for industrial machines, savings are always over the whole process and not necessarily on the single machine level. The process should be considered rather than the machine level. Consumers were explained to choose machines mainly based on cost and productivity. One of the manufacturers showed average productivity numbers for the different categories to clarify the huge difference in productivity between commercial and industrial.
- Stakeholders representing manufacturers of commercial machines explained that their customers also look at efficiency similarly as is done for industrial machines. The standards were proposed as a solution for the discussion.
- Whereas it is clear how to differentiate between domestic and non-domestic (or household and non-household), supporting information is still needed to consider how to differentiate between commercial and industrial, for the sake of setting clear rules for market surveillance authorities.
- A stakeholder representing manufacturers of industrial machines concluded that it is acceptable to distinguish between "household" vs. "non-household", and then within "non-household" between "commercial" and "industrial".
- The means to distinguish, within the "non-household" category, between "commercial" and "industrial" machines was on the other hand not agreed during the meeting.

Task 5 - Life-cycle assessment: Presentation of the results + discussion – Mieke de Jager (Ecomatters)

Ecomatters presented results from the Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) analysis.

- Clarification was asked as to what was meant with the reference to raw materials? Virgin/primary/secondary? Ecomatters explained the Ecoreport tool (ERT) to have default settings of input as raw materials (regarding their recycled content) as described by the

Circular Footprint Formula used in PEF. The data suggest that this is based on performance of virgin raw materials.

- A stakeholder commented that in reference to the materials composing a washing machine glass, plastics and rubber seals have not been included. Ecomatters clarified that these materials are less frequent in models but have been included in the bill of materials. More input was asked for from stakeholders as to the use of recycled materials in current Bill of Materials (BoM) of appliances.
- As under Task 1, here too, a stakeholder representing manufacturers of industrial machines raised that [industrial washing machines] are part of a process and that the assessment would be different if things were analysed at the process level. This was supported by another stakeholder that suggested that considering e.g., heat recovery, water recovery tanks, green energy sources, etc. would improve the results for machines operating as part of a process.
- It was questioned whether ESPR would focus on the design phase or the use phase and suggested to also factor in high costs for the customers into consideration when going to the testing phase. Organisations representing commercial users of industrial appliances agreed that costs play a very significant role – both investment and operation costs. A different stakeholder representing manufacturers also referred to the costs of testing that will be associated with introduction of a new regulation [to show compliance]. In this respect, the Oeko Institute stated that ESPR emphasizes the Least Lifecycle Cost Approach.
- A representative of a public authority explained that all [ESPR] requirements need to be tested. Even if this will create costs, the impact assessment is there to show if the costs would be set off by related benefits. A stakeholder representing manufacturers responded that there are thousands of variants of machines, so that all variants cannot be tested.
- A stakeholder representing manufacturers mentioned that industry is already doing everything to reach the net zero strategy and is succeeding in reducing the water, energy consumption per kg of laundry, but did not detail what technical improvements this refers to, nor provided data on test results, performed along recognised standards, to support this statement.
- A stakeholder representing manufacturers mentioned the differences between the test case performed as per the standard and the real-life use case, which depends on the specifics of the laundry being treated (e.g. hospital linen, factory working gear soiled with grease) so that the machine is specifically programmed in a way that is different from the test case.
- A public authority stated that all regulations allow manufacturers to declare performance based on calculations and reference to existing machines, so that there should be no need to exhaustively test all variants. There can be no regulation without testing. There will be testing costs. It added that it is not convinced by the arguments whereby the industry is at the top of the technology and hence should not be subject to regulation. If the testing reduces the energy costs, then there is budget for testing.
- Another stakeholder representing manufacturers referred to the difference between household and non-household regarding repairs, explaining that a household machine needs to prove that it will be repairable for ESPR, but for commercial and industrial machines, maintenance is a routine activity aimed at avoiding malfunctions and extended downtime.
- Another public authority questioned the data on lifetimes which suggested very long service times of machines. Stakeholders confirmed that there are such machines on the market.
- A stakeholder representing manufacturers reminded that the machines are run 24/7 and are maintained preventively before they break down, so that they have a very long lifetime.
- Another stakeholder representing manufacturers claimed that the first period in the implementation of the ESPR should focus on information requirements, based on the testing using the standard and on the real use cases.

