Preparatory study on commercial and industrial laundry appliances

Draft report of Tasks 1-7 of the Preparatory Study
(Phase II)
Version 1.2

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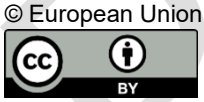

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Contents

1. Changes introduced in this version 1

2. Introduction 2

2.1. General remarks to this preparatory study within the ESPR work stream 2

2.2. Objective of the preparatory study on industrial and commercial laundry appliances 4

2.3. Prior work 5

2.3.1. Preparatory Study 2011 for Eco-design Requirements of Energy-using Products Preparatory ecodesign study - Lot 24: Professional Washing Machines, Dryers and Dishwashers 5

3. Methodology 7

3.1. Background - on the MEErp Approach 7

3.1.1. MEErP and EcoReportTool 7

3.2. Approach of the preparatory study 9

3.2.1. Stakeholder consultation 9

4. Results 10

4.1. Task 1 – Scope, definitions, standards, legislation 10

4.1.1. The professional laundry process 11
4.1.2. Product category and performance assessment 15
4.1.3. Delimitation of professional washing machines and dryers 29
4.1.4. Test standards of professional washing machines and dryers 34
4.1.5. Existing legislation and environmental labelling 52
4.1.6. Conclusions as to the scope of the study 72
4.1.7. Categorisation proposed following the stakeholder meeting of 30 September 2024 75

4.2. Task 2 – Markets 77

4.2.1. General economic data from official sources 77
4.2.2. Market and stock data 89
4.2.3. Market trends 99
4.2.4. Customer expenditure database 105

4.3. Task 3 – Users 122

4.3.1. Collection of data and its quality 123
4.3.2. Typical capacity and use intensity 123
4.3.3. Annual weight of cleaned and dried laundry 127
4.3.4. Ideal operating conditions and user behaviour 134
4.3.5. User behaviour in practice 137
4.3.6. Measures to optimise user behaviour and consumption parameters 142

Draft for SH

4.3.7. Infrastructure 143
4.3.8. Maintenance and repairs, end-of-life behaviour 147
4.4. Task 4 – Technologies 148
4.4.1. Technical analysis of non-household washing machines 148
4.4.2. Technical analysis of non-household dryers 158
5. Task 5 – Environment and Economics (Base Case LCA and LCC) 166
5.1. Objectives of Task 5 166
5.2. Definition of Base Cases 168
5.3. Product-specific inputs 175
5.3.1. Raw materials 175
5.3.2. Packaging 176
5.3.3. Manufacturing & Assembly 176
5.3.4. Distribution 177
5.3.5. Use phase 177
5.3.6. Maintenance and repair 178
5.3.7. End-of-Life (EoL) 178
5.3.8. Life cycle costs (LCC) 179
5.4. Base Case Environmental Impact Assessment 179
5.4.1. Results overview LCA 180
5.4.2. Contribution analysis per Base Case 184
5.5. Base Case Life Cycle Cost for customers 204
5.5.1. Results overview LCC 204
5.5.2. Contribution analysis LCC 205
5.6. EU Totals 215
5.6.1. Life cycle assessment (LCA) 215
5.6.2. Life cycle costs 219
5.7. Sensitivity analysis 221
5.7.1. Sensitivity analysis for WM5 221
5.7.2. Sensitivity analysis for washing machines WM1-WM4 based on updated stakeholder data 223
5.7.3. Sensitivity analysis for dryers D1-D3 based on updated stakeholder data 231
5.8. Conclusions 237
5.8.1. Conclusions on the LCA and LCC assessment 237
5.8.2. Conclusions on Substances of Concern assessment 238
6. MEErP Task 6 – Design Options for Ecodesign requirements 240
6.2.1. Design Options for commercial and industrial washing machines 242
6.2.2. Design Options for commercial and industrial dryers 251
6.2.3. Summary of the selection of Design Options for commercial and industrial laundry appliances 256
6.2.4. Stakeholder consultation process 257
6.3. Base Cases for the assessment of Design Options 258

Draft for SH

6.3.1. Input parameters for Design Options of commercial and industrial washing machines 258
6.3.2. Input parameters for Design Options of commercial and industrial dryers 266

6.4. Environmental impact of Design Options and comparison to the respective Base Cases 270

6.4.1. WM1: Environmental impact of Design Options 271
6.4.2. 271
6.4.3. WM2: Environmental impact of Design Options 272
6.4.4. WM3: Environmental impact of Design Options 273
6.4.5. WM4: Environmental impact of Design Options 274
6.4.6. WM5: Environmental impact of Design Options 275
6.4.7. D1: Environmental impact of Design Options 276
6.4.8. D2: Environmental impact of Design Options 277
6.4.9. D3: Environmental impact of Design Options 278
6.4.10. D4: Environmental impact of Design Options 279
6.4.11. Further discussion on Design Options not assessed by means of LCA. 279

6.5. Impact and costs of selected Design Options 280

6.5.1. WM1: LCC impact of Design Options 281
6.5.2. WM2: LCC impact of Design Options 281
6.5.3. WM3: LCC impact of Design Options 282
6.5.4. WM4: LCC impact of Design Options 282
6.5.5. WM5: LCC impact of Design Options 283
6.5.6. D1: LCC impact of Design Options 283
6.5.7. D2: LCC impact of Design Options 284
6.5.8. D3: LCC impact of Design Options 284
6.5.9. D4: LCC impact of Design Options 285

6.6. Overview of Design Options per Base Case 285

6.6.1. Overview of environmental impact of Design Options per Base Case ... 285
6.6.2. Total yearly cost of Design Options per Base Case 287

7. Task 7: Policy Options and Scenarios 289

7.1. Objectives of MEErP Task 7 289

7.1.1. Introduction to the evaluation of Scenarios using the MEErP methodology 289

7.2. Policy analysis 290

7.2.1. Stakeholder consultation 290
7.2.2. Barriers (and opportunities) for improvements 294
7.2.3. ESPR Framework 297
7.2.4. Potential Policy Options 298

7.3. Scenario analysis 322

7.3.1. Inputs from previous Tasks and necessary assumptions 322
7.3.2. Stock model description 326
7.3.3. Results: Sales and stock 329
7.3.4. Results: Environmental Impacts 332
7.3.5. Results: Socio-economic impact analysis 335
7.3.6. Sensitivity analysis 338
7.3.7. Overview of results 339

Draft for SH

7.4. Conclusions 343

8. References 345

9. Annexes 364

Draft for SH

List of Tables

Table 4-1: Extract from PRODCOM lists 2023. 16

Table 4-2: Classification of washing machines and dryers according to the HS-Classification. (WCO) 17

Table 4-3: Terms and definitions included in EN 17116-4:2019 that are relevant for categorisation..... 19

Table 4-4: Terms and definitions included in EN 50640:2018 that are relevant for categorisation..... 20

Table 4-5: Classification of washing machines and dryers according to ISO 10472. ... 23

Table 4-6: Specific criteria for large-scale or outsourced laundry operations in tourism facilities. 66

Table 4-7: Minimum energy and water factors that need to be complied with. 70

Table 4-8: Number of household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers) produced, 2019-2023. 78

Table 4-9: Number of drying machines of a dry linen capacity superior to 10 kg produced, 2019-2023..... 80

Table 4-10: Value of household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers) produced in EU27 by Member State (in million Euros). 83

Table 4-11: Value of drying machines of a dry linen capacity superior to 10 kg produced in EU27 by Member State (in million Euros)..... 84

Table 4-12: 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 MS reporting, latest available data in years 2018-2023. 86

Table 4-13: 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). 87

Table 4-14: Non-exhaustive list of non-household washing machine and dryer manufacturers relevant to EU market. 91

Table 4-15: Non-household Laundry Appliances - Number of batch-loaded units manufactured in the EU. 92

Table 4-16: Number of batch-loaded washing machines manufactured in the EU27. .. 93

Table 4-17: Number of batch-loaded dryers manufactured in the EU27. 94

Table 4-18: Target customer segments of professional washing machines by product category. 96

Table 4-19: Target customer segments of professional dryers by product category. ... 97

Table 4-20: Approximation of the stock of professional laundry appliances in the EU27.99

Table 4-21: Share of employees per function in the business unit manufacturing of professional laundry appliances (case study). 101

Table 4-22: Presence of technical features related to sustainability in current (2024) professional laundry appliances and trends for the future. 103

Draft for SH

Table 4-23: Average prices of professional washing machines manufactured in the EU27, years 2009-2023 (PRODCOM data). 107

Table 4-24: Average prices of professional dryers manufactured in the EU27, years 2009-2023 (PRODCOM data). 108

Table 4-25: Estimate of the unit prices of professional laundry appliances in 2023 (based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices). ... 110

Table 4-26: Price of electric energy for non-household uses; Consumption band IA. 112

Table 4-27: Price of electric energy for non-household uses; Consumption band IB. 113

Table 4-28: Price of electric energy for non-household uses; Consumption band IC. 114

Table 4-29: Price of natural gas for non-household uses; Consumption band I1. 115

Table 4-30: Price of natural gas for non-household uses; Consumption band I2. 116

Table 4-31: Prices of water from utilities in EU Member States. 118

Table 4-32: EU (+UK + CH + NO) market of household detergents for laundry care in 2023. 119

Table 4-33: Repair and maintenance costs over lifetime of professional laundry equipment. 120

Table 4-34: Inflation in the EU27: All-items Harmonised Index of Consumer Prices, 2014-2023..... 121

Table 4-35: Key market segments of non-household washing machines according to spatial requirements and operator skills. 125

Table 4-36: Key market segments of non-household dryers according to spatial requirements and operator skills. 126

Table 4-37: Typical intensity of use of the regarded washing machine categories..... 129

Table 4-38: Typical intensity of use of the regarded dryer categories. 131

Table 4-39: Specific energy, water and detergent consumption of an average current device of different washing machines categories under ideal conditions. 135

Table 4-40: Specific energy consumption of an average current device of different dryer categories under ideal conditions. 136

Table 4-41: Annual energy, water and detergent consumption of different non-household washing machine categories under ideal conditions. 136

Table 4-42: Annual energy consumption of different professional dryer categories under ideal conditions. 137

Table 4-43: Programme selection of non-household washing machine categories.... 139

Table 4-44: Programme selection of non-household dryer categories. 140

Table 4-45: Typical time in low-power mode(s) consumption of non-household washing machines. 142

Table 4-46: Typical time in low-power mode(s) consumption of non-household dryers.142

Table 4-47: Energy Sources for water heating in non-household washing machines. 145

Table 4-48: Energy Sources for heating in new professional dryers. 146

Table 4-49: Categorisation of non-household washing machines. 148

Table 4-50: Share of material categories (according to MEErP) for the different categories of non-household washing machines (including packaging). 149

Draft for SH

Table 4-51: Average volume of the final packaged product of the different categories of non-household washing machines. 150

Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines. 151

Table 4-53: Energy, water and detergent consumption of a semi-professional washer extractor. 153

Table 4-54: Energy, water and detergent consumption of a professional washer extractor. 154

Table 4-55: Energy, water and detergent consumption of a professional washer dryer (category WM3). 154

Table 4-56: Energy, water and detergent consumption of a professional barrier washer (category WM4). 155

Table 4-57: Energy, water and detergent consumption of a professional washing tunnel machine (category WM5). 155

Table 4-58: Annual energy, water and detergent consumption (real life conditions) of all non-household washing machine categories. 156

Table 4-59: Most frequent failure modes in washing machines. 157

Table 4-60: Disposable fraction of non-household washing machines that is not recovered. 158

Table 4-61: Categorisation of non-household dryers. 159

Table 4-62: Share of material categories (according to MEErP) for the different categories of non-household dryers (including packaging). 159

Table 4-63: Average volume of the final packaged product of the different categories of non-household dryers. 160

Table 4-64: Share of the average energy consumption in the different categories of non-household dryers (Source: information provided by manufacturers). 161

Table 4-65: Energy consumption of semi-professional tumble dryers. 161

Table 4-66: Energy consumption of professional tumble dryers (category D4-5-6). 162

Table 4-67: Energy consumption of professional cabinet dryers. 163

Table 4-68: Energy consumption of industrial pass-through dryers. 163

Table 4-69: Annual energy consumption (real life conditions) of all dryer categories. 164

Table 4-70: Landfill (fraction of products not recovered) in % of non-household dryers (based on stakeholder input). 165

Table 5-1: Data quality scoring. 167

Table 5-2: Overview of Base Cases for non-household washing machines and dryers. 168

Table 5-3: Overview of Base Case WM1: Semi-professional washer extractor. 169

Table 5-4: Overview of Base Case WM2: Professional washer extractor. 169

Table 5-5: Overview of Base Case WM3: Professional washer dryer. 170

Table 5-6: Overview of Base Case WM4: Professional barrier washer. 171

Table 5-7: Overview of Base Case WM5: Industrial continuous tunnel washer. 172

Table 5-8: Overview of Base Case D1: Semi professional tumble dryer. 172

Draft for SH

Table 5-9: Overview of Base Case D2: Professional tumble dryer. 173
Table 5-10: Overview of Base Case D3: Professional cabinet dryer..... 174
Table 5-11: Overview of Base Case D4: Industrial pass-through tumble dryer. 175
Table 5-12: Overview of missing datasets and proxies used for raw materials. 175
Table 5-13: Overview of missing datasets and proxies used for packaging. 176
Table 5-14: Overview of missing and proxy datasets used for manufacturing. 176
Table 5-15: Transport scenarios for all Base Cases. 177
Table 5-16: Use phase input data for washing machine Base Cases. 178
Table 5-17: Use phase input data for dryer Base Cases 178
Table 5-18: Life cycle costing input data for all washing machine Base Cases..... 179
Table 5-19: Life cycle costing input data for all dryer Base Cases. 179
Table 5-20: Total life cycle impact per washing machine Base Case total lifetime (WM1, WM2, WM3, WM4, WM5)..... 181
Table 5-21: Total life cycle impact per dryer Base Case total lifetime (D1, D2, D3, D4).182
Table 5-22: Total life cycle impact per washing machine Base Case per year of use (WM1, WM2, WM3, WM4, WM5)..... 182
Table 5-23: Total life cycle impact per dryer Base Case per year of use (D1, D2, D3, D4). 183
Table 5-24: Total life cycle costs per washing machine Base Case (WM1, WM2, WM3, WM4, WM5). 204
Table 5-25: Total life cycle costs per drying machine Base Case (D1, D2, D3, D4)... 205
Table 5-26: Total EU stock numbers (as calculated in the ERT) for all Base Cases.. 215
Table 5-27: Summary environmental impacts EU stock for washing machines (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers). 216
Table 5-28: 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). ... 217
Table 5-29: Summary environmental impacts EU new product for washing machines (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers). ... 218
Table 5-30: 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). 219
Table 5-31: Total annual expenditure in the EU27 for washing machines. 220
Table 5-32: Total annual expenditure in the EU27 for dryers..... 220
Table 5-33: Sensitivity analyses for WM5..... 221
Table 5-34: Sensitivity analysis parameters for WM1. 223
Table 5-35: Sensitivity analysis consumption data and life cycle environmental impact compared to original results for WM1. 224
Table 5-36: Sensitivity analysis life cycle costing impact compared to original results for WM1. 225
Table 5-37: Sensitivity analysis parameters for WM2. 225

Draft for SH

Table 5-38: Sensitivity analysis consumption data and environmental impact compared to original results for WM2. 226

Table 5-39: Sensitivity analysis life cycle costing impact compared to original results for WM2. 227

Table 5-40: Sensitivity analysis parameters for WM3. 227

Table 5-41: Sensitivity analysis consumption data and environmental life cycle impact compared to original results for WM3. 228

Table 5-42: Sensitivity analysis life cycle costing impact compared to original results for WM3. 229

Table 5-43: Sensitivity analysis parameters for WM4. 229

Table 5-44: Sensitivity analysis consumption data and environmental impact compared to original results for WM4. 230

Table 5-45: Sensitivity analysis life cycle costing impact compared to original results for WM4. 231

Table 5-46: Sensitivity analysis parameters for D1. 231

Table 5-47: Sensitivity analysis consumption data and environmental impact compared to original results for D1. 232

Table 5-48: Sensitivity analysis life cycle costing impact compared to original results for D1. 232

Table 5-49: Sensitivity analysis parameters for D2. 233

Table 5-50: Sensitivity analysis consumption data and environmental impact compared to original results for D2. 233

Table 5-51: Sensitivity analysis life cycle costing impact compared to original results for D2. 234

Table 5-52: Sensitivity analysis parameters for D3 235

Table 5-53: Sensitivity analysis consumption data and environmental impact compared to original results for D3. 235

Table 5-54: Sensitivity analysis life cycle costing impact compared to original results for D3. 236

Table 6-1: Review of in 2011 Best Available Technologies (BAT) for commercial and industrial washing machines, based on Lot 24 study (2011). 243

Table 6-2: Review of in 2011 Best Not Yet Available Technologies (BNAT) for commercial and industrial washing machines in 2011, based on Lot 24 study (2011). 244

Table 6-3: Selection of PRESENT Best Available Technologies as Design Options (DO) for commercial and industrial washing machines 245

Table 6-4: Overview of present BNAT for commercial washing machines in 2025. 249

Table 6-5: Review of in 2011 Best AVAILABLE Technologies for commercial and industrial dryers, based on Lot 24 study (2011). 252

Table 6-6: Review of in 2011 Best NOT yet Available Technologies for non-domestic dryers in 2011, based on Lot 24 study (2011). 253

Table 6-7: PRESENT Best AVAILABLE Technologies for commercial and industrial dryers. 254

Draft for SH

Table 6-8: Overview of BNAT Design Options for commercial and industrial washing machines in 2025. 255

Table 6-9: Summary of selected Design Options for commercial and industrial washing machines in 2025. 256

Table 6-10: Summary of selected Design Options for commercial and industrial dryers in 2025. 256

Table 6-11: Overview of Base Cases for commercial and industrial washing machines and dryers. 258

Table 6-12: Design option parameters for WM1: Light duty commercial washer extractor. 259

Table 6-13: Design option parameters for WM2: Commercial washer extractor. 260

Table 6-14: Design option parameters for WM3: Commercial washer dryer. 262

Table 6-15: Design option parameters for WM4: Commercial barrier washer. 264

Table 6-16: Design option parameters for WM5: Industrial continuous tunnel washer. 265

Table 6-17: Design option parameters for D1: Light duty commercial tumble dryer. 266

Table 6-18: Design option parameters for D2: Commercial tumble dryer. 267

Table 6-19: Design option parameters for D3: Cabinet dryer 268

Table 6-20: Design option parameters for D4: Industrial pass-through tumble dryer. 269

Table 6-21: Results for WM1: Environmental impact of Design Options compared to Base Case per product per year of use. 271

Table 6-22: Results for WM2: Environmental impact. of Design Options compared to Base Case per product per year of use. 272

Table 6-23: Results for WM3: Environmental impact of Design Options compared to Base Case per product per year of use. 273

Table 6-24: Results for WM4: Environmental impact of Design Options compared to Base Case per product per year of use. 274

Table 6-25: Results for WM5: Environmental impact of Design Options compared to Base Case per product per year of use. 275