- A stakeholder representing manufacturers suggested to check the CSRD reports filed by the manufacturers in the industry, to help in identifying and getting more detailed results. These focus on water efficiency, Substances of Concern (SoC), etc. Benchmark analysis in the industry could also help to get more details. Oeko Institute asks to forward such reports.

4. Task 6 - Design options: Presentation of first ideas + discussion – Andreas Köhler (Oeko-Institut)

OEKO Institute designed the background to and possible design options, highlighting the need to find a balance between cost, feasibility, durability and energy efficiency. It was also explained that there are too many data gaps to have a reliable LCA on Ecodesign aspects such as circularity, product lifetime, Substances of Concern.

- Stakeholders were asked, which design options have been implemented to support improvements and how these have contributed to the environmental performance of appliances.
- DG ENV emphasised that ESPR is not phrased in the same restrictive way as the previous Ecodesign Directive in relation to life cycle costing (LCC), but rather as a more general requirement to be taken into account to avoid disproportionate costs (whereas the Ecodesign Directive mandated a Least Lifecycle Costing approach). As for Substances of Concern (SoC), it was clarified that there is a clear requirement to give information on SoCs present in the product and life cycle. As for performance requirements for SoCs, this is subject to the assessment. The delegated act has to include the tracking of SoCs as an information requirement, with potential derogations and leeway for implementing time.
- One stakeholder representing manufacturers commented on the reference in the presentation to Sinner's circle, expressing doubt whether changing the parameters in Sinner's Circle was a useful strategy to find design options. Another stated that [in their machines] they are constantly adjusting the mix between the elements of the "Sinner's Circle: mechanical action (better term than mechanical force) to increase the flow of liquor through the fibres, temperature and chemicals (which according to another stakeholder, include the water itself, which is treated to modify its "hardness"). The mix depends on the fabric type, soil type, etc.
- A stakeholder representing manufacturers of industrial machines explained that all changes are aimed at supporting [improving] the complete process of the laundry and to generate savings at the process level. As for specific design options proposed, they commented that e.g. heat pumps [at the level of individual machine] is not possible for industrial laundry machines. Manufacturers make sure that the lifetime of machines reaches 20 and up to 30 years, and ensure the availability of spare parts and remanufacture them. Everything asked for in the industrial market, is already offered on the market, but it's up to the customer to choose which option they apply to make the process better. The manufacturer only offers them options, and some are less efficient than others. For example, an ironing line as an open system loses a lot of energy. The manufacturer informs the customer on the solutions he can get, but it is up to the customer to decide what he chooses.
- A national public authority stated that the very purpose of the ESPR is to mandate the improvements that are cost-effective and environmentally sound, hereby removing some options from the set of those available for the customer to choose from. This is normal.
- Fraunhofer ISI asked, under the pretence that all options are available, whether all the options are used as they should be used and where ESPR could be supportive, for example by harmonising information made available to the customer. It was also asked whether certain improvements could be mandated or if certain options should be prohibited as they decrease the overall energy efficiency. A public authority clarified in this respect that ESPR should not mandate specific technologies, but that if there are a number of options, that they could be

associated with the general range of savings so that the bar can be set requiring for example that out of five available options new installations need to include at least two. In addition, manufacturers would need to provide standardized information so that consumers can compare appliances.

- A stakeholder representing recyclers contended that there should be strategies to increase recycling without distinction between household or non-household as the material composition is similar. These strategies should be more elaborate than simply recovering steel scrap in an open shredder. The commercial equipment is the low hanging fruit. A few steps were detailed to improve waste management: recycled plastics can be used, neodymium magnets from electric motors too (requiring dismantling prior to shredding). The glass cullet can also be recovered and reused. Secondary raw materials should be looked at as the primary resource. Recycled content already is present in the existing materials: stainless steel, copper.
- A stakeholder representing manufacturers promised to answer the questions raised by Task 6 in writing.