Table 6-26: Results for D1: Environmental impact of Design Options compared to Base Case related to kg of dry textiles treated. 276

Table 6-27: Results for D2: Environmental impact of Design Options compared to Base Case related to kg of dry textiles treated. 277

Table 6-28: Results for D3: Environmental impact of Design Options compared to Base Case related to kg of dry textiles treated. 278

Table 6-29: Results for D4: Environmental impact of Design Options compared to Base Case related to kg of dry textiles treated. 279

Table 6-30: Results for WM1: Life cycle costing impact of Design Options compared to Base Case. 281

Table 6-31: Results for WM2: Life cycle costing impact of Design Options compared to Base Case. 281

Table 6-32: Results for WM3: Life cycle costing impact of Design Options compared to Base Case. 282

Table 6-33: Results for WM4: Life cycle costing impact of Design Options compared to Base Case. 282

Draft for SH

Table 6-34: Results for WM5: Life cycle costing impact of Design Options compared to Base Case. 283

Table 6-35: Results for D1: Life cycle costing impact of Design Options compared to Base Case. 283

Table 6-36: Results for D2: Life cycle costing impact of Design Options compared to Base Case. 284

Table 6-37: Results for D3: Life cycle costing impact of Design Options compared to Base Case. 284

Table 6-38: Results for D4: Life cycle costing impact of Design Options compared to Base Case. 285

Table 6-39: Percentage change in environmental impact for washing machine Design Options compared to the original Base Cases. 286

Table 6-40: Percentage change in environmental impact for dryer Design Options compared to the original Base Cases. 287

Table 6-41: Total yearly costs of Design Options in EUR per washing machine Base Case. 288

Table 6-42: Total yearly costs of Design Options in EUR per dryer Base Case. 288

Table 7-1: Requirements. 291

Table 7-2: average performance of the tested industrial products. 293

Table 7-3: Contribution to the LCA impact (PEF single score) over the total lifetime of the product, on product level. 294

Table 7-4: Relevance of the use phase in the LCC, at product level. 294

Table 7-5: Improvement potentials, on product level. 295

Table 7-6: Contribution of each BC to the achievable savings of the whole market. 295

Table 7-7: Overview of the scope and standards to be applied. 298

Table 7-8: Overview of the EN performance and safety EN standards for commercial and industrial laundry products. 299

Table 7-9: Main differences between standards EN50640:2018 & EN17116-3/4:2019. 306

Table 7-10: Data available to assess performance requirements. 308

Table 7-11: Suggested weighting factor to convert specific consumption in PEF single score. 311

Table 7-12: Overview of use-cases per stakeholder and whether a DPP is necessary. 314

Table 7-13: Overview of aspects to be determined according to ESPR Article 9 315

Table 7-14: Evaluation of data / requirements related requirements according to ESPR ANNEX III Information requirements. 316

Table 7-15: Evaluation of data related requirements according to ESPR Article 7 Information requirements. 317

Table 7-16 Selected input data from Tasks 5 and 6 for BAU and BAT. 323

Table 7-17 Input data from Tasks 5 and 6 and Task 7 assumptions. 325

Table 7-18 Data on greenhouse gas intensity of electricity production and electricity prices from the EU reference scenario and derived dynamic data for Task 7. 326

Draft for SH

Table 7-19 Use-phase 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) .332

Table 7-20 Greenhouse gases associated to use-phase 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)..... 334

Table 7-21 Use-phase water and detergent consumption of the BAU and the BAT scenario. 335

Table 7-22 Overview of costs of the BAU and the BAT scenario for selected years. . 337

Table 7-23 Variations in the electricity price considered for the sensitivity analysis. .. 338

Table 7-24 Overview of results for 2025..... 340

Table 7-25 Overview of results for 2035..... 341

Table 7-26 Overview of results for 2050..... 342

Table 9-1: Proposed categorisation in (Graulich et al. 2011). 374

Table 9-2: Description of the fundamental difference between a commercial and industrial laundry. 378

Table 9-3: Description of the fundamental difference between a commercial and industrial laundry 379

Table 9-4: Consumption based on lifetime of different types of machines Source: ETCT (2025b). 383

Table 9-5: Bill of Materials for WM1. 385

Table 9-6: Packaging used for WM1. 388

Table 9-7: Energy inputs Manufacturing for WM1. 390

Table 9-8: Material inputs Manufacturing for WM1. 390

Table 9-9: Distribution input for WM1. 393

Table 9-10: Use phase parameters for calculation for WM1. 394

Table 9-11: Use phase input data for WM1. 395

Table 9-12: Economic inputs for WM1. 397

Table 9-13: Escalation rate parameters for WM1 399

Table 9-14: Bill of Materials for WM2. 400

Table 9-15: Packaging used for WM2 402

Table 9-16: Energy inputs Manufacturing for WM2 403

Table 9-17: Material inputs Manufacturing for WM2. 404

Table 9-18: Distribution input for WM2. 405

Table 9-19: Use phase parameters for calculation for WM2. 406

Table 9-20: Use phase input data for WM2. 407

Table 9-21: Economic inputs for WM2. 409

Table 9-22: Escalation rate parameters for WM2. 411

Table 9-23: Bill of Materials for WM3. 412

Table 9-24: Packaging used for WM3 414

Draft for SH

Table 9-25: Energy inputs Manufacturing for WM3. 415
Table 9-26: Material inputs Manufacturing for WM3. 415
Table 9-27: Distribution input for WM3. 416
Table 9-28: Use phase parameters for calculation for WM3. 417
Table 9-29: Use phase input data for WM3. 419
Table 9-30: Economic inputs for WM3. 420
Table 9-31: Escalation rate parameters for WM3. 422
Table 9-32: Bill of Materials for WM4. 423
Table 9-33: Packaging used for WM4. 426
Table 9-34: Energy inputs Manufacturing for WM4. 427
Table 9-35: Material inputs Manufacturing for WM4. 427
Table 9-36: Distribution input for WM4. 429
Table 9-37: Use phase parameters for calculation for WM4. 431
Table 9-38: Use phase input data for WM4 433
Table 9-39: Economic inputs for WM4. 434
Table 9-40: Escalation rate parameters for WM4. 436
Table 9-41: Bill of Materials for WM5. 437
Table 9-42: Energy inputs Manufacturing for WM5. 439
Table 9-43: Material inputs Manufacturing for WM5. 439
Table 9-44: Distribution input for WM5. 440
Table 9-45: Use phase parameters for calculation for WM5. 442
Table 9-46: Use phase input data for WM5 444
Table 9-47: Economic inputs for WM5. 445
Table 9-48: Escalation rate parameters for WM5. 447
Table 9-49: Bill of Materials for D1. 448
Table 9-50: Packaging used for D1. 451
Table 9-51: Energy inputs Manufacturing for D1. 452
Table 9-52: Material inputs Manufacturing for D1. 452
Table 9-53: Distribution input for D1. 453
Table 9-54: Use phase parameters for calculation for D1 455
Table 9-55: Use phase input data for D1. 456
Table 9-56: Economic inputs for D1. 457
Table 9-57: Escalation rate parameters for D1. 459
Table 9-58: Bill of Materials for D2. 460
Table 9-59: Packaging used for D2. 463
Table 9-60: Energy inputs Manufacturing for D2. 464
Table 9-61: Material inputs Manufacturing for D2. 464

Draft for SH

Table 9-62: Distribution input for D2. 466
Table 9-63: Use phase parameters for calculation for D2. 467
Table 9-64: Use phase input data for D2. 468
Table 9-65: Economic inputs for D2. 469
Table 9-66: Escalation rate parameters for D2. 472
Table 9-67: Bill of Materials for D3. 473
Table 9-68: Packaging used for D3. 475
Table 9-69: Energy inputs Manufacturing for D3. 476
Table 9-70: Material inputs Manufacturing for D3. 476
Table 9-71: Distribution input for D3. 477
Table 9-72: Use phase parameters for calculation for D3. 478
Table 9-73: Use phase input data for D3. 479
Table 9-74: Economic inputs for D3. 481
Table 9-75: Escalation rate parameters for D3. 483
Table 9-76: Bill of Materials for D4. 484
Table 9-77: Energy inputs Manufacturing for D4. 486
Table 9-78: Material inputs Manufacturing for D4. 486
Table 9-79: Distribution input for D4. 487
Table 9-80: Use phase parameters for calculation for D4 488
Table 9-81: Use phase input data for D4. 489
Table 9-82: Economic inputs for D4. 490
Table 9-83: Escalation rate parameters for D4. 492
Table 9-84: Overview of Eurostat datasets. 493
Table 9-85: Escalation rate per product 494
Table 9-86: Life cycle impact per product: WM1 495
Table 9-87: Life cycle impact per product per year of use: WM1. 497
Table 9-88: EU total impact of new products sold in the year of study: WM1 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers) 500
Table 9-89: EU total impact of Stock of products in the year of study: WM1 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 502
Table 9-90: Life cycle costs per product and total EU expenditure: WM1. 504
Table 9-91: Life cycle impact per product: WM2 505
Table 9-92: Life cycle impact per product per year of use: WM2. 507
Table 9-93: EU total impact of new products sold in the year of study: WM2 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers) 510
Table 9-94: EU total impact of Stock of products in the year of study: WM2 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers). 512
Table 9-95: Life cycle costs per product and total EU expenditure: WM2. 514

Draft for SH

Table 9-96: Life cycle impact per product: WM3. 515

Table 9-97: Life cycle impact per product per year of use: WM3. 517

Table 9-98: EU total impact of new products sold in the year of study: WM3 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers). 520

Table 9-99: EU total impact of Stock of products in the year of study: WM3 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers). 522