5. Task 7 – Policy options: Presentation of principles – Antoine Durand (Fraunhofer ISI)

Fraunhofer ISI presented the current state-of-play concerning the policy options and also provided some explanation on possible requirements related to SoC.

- DG ENV commented on the lack of data, which was problematic, seeing as a series of standards were developed after the 2011 preparatory study precisely to bring harmonization and to enable regulation but have not been widely applied by the industry. Industry was called to transmit results of tests that follow these standards, for assessment by the consultants in confidentiality. It added that the policy option presented, namely that of an information requirement only, means more administrative burden for limited gain. It was assessed as not being the best option.
- DG ENV added on the definition of SoCs: the ESPR includes references to other legislation for the first three items of the list. The last item (Art2(27)), i.e. substances that negatively affects the reuse or recycling, must be defined on a per-product basis. Information from recyclers is needed to define them.
- A stakeholder representing manufacturers commented that there are two standards sets, for commercial and for industrial machines, which yield different results, because the testing conditions are different. Hence the test results are not comparable between the two sectors.
- A public authority asked whether green public procurement was excluded for a reason. Fraunhofer ISI agreed that it would be relevant for this type of machines because some machines are sold to e.g., public hospitals and schools, but that the current focus for this stakeholder meeting is on general requirements.
- Fraunhofer ISI stated that there is no scientific base to set performance requirements, due to the current lack of data. Therefore, information requirements would be a first step even if it may not the best option.

6. Conclusions of the main meeting - Final observations by participants

- **Information by consultant team on the next steps in the process**
- Next steps were discussed.
- OEKO addressed the delay/postponement of impact assessment by two months (if confirmed by DG ENV) to allow launching an online stakeholder consultation on SoC and any remaining questions.

- A stakeholder representing manufacturers of industrial machines raised concerns on the discussion during the meeting and requested that the concerns raised by the manufacturers of industrial machines for Task 1-4 be shared with the Commission, even if the Task is already final.
- It was clarified that the minutes and the presentation shall be shared.

5.10. Annex X: Position paper APPLiA

Home Appliances Sweden
Commercial Laundry
Date 2025-05-30, Rev6

Position paper on the ESPR for *Commercial* Laundry

Position paper from APPLiA Commercial in view of the ongoing preparatory study on Commercial and Industrial Laundry Appliances

Summary of our messages

Based on the assumption that the commission will introduce regulations in line with ESPR also for commercial and industrial laundry appliances, the below summaries our position.

1. Establishing a basis for fair competition by ESPR
2. ESPR regulations for commercial and industrial laundry need to be different from household
3. Commercial and industrial laundry appliances are covered by the Machinery Regulation (EU) 2023/1230 and thus can be distinguished from domestic appliances
4. Updated product categories (adjusted after 1st stakeholder meeting) and renaming of professional to commercial (according to 2nd stakeholders meeting) are supported
5. Whenever regulation is intended the differences between product categories should be taken into account
6. Regulation must be based on reliable data, which is currently not available
   - 1st tier Information requirements based on harmonized standards
   - 2nd tier Definitions of minimum efficiency requirements
7. Appropriate transition times to generate the necessary database must be considered
   - The performance of batch loaded washers and dryers, all sizes, should be declared according to EN50640 and EN50594
   - The performance of appliances build in situ should be conducted and declared according to EN17116
8. Regulations should not overlap or contradict existing regulations. Examples to be considered with particular regard to spare parts are the Eco Design regulations for motors and fans.
9. SoCs are covered by the safety and chemicals regulations, they should not be additionally included in ESPR measures

More detailed motivation on our messages is presented in the following pages.

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0 Preamble

The commercial laundry business has been engaged and preparing for ecodesign regulations since the very first preparatory study, LOT24.
The first outcome was the creation of new standards for measuring consumption and performance of commercial washers and dryers. They are now released and available since some years ago.
Further on, the commercial laundry manufacturers have invested significantly in new laboratory facilities according to the standard requirements.
The published standards together with the new laboratories are crucial for collecting reliable data.
In general, we would state that European manufacturers of commercial are already considering robustness, serviceability, repairability etcetera since these are major demands of commercial customers.