Table 9-100: Life cycle costs per product and total EU expenditure: WM3. 524

Table 9-101: Life cycle impact per product: WM4. 525

Table 9-102: Life cycle impact per product per year of use: WM4. 527

Table 9-103: EU total impact of new products sold in the year of study: WM4 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 530

Table 9-104: EU total impact of Stock of products in the year of study: WM4 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 532

Table 9-105: Life cycle costs per product and total EU expenditure: WM4. 534

Table 9-106: Life cycle impact per product: WM5. 535

Table 9-107: Life cycle impact per product per year of use: WM5.. 537

Table 9-108: EU total impact of new products sold in the year of study: WM5 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers). 540

Table 9-109: EU total impact of Stock of products in the year of study: WM5 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 542

Table 9-110: Life cycle costs per product and total EU expenditure: WM5. 544

Table 9-111: Life cycle impact per product: D1. 545

Table 9-112: Life cycle impact per product per year of use: D1. 547

Table 9-113: EU total impact of new products sold in the year of study: D1 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 549

Table 9-114: EU total impact of Stock of products in the year of study: D1 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 551

Table 9-115: Life cycle costs per product and total EU expenditure: D1. 553

Table 9-116: Life cycle impact per product: D2. 555

Table 9-117: Life cycle impact per product per year of use: D2. 557

Table 9-118: EU total impact of new products sold in the year of study: D2 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 560

Table 9-119: EU total impact of Stock of products in the year of study: D2 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers). 562

Table 9-120: Life cycle costs per product and total EU expenditure: D2. 564

Table 9-121: Life cycle impact per product: D3. 565

Table 9-122: Life cycle impact per product per year of use: D3. 567

Table 9-123: EU total impact of new products sold in the year of study: D3 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 569

Table 9-124: EU total impact of Stock of products in the year of study: D3 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 572

Draft for SH

Table 9-125: Life cycle costs per product and total EU expenditure: D3. 574

Table 9-126: Life cycle impact per product: D4. 575

Table 9-127: Life cycle impact per product per year of use: D4. 577

Table 9-128: EU total impact of new products sold in the year of study: D4 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 580

Table 9-129: EU total impact of Stock of products in the year of study: D4 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers). 582

Table 9-130: Life cycle costs per product and total EU expenditure: D4. 584

Draft for SH

List of Figures

Figure 2-1: Policy cycle in the Ecodesign context. 3

Figure 2-2: Stages of this preparatory study in advance of the subsequent impact assessment study. 4

Figure 3-1: Basic structure of MEErP (a) (note), Detailed structure of MEErP (b). 8

Figure 4-1: Different steps of a professional laundry process (Graulich et al., 2011). 11

Figure 4-2: Different steps of an industrial laundry process. 13

Figure 4-3: 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. 81

Figure 4-4: 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).82

Figure 4-5: Market share of manufacturers of dryers above 10kg capacity per Member State. 84

Figure 4-6: International trade of the EU27 of Laundry-type washing machines, of a dry linen capacity > 10 kg, 2014-2023 (in MEUR) - COMEXT data. 88

Figure 4-7: International trade of the EU27 of Drying machines, of a dry linen capacity > 10 kg, 2014-2023 (in MEUR) - COMEXT data. 89

Figure 4-8: Long-term interest rates in the EU27 (2010-2024), in percentage points / year. 122

Figure 4-9: Various heating systems in laundries. 144

Figure 4-10: Example of a modular detergent system and wash programme for blue work wear. 152

Figure 5-1: Contribution analysis (including EoL credits), WM11. 185

Figure 5-2: Contribution analysis – Use phase, WM1. 186

Figure 5-3: Contribution analysis – Raw materials, WM1WM2: Professional washer extractor. 186

Figure 5-4: Contribution analysis (including EoL credits), WM2. 187

Figure 5-5: Contribution analysis – Use phase, WM2. 188

Figure 5-6: Contribution analysis – Raw materials – WM2. 189

Figure 5-7: Contribution analysis (including EoL credits), WM3. 190

Figure 5-8: Contribution analysis – Use phase, WM3. 191

Figure 5-9: Contribution analysis – Raw materials, WM3. 191

Figure 5-10: Contribution analysis (including EoL credits), WM4. 192

Figure 5-11: Contribution analysis – Use phase, WM4. 193

Figure 5-12: Contribution analysis – Raw materials, WM4. 193

Figure 5-13: Contribution analysis (including EoL credits), WM5. 194

Figure 5-14: Contribution analysis – Use phase, WM5. 195

Figure 5-15: Contribution analysis – Raw materials, WM5. 195

Figure 5-16: Contribution analysis (including EoL credits), D1. 196

Draft for SH

Figure 5-17: Contribution analysis – Raw materials, D1. 197
Figure 5-18: Contribution analysis (including EoL credits), D2. 198
Figure 5-19: Contribution analysis – Use phase, D2. 199
Figure 5-20: Contribution analysis – Raw materials, D2. 199
Figure 5-21: Contribution analysis (including EoL credits), D3. 200
Figure 5-22: Contribution analysis – Raw materials, D3. 201
Figure 5-23: Contribution analysis (including EoL credits), D4. 202
Figure 5-24: Contribution analysis – Use phase, D4. 203
Figure 5-25: Contribution analysis – Raw materials, D4. 203
Figure 5-26: Cost contribution (per year), WM1. 206
Figure 5-27: Cost contribution (per year), WM2. 207
Figure 5-28: Cost contribution (per year), WM3. 208
Figure 5-29: Cost contribution (per year), WM4. 209
Figure 5-30: Cost contribution (per year), WM5. 210
Figure 5-31: Cost contribution (per year), D1. 211
Figure 5-32: Cost contribution (per year), D2. 212
Figure 5-33: Cost contribution (per year), D3. 213
Figure 5-34: Cost contribution (per year), D4. 214
Figure 6-1: Comparison between ultrasonic cleaning and traditional washing methods in commercial laundry. 250
Figure 6-2: Nanofiltration technology in commercial laundry. 251
Figure 7-1: Type of requirements within the ESPR framework. 298
Figure 7-2:Suggested EN standards to be applied in a possible ESPR regulation according to the product to be tested 302
Figure 7-3 Schematic representation of the scenario analysis model. 329
Figure 7-4 Sales in the BAU scenario for all base cases (sorted according to sales numbers). 330
Figure 7-5 Calculated stock in the BAU scenario based on sales data assumptions and lifetimes. 331
Figure 7-6 Changes in the stock of the BAT scenario for base case D2 due to BAU and BAT product sales. 331
Figure 7-7 Electricity consumption of the BAT scenario and savings compared to the BAU scenario. 332
Figure 7-8 Greenhouse gases associated to use-phase electricity consumption of the BAT scenario and savings compared to the BAU scenario. 333
Figure 7-9 Use-phase water consumption of the BAT scenario and savings compared to the BAU scenario. 334
Figure 7-10 Use-phase detergent consumption of the BAT scenario and savings compared to the BAU scenario. 335

Draft for SH

Figure 7-11 costs of use-phase electricity consumption of the BAT scenario and savings compared to the BAU scenario. 336

Figure 7-12 sensitivity of use-phase electricity consumption of the BAT scenario. 339

Figure 9-1: Laundry process diagram..... 382

Draft for SH

List of Abbreviations

AC	Alternate current
AHL	Apartment Household Laundry
BAT	Best Available Technologies
BEP	Break-even Point
CCL	Coin & Card Laundry
CIL	Commercial Industrial Laundry
CN	Combined nomenclature
D	Dryer
DC	Direct current
DoC	Declaration of conformity
DPP	Digital Product Passport
EoL	End-of-Life
EPREL	European Product Registry for Energy Labelling
ESPR	Ecodesign for Sustainable Products Regulation
HCL	Healthcare Laundry
HH	Healthcare Hospital
HN	Healthcare Nursing Home
HPL	Hospitality Laundry
HS	Harmonized Commodity Description and Coding System
JRC	Joint Research Centre
LCA	Life Cycle Assessment
LCC	Life Cycle Cost
LLCC	Least Life Cycle Costs
LVD	Low Voltage Directive
MEErP	Methodology for Ecodesign of Energy-related Products
PEF	Product Environmental Footprint

Draft for SH

PEFCR Product Environmental Footprint Category Rules

PRODCOM A system for the collection and dissemination of statistics on the production of manufactured goods

SP Speciality Laundry

ToR Terms of Reference

WCO World Customs Organization

WM Washing machine

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1. Changes introduced in this version

During the stakeholder workshop held on 30 September 2024, a few possible changes to the product group categorisation were discussed. Stakeholders requested that some of these be introduced into the categorisation so that they could consider these changes in the last feedback that they provide. To this end, a section has been added at the end of Task 1 titled 4.1.7 ”Categorisation proposed following the stakeholder meeting of 30 September 2024” (see **Section 4.1.7**). In this section the proposed categorisation is specified for these purposes, also giving some explanation as to the intentions of the proposed categorisation.

Moreover, some updates to individual data presented in Task 2, 3 and 4 have been implemented following the extended stakeholder consultation in December 2024.

After the second stakeholder workshop held on 10 April 2025, **Annex IV: Aspects related to industrial laundry machines** was included in this report to reflect stakeholders’ views on the scope and definitions for industrial machines.

Task 5 has been updated following the stakeholder meeting, including the addition of a sensitivity analysis in section 5.7. The reporting on substances of concern is also now referenced in section 5.8.2 of task 5 and included in Annex VIII to this report.

Task 6 and task 7 which were not included in the report sent to stakeholders before the 2nd stakeholder meeting have been completed and are included in this report.

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2. 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 MEErP 2011 methodology (Kemna, 2011), takes into account the 2024 revision of MEErP (Caldas et al., 2022) 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.