1 Establishing a basis for fair competition by ESPR

The introduction of product-specific regulations under ESPR should be carried out in such a way that fair competition between European and non-European manufacturers of commercial and industrial laundry appliances is ensured.
Declaring consumption and performance data according to standards allows for comparability, verification and enforceability. At the same time, it promotes competition towards better declaration data and lower environmental impact.

2 Differences within regulations for commercial and domestic laundry appliances

Commercial laundry shows significant differences compared to domestic laundry. Important differences worth noting when drawing up regulation:

- Commercial laundry appliances are typically designed for high throughput, larger loads, higher frequency of use, and more robust performance
- These machines often include advanced features for specific applications, such as disinfection cycles, faster cycle times to fulfill the high demands in commercial applications
- Also, commercial laundry machines are built to withstand the rigors of continuous operation and the diverse needs of various industries, including hospitality, healthcare, garment care services, contract cleaners, horse blankets, fire brigades and many others
- These various applications result in a significant degree of variance among the appliances, not existing at all for household laundry
- More often customers adjust their washing and drying programs according to their very specific or unique demands
- Furthermore, hygienic demands and disinfection of laundry loads are typical for commercial applications especially in the field of healthcare.

3 Differentiation between commercial laundry appliance and household appliances

Commercial and industrial laundry appliances are covered by the Machinery Regulation (EU) 2023/1230 and thus can be distinguished from domestic appliances.

4 Product categories

We welcome the revision of the product categories resulting in 5 base cases for washing machines and 4 base cases for dryers. We support the renaming from 'professional' to 'commercial' which has been included in the following table.

WM1: Semi commercial washer extractor	D1: Semi commercial tumble dryer
WM2: Commercial washer extractor	D2: Commercial tumble dryer
WM3: Commercial washer dryer	D3: Commercial cabinet dryer
WM4: Commercial barrier washer	
WM5: Industrial continuous tunnel washer	D4: Industrial pass-through (transfer) tumble dryer

We do not recommend introducing capacity limits within product categories that use the same base construction (e.g. front-loading washer extractor, tumble dryer, cabinet dryer etc.). Capacity limits within product categories would increase the risk of circumvention.

Appliances that are comparable should be tested using the same measurement methods to ensure comparison.

5 Whenever regulation is intended the differences between product categories should be taken into account

The following principles supported by standardization should also remain valid for the intended regulation of commercial laundry care appliances.

- No requirements that cannot be measured and verified using recognized standards
- Avoidance of loopholes and circumvention
- The European standardization organizations CEN and CENELEC have developed standards for testing the above-mentioned appliance categories.
- The two commercial standards EN 50640 and EN 50594 and the industrial standards EN 17116 are not covering the same scope of application.
- The results are not comparable since they differ in test methods, among other things, in their definitions, specifications of the tests, and test textiles
- The commercial and industrial standards overlap for washer-extractors and tumble dryers with a rated capacity of 40 kg or more.
- This overlap and the resulting choice of test method that is possible can lead to uncertainty and disable comparability, if regulation does not prescribe to apply a particular standard for measurement.

Based on the above principles and the different existing standards our recommendations are the following.

- WM1 – WM 4 declares relevant values according to EN 50640
- D1 – D2 declares relevant values according to EN 50594
- WM 5 and D4 declares relevant values according to EN 17116

The standards EN 50640 and EN 50594 have attachments called 'Reporting of key parameters' showing the parameters that could be used for future information requirements (see below).

EN 50640:2018 (E)

Annex O
(informative)

Reporting of key parameters

O.1 General

This annex presents a way to report key data for the purpose of being presented in product literature or as a fiche. Only the parameters that are relevant for the test series needs to be included.

O.2 Table of key parameters

Table O.1 shows the key parameters to be reported. The table shows the parameter symbols as defined in this standard where the final calculation of the parameter is performed and the name of the parameter to be published. The obtained values of the requested parameters including units shall be placed in column 4. The precision of the values shall be according to Table N.2. Observe that only column 3 and 4 are to be published.