2.1. 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 ((2022/C 182/01), 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 Ecodesign for Sustainable Products Regulation (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 Digital Product Passport

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With ESPR, the Commission is preparing for the addressing of 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 2-1**, 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).

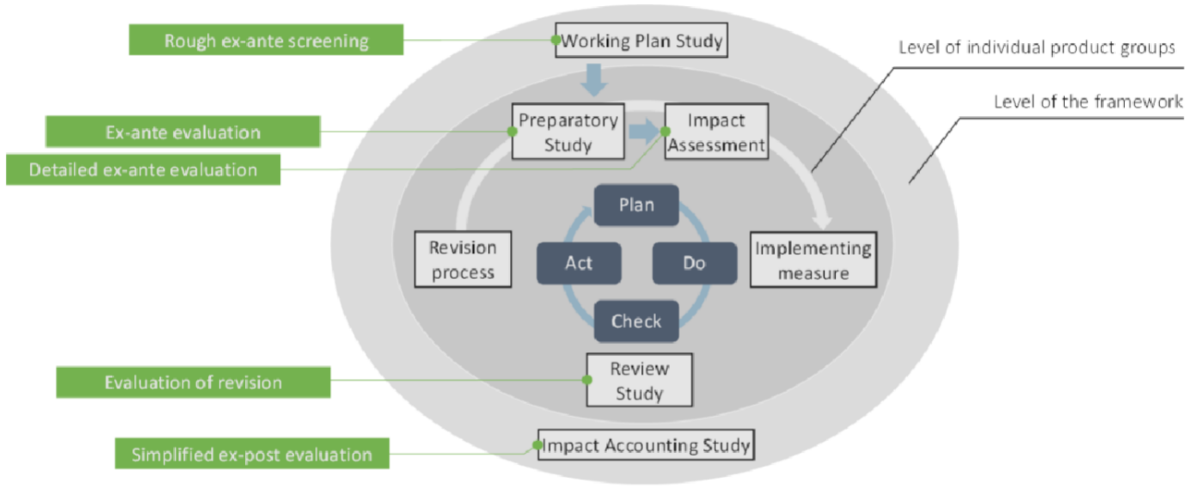

Figure 2-1: Policy cycle in the Ecodesign context.

Source: (Durand et al. 2022)

Figure 2-2 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.

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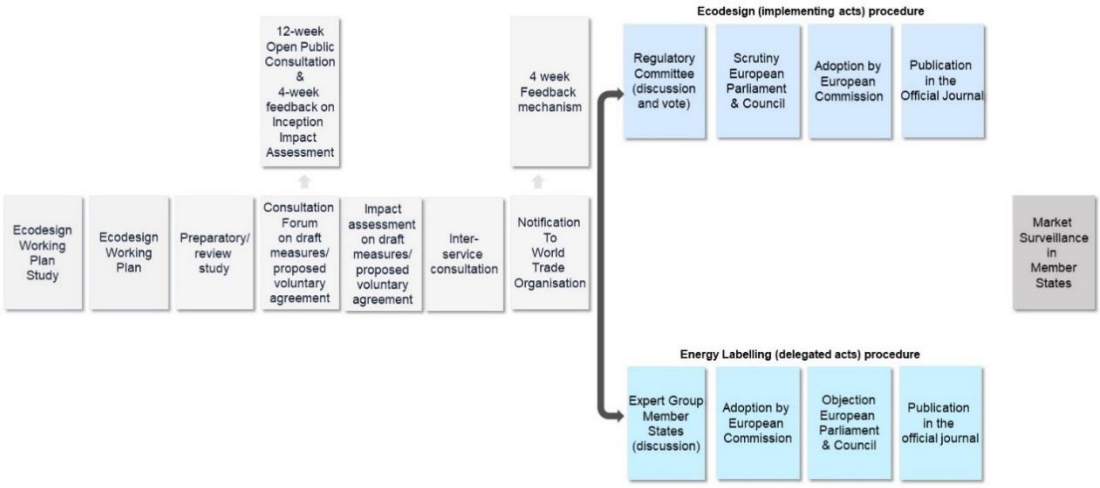

Figure 2-2: Stages of this preparatory study in advance of the subsequent impact assessment study.

Source: based on Lot 25 report (2011)

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

DG ENVIRONMENT 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.

Industrial and professional/commercial 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 ("professional 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 preparatory study

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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 only 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 professional 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.

2.3. Prior work

2.3.1. Preparatory Study 2011 for Eco-design Requirements of Energy-using Products Preparatory ecodesign study - 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 professional 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

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- 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 requirements and the specific on-site and local infrastructure, which calls into question the comparability and classifiability of appliances, e.g. related 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 is still missing, even in the meanwhile developed standards.

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3. Methodology

3.1. Background - on the MEErp Approach

3.1.1. MEErP and EcoReportTool

The ESPR Ecodesign regulation provides a harmonised methodological approach termed MEErP (Methodology and Guidelines for the Ecodesign of Products) 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 (Life Cycle Assessment (LCA) and Life Cycle Cost assessment; (LCC) of representative products (Base cases);
- **Task 6:** Design options;
- **Task 7:** Scenarios (policy, scenario, impact and sensitivity analysis).

Figure 3-1 shows the structure of the MEErP.

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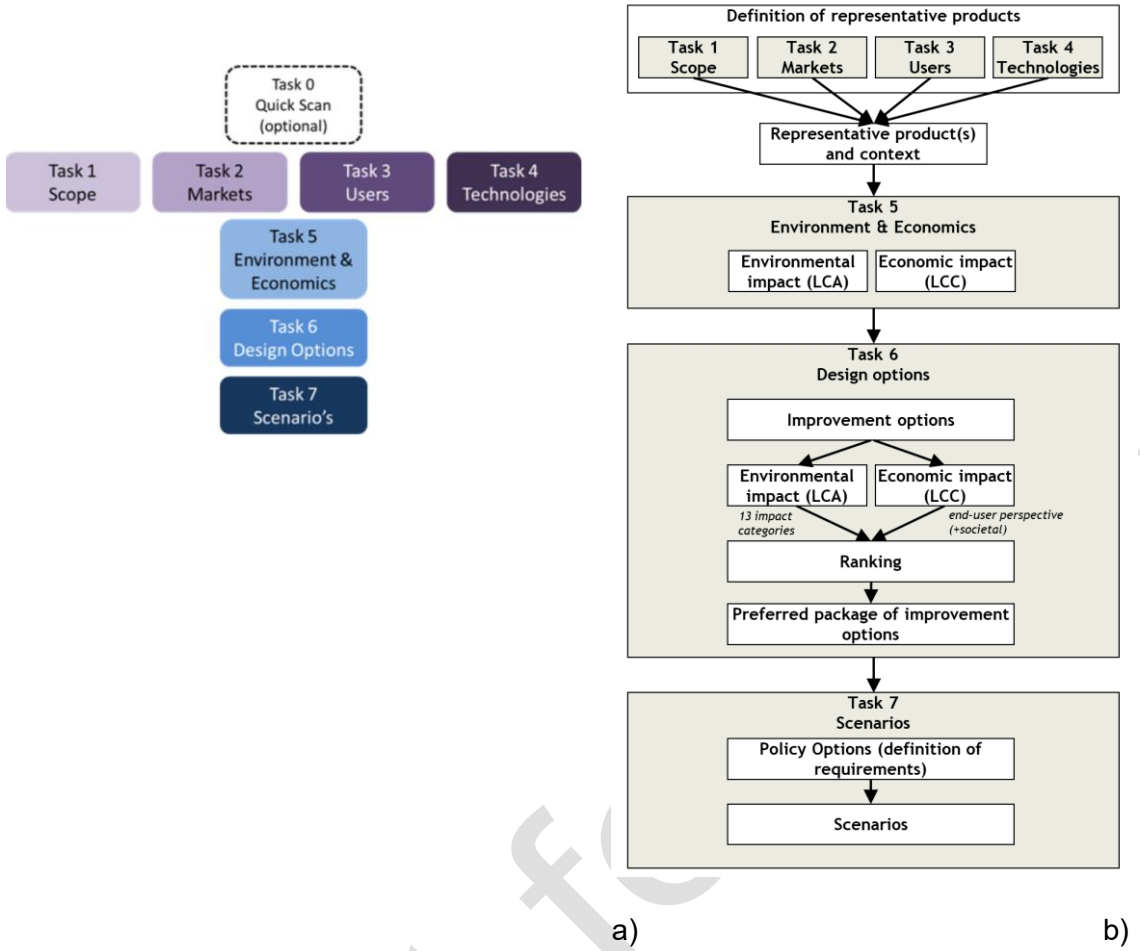

Figure 3-1: Basic structure of MEErP (a) (note 1), Detailed structure of MEErP (b).

A new version of the MEErP methodology has recently been published (European Commission. Joint Research Centre., 2024). The revised MEErP is intended to incorporate material efficiency and environmental aspects more systematically and to update the EcoReport tool. The 2024 MEErP method considers the 16 impact categories used in the Environmental Footprint (EF) method, in an effort to harmonise the EcoReport tool 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.

3.2. Approach of the preparatory study

3.2.1. Stakeholder consultation

To collect data and exchange with stakeholders a few forms of consultation have been implemented so far.

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 is furthermore planned for 15 September 2025.

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4. 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.

Subsequently, though the term professional laundry appliance/s is sometimes used in this report for convenience, this is done 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.

4.1. 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 industrial and commercial 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

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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.

4.1.1. 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.

4.1.1.1. 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.