Table O.1 — Performance result of the test washing machine

Machine model		Model:	(name)
Heating source(electric, gas, steam, non heated)		Heating source:	(type)
Capacity according to the manufacturer		Rated capacity:	(kg)
Tested wash programme + settings		Programme:	(name)
Parameter symbol	*Defined/calculated in clause:*		
D_V	L.5.11	Drum volume	(l)
$\overline{W_{total}}$	L.5.9.7	Total energy consumption	(kWh)
$\overline{W_{el}}$	L.5.9.3	Total electric energy consumption	(kWh)
$\overline{W_{st}}$	L.5.9.5	Total steam energy consumption	(kWh)
$\overline{W_{gr}}$	L.5.9.4	Total gas energy consumption	(kWh)
$\overline{W_{hw}}$	L.5.9.2	Total hot water energy consumption	(kWh)
W_{kg}	L.5.10	Energy consumption/kg load	(kWh/kg)
$\overline{t_c}$	L.5.7.2	Cycle duration	(min)
$\overline{T_{max}}$	L.5.8	Max temperature	(°C)
$\overline{V}$	L.5.6.3	Water consumption	(l)
$\overline{V_w}$	L.5.6.9	Water consumption main wash	(l)
$\overline{V_r}$	L.5.6.6	Water consumption rinses	(l)
I_w	L.5.3.2	Wash performance index	(number)
G_f	L.5.5.3	G force	(number)
$\overline{RMC}$	L.5.4.2	Moisture content after extraction	(%)

NOTE: Information given in table above is obtained from performance tests according to standard EN 50640 using a test load of 50/50 polyester/cotton fabrics.

EN 50594:2018 (E)

Annex L
(normative)

Reporting of key parameters

L.1 General

This annex presents a way to report key data for the purpose of being presented in product literature or as a fiche. Only the parameters that are relevant for the test series needs to be included.

L.2 Table of key parameters

Table L.1 shows the key parameters to be reported. The table shows the parameter symbols as defined in this standard where the final calculation of the parameter is performed and the name of the parameter to be published. The obtained values of the requested parameters including units shall be placed in column 4. The precision of the values shall be according to Table O.2. Observe that only column 3 and 4 are to be published.

Table L.1 — Performance result of the tumble dryer

Tumble dryer model		Model	(name)
Heating source(electric, gas, steam,)		Heating source:	(type)
Capacity according to the manufacturer		Rated capacity:	(kg)
Tested drying programme		Programme:	(name)
Parameter symbol	*Defined/calculated in clause:*		
D_V	K.5.6.14	Drum volume	(l)
W	K.5.6.11	Total energy consumption	(kWh)
W_e	K.5.6.8	Total electric energy consumption	(kWh)
W_s	K.5.6.9	Total steam energy consumption	(kWh)
W_g	K.5.6.10	Total gas energy consumption	(kWh)
W_{kg}	K.5.6.12	Energy consumption/kg load	(kWh/kg)
T	11 K.5.4.2	Cycle duration	(min)
E_c	K.5.6.13	Dewatering capability	(gH_2O/min)
C	K.5.5	Condensation efficiency	(%)

Note: Information given in table above is obtained from performance tests according to standard EN 50594 using a test load of 50/50 polyester/cotton fabrics with an initial moisture content of 50 % water.

6 How to overcome missing reliable data

Regulation must be based on reliable data, which is currently not available.

- Importance of Adequate Lead Time
  Considering the timeline for potential upcoming regulations, it is essential to ensure that manufacturers are granted sufficient lead time to adapt their processes and comply with the new requirements.
- Benefits of a Phased Implementation
  A phased implementation approach would accommodate the varying capacities of commercial laundry appliance manufacturers and help prevent sudden market disruptions. It would also provide manufacturers and independent laboratories with the opportunity to invest in improved equipment that aligns with the new standards.

- Proposed Two-Tiered Regulatory Approach according to below
  If the preparatory study and the European Commission's assessment conclude that commercial laundry care appliances should be regulated under the ESPR framework, we recommend the following two-tiered approach:

  - Tier 1: Require the declaration of performance and consumption data, along with the implementation of harmonized measurement standards and the storage of this data in a centralized database.
  - Tier 2: Based on the data collected in Tier 1, establish minimum efficiency requirements that reflect realistic and achievable benchmarks.

7 Coordination and alignment with other EU regulations

Effective coordination with other EU regulations is essential to ensure coherent and comprehensive rules for commercial laundry appliances. Aligning with regulations on energy efficiency, waste management, and chemical use avoids overlaps, simplifies compliance, and supports the EU's sustainability goals. This also eases market access, reduces bureaucracy, and fosters innovation in the industry.

8 Messages on specific regulations for spare parts

Potential requirements for the reparability of commercial laundry appliances are being undermined by other regulations. Specifically, limitations on the availability of spare parts such as motors and fans.

Regulation (EU) 2019/1781 – Electric Motors

Article 2(2)(m):

- Exemptions from the requirements apply to:
  "Motors placed on the market before 1 July 2029 as substitutes for identical motors integrated in products placed on the market before 1 July 2022 and specifically marketed as such."

- Implication: Replacement motors may only be used until 1 July 2029 for products placed on the market before 1 July 2022.

- Criticism: This limits reparability to **7 years**

Regulation (EU) 2024/1834 – Fans

Scope: Applies to fans driven by motors with an electric input power between 125 W and 500 kW.

- Article 9 – Transitional Provisions:
  The previous Regulation (EU) No 327/2011 is repealed as of 24 July 2026.
  However: Annexes I–III of the old regulation will continue to apply until 24 July 2037 for:
  - Fans integrated into other products
  - Spare part fans

- Implication: Spare parts for fans remain available for **11 years** – a significantly longer period than for motors.

To avoid legally enforced obsolescence, it is necessary that:

- Components such as motors and fans to be excluded from spare parts requirements in component-specific regulations.
- The guiding principle should be "**repair as produced**" – meaning that appliances should remain repairable with the same quality, functionality, and availability of components as when they were originally manufactured.

9 Message on Substances of Concern SoC

We are very concerned about the approach taken to identify Substances of Concern (SoC) across different product groups. We see no possibility at all to reply to your latest questionnaire regarding SoC.
After intensive discussions with ZVEI, Consumer Division, Section Home Appliances we have concluded that that we fully share the position set out in the ZVEI statement dated 2025-05-09. As this statement also reflects our view, we have decided not to prepare a separate document for the sake of efficiency and are instead attaching the aforementioned document.

Attachment:
ZVEI statement regarding SoC, dated 2025-05-09

5.11. Annex XI: Further DPP aspects

Description (Product Parameter from Annex I ESPR)	Relevant for DPP? (Yes/No)
(a) Durability and reliability of the product or components (e.g., guaranteed lifetime, mean time between failures, real use data, resistance to ageing)	
(b) Ease of repair and maintenance (e.g., availability and affordability of spare parts, modularity, standard components, disassembly, repair instructions, tool requirements, access to product data)	
(c) Ease of upgrading, reuse, remanufacturing and refurbishment (e.g., disassembly, material/component standardisation, access to data, IPR barriers, guarantees for refurbished products)	
(d) Design for recycling, ease and quality of recycling (e.g., recyclability of materials, hazardous substances, high-purity sorting, disassembly, access to data)	
(e) Avoidance of technical solutions detrimental to reuse, upgrading, repair, maintenance, refurbishment, remanufacturing and recycling	
(f) Use of substances, especially substances of concern, throughout life cycle and their impacts on health/environment	
(g) Use or consumption of energy, water, and resources across life cycle stages (including software/firmware effects, deforestation impact)	
(h) Use or content of recycled materials and recovery of materials (including critical raw materials)	
(i) Use or content of sustainable renewable materials	
(j) Weight and volume of product and packaging, product-to-packaging ratio	
(k) Incorporation of used components	
(l) Quantity, characteristics and availability of consumables (e.g., yield, lifetime, reusability, efficiency, interoperability)	
(m) Environmental footprint (quantified life-cycle environmental impacts in one or more impact categories)	
(n) Carbon footprint of the product	
(o) Material footprint of the product	
(p) Microplastic and nanoplastic release across life cycle stages (e.g., manufacturing, use, EOL)	
(q) Emissions to air, water or soil during life cycle stages (including noise)	
(r) Waste generation (including plastic, packaging, hazardous waste), ease of reuse	
(s) Functional performance and conditions for use (e.g., usability, compatibility, required skills)	
(t) Lightweight design (e.g., material reduction, hybrid materials, function integration, recycling benefits)	