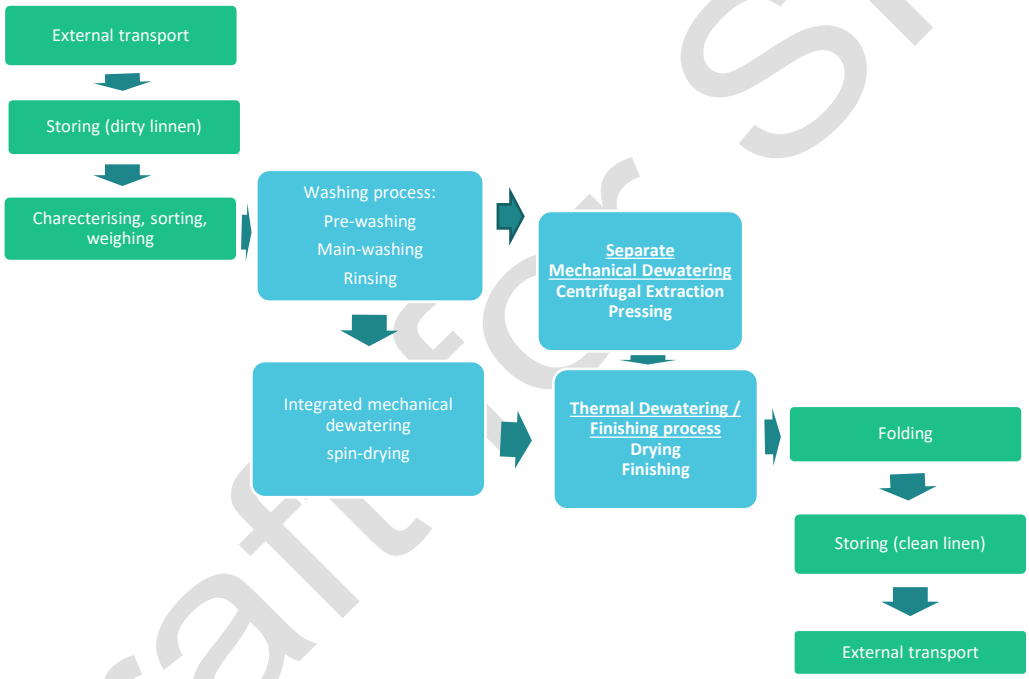

Figure 4-1: Different steps of a professional laundry process (Graulich et al., 2011).

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, professional 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.

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- 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:

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- 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 4-2,** specifying such additional equipment.

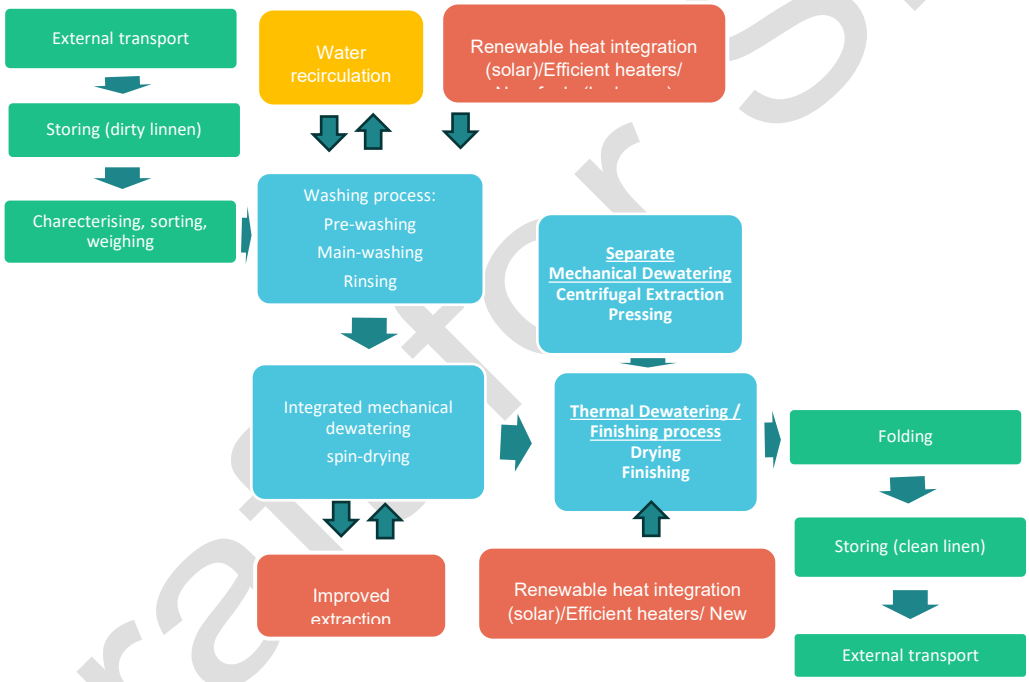

Figure 4-2: Different steps of an industrial laundry process.

(Industrial stakeholder 2024)

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, professional 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.

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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 professional washing machine or dried by a professional dryer, e.g. clothes, 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 professional washing machine or dryer.

4.1.1.2. 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.

4.1.1.3. Detergents for professional 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 professional 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)

Professional textile detergents 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.

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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.

4.1.2. 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);
- Harmonized 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.

4.1.2.1. PRODCOM category or categories (Eurostat) and the classification of professional 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.

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Table 4-1: 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 calendering 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
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 professional washing machines and dryers. For example, among the washing machines or dryers there is no further differentiation regarding capacity or other functional performance parameters.

4.1.2.2. The Combined Nomenclature

The Harmonized 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 Organization (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 on the basis of the Harmonized 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 4-2: Classification of washing machines and dryers according to the HS-Classification. (WCO)

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	Calendering or other rolling machines, other than for metals or glass, and cylinders therefore
8420.10	Calendering or other rolling machines
8420.91 / 8420.99	Parts: Cylinders / Other
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

Code	Description
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 Combined Nomenclature is also too rough to provide a basis for defining a clear scope of professional 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”.

4.1.2.3. 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 professional 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 4-3: 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 program 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 (Manufacturer, 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 3.2.1**) performed so far 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

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threshold in 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 are described very similarly to those specified in **Table 4-3** above:

Table 4-4: 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
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

Term	Definition
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 4.1.4**).

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

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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 4-1 provides an overview of product categories being in the scope of ISO 10472.

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579 **Table 4-5: 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.

Washing machines and washer extractors > 60 litres (ISO 10472-2) with definitions for the following sub-categories:	
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.

Washing machines and washer extractors > 60 litres (ISO 10472-2) with definitions for the following sub-categories:	
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. However, though the ISO standards refer to industrial laundry machines, it is noted that, the term “industrial” includes also rather small semi-professional and professional machines. There is not always a clear differentiation between washing machines or dryers with regard to industrial and commercial equipment, e.g.

capacity or other functional performance parameters **Section 4.1.3.1** takes a deeper look into the possible distinction between the three appliance segments. Household, commercial and industrial.

4.1.2.4. 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 4.1.5.4**). 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.

4.1.2.5. 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,

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- 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), 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 non-Household appliances** (possible through reference to LVD and 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. 4 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 (drying cabinet). 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 D4 was not found (pass through dryers) and the related stakeholder reference needs to be confirmed. A suitable standard was also not found for D3 (cabinet dryers) as also claimed in the statement above. In its scope, standard 50640:2018 is explained to apply to washer extractors, washer dryers (the washing function) and washing machines with more than one compartment, assumed to represent barrier washers. In this sense, standardisation of washing machines is understood to cover all above specified categories, whereas for dryers, for categories D3 and D4 standardisation seems to be missing.

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 misleading, one stakeholder explained that differentiation between semi-professional and professional 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 laundromats, 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 semi-professional machines as compared to professional ones. They proposed to also include it in future declaration of performance.

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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 professional 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 semi-professional machine that has a durability between the household machines and professional 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 - <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:

- 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 is specified as "Professional cabinet dryer". 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).

[2] It is noted that of the 13 manufacturers that participated in the 1st consultation, only 3 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).

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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. 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 an energy 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 is specified as “Professional barrier washers” 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 WM6 “Professional barrier washers” category, 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 WM6 “Professional barrier washers” category: 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.

4.1.3. Delimitation of professional washing machines and dryers

This study focuses on professional laundry appliances. They are used to clean, rinse and dry textiles in commercial customer and market segments. Professional 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. Professional washing machines may or may not have a specific drying operation at the end of the washing phase of a washing program resulting in different kinds of machinery (washing machines, washer extractors, washer dryers).

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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 Declaration of Conformity 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.

4.1.3.1. Distinction between household and non-household 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

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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 (semi-) professional 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 and non-household 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 4.1.1.3**).

A possible general differentiation is given in the amended version of the Machinery Directive 2006/42/EC (Machine Directive, 2006/9.6.2006), in force since 29th December 2009. It clarifies the borderline between machinery for households (domestic) and for professional use (non-domestic, i.e., commercial and industrial use) in order to provide greater legal certainty. Whereas professional use machinery 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 (LVD, 2014/29.3.2014)[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 declaration of conformity or product information (European Commission [EC], 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” (EC, 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 Declaration of Conformity provides a clear cut-differentiation between household appliances and those intended for commercial or industrial use.

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

Draft for SH

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 3.2.1**), 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:

- **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

[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

Draft for SH

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-program and programmability may become increasingly available in domestic machines in the future.
- **Durability** and related specifications of materials and components: though stakeholders agree that non-household 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 semi-professional and professional.
- **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; program duration or cycle time due to productivity demands of commercial users.

Though different parameters were investigated in this manner, none of them would provide clear differentiation between household and non-household 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 2023/1230 EU, regardless of the size or the technology used.
- **tunnel washer**: a professional 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 definition 1 but not with definition 2. 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 definition 3 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

Draft for SH

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.