5.12. Annex XII: DPP use cases and derived requirements

Green colour indicates use-cases that are seen potentially relevant by the project team. TO NOTE: each information has to be validated by the stakeholders towards their relevance (effort vs. benefit in context of the scope). “item-level” and “batch-level” granularity (currently) can only be established through a DPP. Other aspects (access rights management, model-level, RFID data carrier, machine readable could be established through EPREL.

Stakeholder	Use-case (CE-goal)	Information to be provided	Feasible with EPREL / DPP	Public data	Confidential	Granularity	Hierarchy	Data carrier	Offline available	Machine readable
Customer	Sustainable purchase	CO2 footprint, circularity indicators (e.g. reparability), recycled content	EPREL (extended with sustainability information)	Public	No	Model/ Batch	Product	QR-code	-	-
Customer	Sustainable purchase	Environmental and social label	EPREL (extended with label)	Public	No	Model/ Batch	Product	QR-code	-	-
Customer	Sustainable purchase	Technical specifications / documentation	EPREL	Public	No	Model/ Batch	Product	QR-code	-	-
Customer	Prolong use (maintenance, DIY repair)	Use, maintenance and DIY repair instructions	EPREL (extended with manuals)	Public	No	Model	Component	QR-code	-	-
Customer	Resell & 2.hand purchase	Usage history, repair history	DPP (item level information)	No	Yes	Item	Product	QR-code	-	-
Customer	Proper disposal	Disposal and return options	EPREL (extended with disposal information)	Public	No	Model	Product	QR-code	-	-

Stakeholder	Use-case (CE-goal)	Information to be provided	Feasible with EPREL / DPP	Public data	Confidential	Granularity	Hierarchy	Data carrier	Offline available	Machine readable
Repairer	Professional (certified) repair	Dismantling instructions, spare part availability, etc.	EPREL (extended with repair information)	No	Yes	Model/item	Component	QR-code	-	-
Reuser	Enable reuse	Usage history, repair history	**DPP (item level information)**	No	Yes	Item	Component	QR-code	-	-
Refurbisher	Enable refurbishment	Dismantling instructions, usage & repair history	**DPP (item level information)**	No	Yes	Item	Component	QR-code	-	-
Remanufacturer	Enable remanufacturing / repurposing	Dismantling instructions, usage & repair history	**DPP (item level information)**	No	Yes	Item	Component	QR-code	-	-
Collection & Presorting	Preparation for reuse	Energy efficiency, Usage/repair history, purchase date, original product price	**DPP (item level information)**	No	Yes	Item	Component	QR-code	-	-
Collection & Presorting	Component sorting	Dismantling instructions	EPREL (extended)	No	Yes	Model	Component	RFID	x	-
Collection & Presorting	Separation of products/components with prohibited substances (WEEE, RoHS, REACH, etc.)	Prohibited / hazardous substances per component (incl. Batteries)	EPREL (extended with material information)	Public	No	Model/ Batch	Component	RFID	x	(x)

Stakeholder	Use-case (CE-goal)	Information to be provided	Feasible with EPREL / DPP	Public data	Confidential	Granularity	Hierarchy	Data carrier	Offline available	Machine readable
Collection & Presorting	Separation of products/components with valuable materials	Valuable materials	EPREL (extended)	No	Yes	Model/ Batch	Component	RFID	x	(x)
Collection & Presorting	Closed loop recycling	Application type, model	EPREL (extended)	Public	No	Model/ Batch	Product	RFID	-	-

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