4.1.4. Test standards of professional washing machines and dryers

This subtask aims to specify the relevant test standards for professional 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. A short overview of existing test standards is given, in some cases including household standards whose scope also addresses non-household appliances.

4.1.4.1. Performance

Following a mandate given by the Commission to CENELEC and CEN to develop new performance standards for professional laundry machines, a few new standards were developed regarding the performance and related tests procedures for professional washing and drying appliances. The standards differ for industrial laundry machines (EN 17116 series) and professional 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 professional 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 addresses “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,

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946 – steam consumption,
947 – and gas consumption,
948 • water consumption,
949 • detergent consumption,
950 • hourly production input.

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

955 **Standard EN 17116-4:2019**

956 This standard addresses “Specifications for industrial laundry machines – Definitions and
957 testing of capacity and consumption characteristics – Part 4_ Washer extractors”. From its title
958 it is concluded that the standard addresses industrial washers considered to have “a net
959 usable cage volume of 400 dm^3 (litres), respectively 40 kg and above”. The standard lays
960 down procedures for the testing of the following performance parameters of wash machines
961 that are in its scope. For this purpose, general test conditions including specification of the
962 reference machine, test load and number of test runs and others are given. For the same
963 purpose, the standard also specifies: ambient temperature and humidity, water supply and
964 water properties (hardness, temperature, pressure), energy and electricity supply,
965 compressed air supply, steam supply. The parameters for which test procedures are specified
966 include:

967 • Wash performance, including:
968 – Moisture content of the soiled load,
969 – Corrected weight of the nominal load,
970 – Primary wash performance,
971 – Secondary wash performance,
972 – Rinse performance.
973 • Energy consumption, including:
974 – Determination of electrical energy,
975 – Determination of steam and gas consumption;
976 • Water consumption,
977 • Detergent consumption,
978 • Hourly productivity,
979 • Residual moisture after extraction.

980 **Standard EN 50640:2018**

981 The standard addresses Household and similar electric appliances – Methods for measuring
982 the performance of clothes washing machines intended for commercial use. The name is a bit
983 misleading, but the specific standard is actually intended to detail performance testing

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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 components (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

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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 non-household 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 developed can be used to determine some consumption data (water and energy consumption). However, stakeholders mentioned that these two CLC standards (EN 50640 and EN 50594) 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:

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- EN 17116-2: Batch drying tumblers
- EN 17116-3: Continuous tunnel washer
- EN 17116-4: 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 professional 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 professional washing machines and dryers due to insufficient reproducibility; however, manufacturers feed their experiences into the work on the development of new performance standards for professional laundry machines (sub working group CLC/TC59X/ SWG1.12 of CENELEC TC59X).

- 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

Draft for SH

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

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 de-vice. 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:

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- 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 professional washing machines and dryers in Europe.

ISO 9398 series for professional laundry machinery defines a measurement method for the energy and water consumption; however, 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 professional 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.

4.1.4.2. 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

[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.

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combination with the machine-specific parts of this standard series, fall into the commercial/professional 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 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 4.1.2.3**). 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;

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- 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

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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.

Draft for SH

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 provides requirements and recommendations relating to the electrical equipment of machines so as to promote safety of persons and property; consistency of control response; – 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

Draft for SH

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.

4.1.4.3. 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)

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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 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

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

Draft for SH

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.

4.1.4.4. 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 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

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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).

Draft for SH

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

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permit comparison of the performance of different units of a given family of machines, under defined environmental conditions and standardized 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.

4.1.4.5. 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,

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- 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 10Hz 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)

4.1.4.6. 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.

Draft for SH

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

4.1.5. Existing legislation and environmental labelling

This task aims at identifying and screening relevant legislation for the product group. The task can be subdivided into three parts (European legislation, Member State legislation and third country legislation) and is structured accordingly.

4.1.5.1. European legislation

Apart from the obvious environmental directives (RoHS, WEEE, Packaging directive), relevant regulations could be such 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 eco-design standards (e.g. ECMA, EIA) for the sector or related sectors need to be identified. Finally, especially in a business-to-business context, it needs to be described which quality requirements (e.g. "proven design", maximum failure rate) are customary.

Machinery Directive (MD) 2006/42/EC (replacing 98/37/EC)

The new Machinery Directive 2006/42/EC (Machine Directive, 2006/9.6.2006) 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 declaration of conformity 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 Machinery Directive was to clarify the borderline between the scope of the Machinery Directive (MD) and the former Low Voltage Directive

[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.

Draft for SH

(LVD) 2006/95/EC20[8] (see further details below), now recast as Directive 2014/35/EU, in order to provide greater legal certainty (EC, 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 Low Voltage Directive (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 declaration of conformity or product information (EC, 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" (EC, 2024b).

The Machinery Directive therefore applies to all professional 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 for household and professional use, see also **Section 4.1.3.1**).

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; Corrigendum to Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC, 2023/04.07.2023; Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC (Text with EEA relevance), 2023/29.06.2023). Under the new Regulation:

- Household appliances intended for domestic use that fall under the scope of the Low Voltage Directive (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 (Corrigendum to Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC, 2023/04.07.2023; Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the

[8] Formerly Directive 73/23/EEC as amended.

Draft for SFR

European Parliament and of the Council and Council Directive 73/361/EEC (Text with EEA relevance), 2023/29.06.2023).

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 Declaration of Conformity. Evidently, this statement must accurately reflect the foreseeable use of the product." (EC, 2024b).

Low Voltage Directive (LVD) 2014/35/EU

The initial Low Voltage Directive (LVD) 73/23/EEC was revised and recast as 2006/95/EC and later again as Directive 2014/35/EU (LVD, 2014/29.3.2014). 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 (EC, 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 (EMC, 2014/29.3.2014) 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 tele-communication 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.

Draft for SH

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

Directive 2002/95/EC was reviewed and recast as Directive 2011/65/EU (RoHS, RoHS, 2011/1.7.2011) 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 electronic and electrical 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 (EC, 2012) on RoHS and WEEE Directives which clarifies that professional 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”.

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 investigate din 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

[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.”

[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.

Draft for SH

2012/19/EU (WEEE, 2012/24.7.2012) 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 (EC, 2014), but reference is made to the FAQ document for the RoHS directive (EC, 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

(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

Draft for SH

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.

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 Act (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" (CRM Act, 2024/3.5.2024).

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

[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.

Draft for SH

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.

Packaging Directive 94/62/EC

The purpose of the Packaging Directive (European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, 1994/31.12.1994) 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

Draft for SH

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 current Directive many requirements remain vague in nature. These requirements affect manufacturers of packaging directly as specified in Article 13 of the Directive. The Regulation is understood to still be under negotiations and any changes could affect the packaging of commercial and industrial laundry appliances and its manufacturers.

Biocide Directive 528/2012/EU

The Biocide Directive 98/8/EC was reviewed and recast as Regulation (EU) No 528/2012 (Biocide, 2012/27.6.2012) 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

Draft for SH

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 (Regulation (EU) 2016/426 of the European Parliament and of the Council of 9 March 2016 on appliances burning gaseous fuels and repealing Directive 2009/142/EC (Text with EEA relevance), 2016/31.3.2016). 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 (EC, 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 declaration of conformity, 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 (WFD) 2000/60/EC

The Water Framework Directive (WFD) 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

Draft for SF

management, including public participation in planning and economic approaches, including the recovery of the cost of water services.

Inter alia, the Water Framework Directive 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 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 Kyoto Protocol and Parties to the Protocol that have an emissions target are required to control and reduce emissions of fluorinated gases. Fluorinated gases are man-made substances and Regulation No. 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) No. 517/2014 (Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 Text with EEA relevance, 2014/20.05.2014). 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;

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(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 CO2 equivalents and the global warming potential. Where applicable, it must also contain a

[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."

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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 declaration of conformity, 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) No. 1275/2008 – Standby

The Regulation (EC) No. 1275/2008 (Commission Regulation (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment (Text with EEA relevance), 2008/18.12.2008), 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 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

[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”.

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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 will be 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 articles and to the placing on the market of mixtures”. Hazardous substances that are relevant for washing machines will be analysed in later tasks.

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 (Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC (Text with EEA relevance), 2014/22.05.2014). 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

Draft for SH

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 (EC, 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 regulations 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 (EC, 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 for Tourism (BEMP) (Commission Decision (EU) 2016/611 of 15 April 2016 on the reference document on best environmental management practice, sector environmental performance indicators and benchmarks of excellence for the tourism sector under Regulation (EC) No 1221/2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS), 2016/20.4.2016). 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. 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 ecolabelled detergents.

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Table 4-6: 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 ecolabelled 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 out of Commission Decision (EU) 2016/611 of 15 April 2016 on the reference document on best environmental management practice, sector environmental performance indicators and benchmarks of excellence for the tourism sector under Regulation (EC) No 1221/2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) (2016)

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

4.1.5.2. 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

[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

Draft for

for microplastics from January 1, 2025. Detailed requirements are to be set out in a decree 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.

Draft for SH

[17] https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000041553781
[18] https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000041553781

4.1.5.3. Labelling at Member State level

Nordic Swan (Scandinavia)

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

- Nordic Ecolabelling for Textile services

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).

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

[19] For further details see: Nordic Ecolabelling (2024c).
[20] For further details see: Nordic Ecolabelling (2024b).
[21] For further details see: BLUE ANGEL (2021).
[22] For further details see: BLUE ANGEL (2022).
[23] For further details, see: Sustainable Energy Authority of Ireland (seai) (n. d.).

Draft for SH

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,
- 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) professional 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.

[24] See: seai (o. J.b).
[25] See: seai (o. J.a).

Draft for SH

4.1.5.4. 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 program 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 (US DOE, 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 4-7: 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

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Manufactured on or after January 8, 2013, and before January 1, 2018: **Front loading-Loading**	2.00	5.5
Manufactured on or after January 1, 2018: **Front loading-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 Program has a Product specification for clothes washers which is currently in its 8th version (USEPA, 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 is understood to apply t to cases where commercial washers are used in a public place to serve private consumers, meaning that they will be operated by laymen. 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 (USEPA, 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

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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 programs 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 program. However, no information on professional 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 (TEI, 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.

4.1.6. 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

[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 Standardization.

Draft for SH

(and the new Regulation to apply as of 2027) and the LVD 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 non-household 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. This is one of the aspects to be discussed in the next stage with stakeholders. After the stakeholder meeting, 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, and
  - Tunnel machines.

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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 at this stage 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. We will investigate their energy use and performance in the next stages, but we do 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, users 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 should thus also be discussed with stakeholders in the next stage. 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 stakeholders as arbitrary, and it shall need to be discussed at this stage or possibly when requirements are proposed if other values would be more suitable. In this respect, APPLiA (2024) suggests that professional Washers are typically to be tested according to the EN 50640 standard. For very large professional 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

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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 semi-professional appliances could be part of the professional appliances when related specifications are required e.g. durability, reliability, (expected cycles). Another stakeholder (2024) stated that the only difference between semi-professional machines and professional ones 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.

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

On 30 September a meeting was held in Brussels with stakeholders (some participated online) to verify the 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 and is presented below. Some explanations follow to clarify the intention of proposed changes for some categories.

- Professional washing machines (WM) categories:
  - WM1: Semi-professional washer extractor
  - WM2: Professional washer extractor (designed for extra long durability)
  - WM3: Professional washer dryer
  - WM4: Professional barrier washer
  - WM5: Industrial continuous tunnel washer

During the stakeholder meeting, the need to differentiate between WM1 appliances and other more robustly built commercial washing machines was expressed. This was explained as being due to 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.

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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.

- Professional dryers (D) categories:
  - D1: Semi professional tumble dryer
  - D2: Professional tumble dryer (designed for extra long durability)
  - D3: Professional cabinet dryer
  - D4: Industrial pass-through (transfer) tumble dryer

Similarly, to WM1, the new category D1 represents dryers used by untrained users which were originally 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, and this remains to be validated by stakeholders. Thus, the category name now refers to tumble dryers. Furthermore, here too, stakeholders are asked to clarify whether this category could be merged with the new category D2, differentiating between the different tumble dryers as needed, based on their expected lifetime.

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.

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

In December 2025 the 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 to this document. 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.

On the subject of the categorisation, the consultant could not follow the arguments raised in favour of using terms different to the term professional as neither of the terms proposed is defined in other legislation nor does either option solve the problem of the semi-professional categories.

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

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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 approach is no longer feasible in the course of this study.

4.2. Task 2 – Markets

Aim of MEErP Task 2 is to provide insights on market and cost aspects of industrial and commercial 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 Cost (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 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.

4.2.1. General economic data from official sources

4.2.1.1. Production

This section provides a brief description of the market situation of non-household 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 (MS). 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. non-household). 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):

[27] PRODucts of the European COMmunity.

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- **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;
- **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 4-8** and **Table 4-9** show the number of units for 2019-2023, giving an indication of where large manufacturing centres of non-household washing machines and dryers are located.

Table 4-8: 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

[28] These categories might also include large household washing machines or dryers > 10 kg.
[29] PRODCOM Code 28.94.22.30

Member State	2019	2020	2021	2022	2023
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

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 non-household 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.

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Table 4-9: 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 **Table 4-9**, the only year where the reported data constitutes a meaningful share of the total EU27 data is 2021, where Spain

[30] PRODCOM Code 28.94.22.70

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 4-3 shows the value of non-household washing machines and dryers produced according to PRODCOM. The production value of non-household 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 4.2.3** on the market trends.

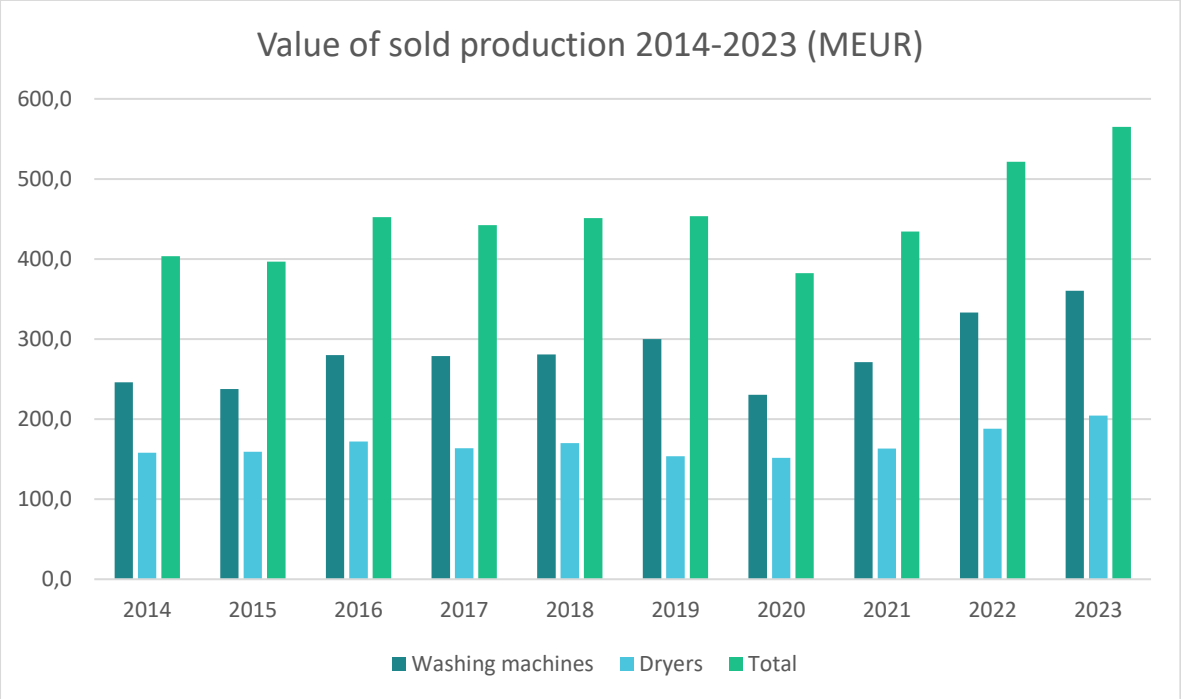

Figure 4-3: Value of household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers) and of Drying machines, of a dry linen capacity > 10 kg produced in EU27 (million Euros), 2014-2023.

Source: Eurostat (PRODCOM) [31]

The value of non-household laundry appliances produced per reporting Member State (see

[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.

Table 4-10: and **Table 4-11**) 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 4-4** below, show that the three dominant EU producing countries in this market of non-household washing machines are Germany, Spain and Sweden, with France and Italy playing minor roles.

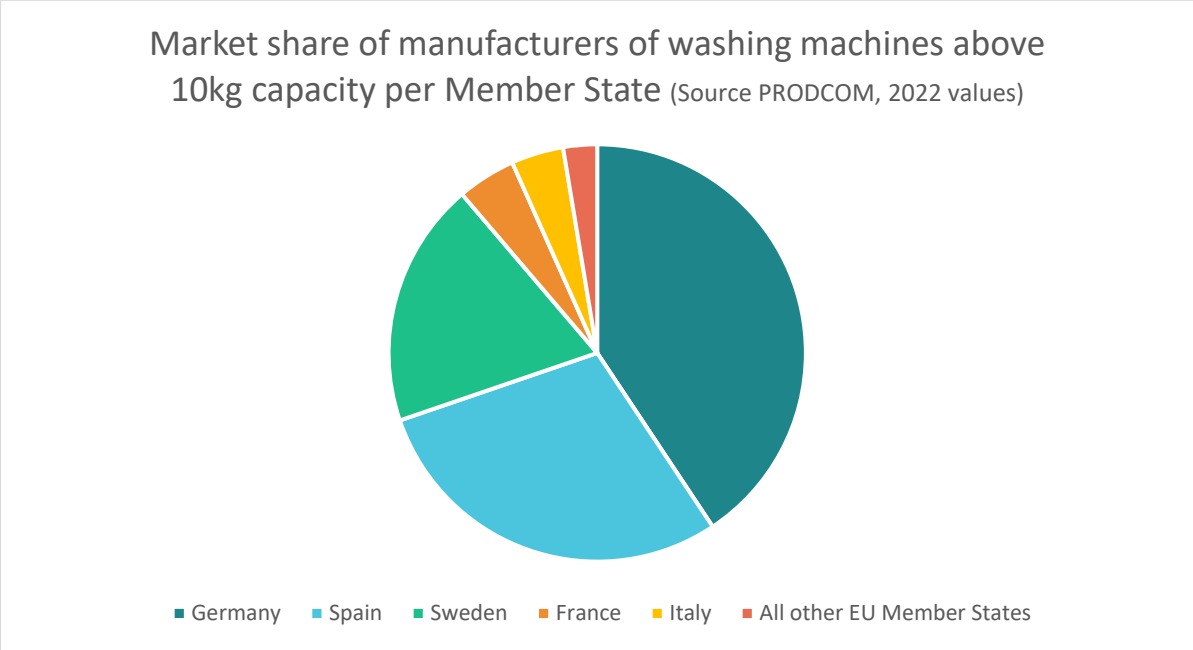

Figure 4-4: Market share of EU Member States manufacturing household or laundry-type washing machines of a dry linen capacity superior to 10 kg (including washer-dryers).

Source: Eurostat (PRODCOM), 2022 data

Table 4-10: 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 4-11** 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 4-5** below.

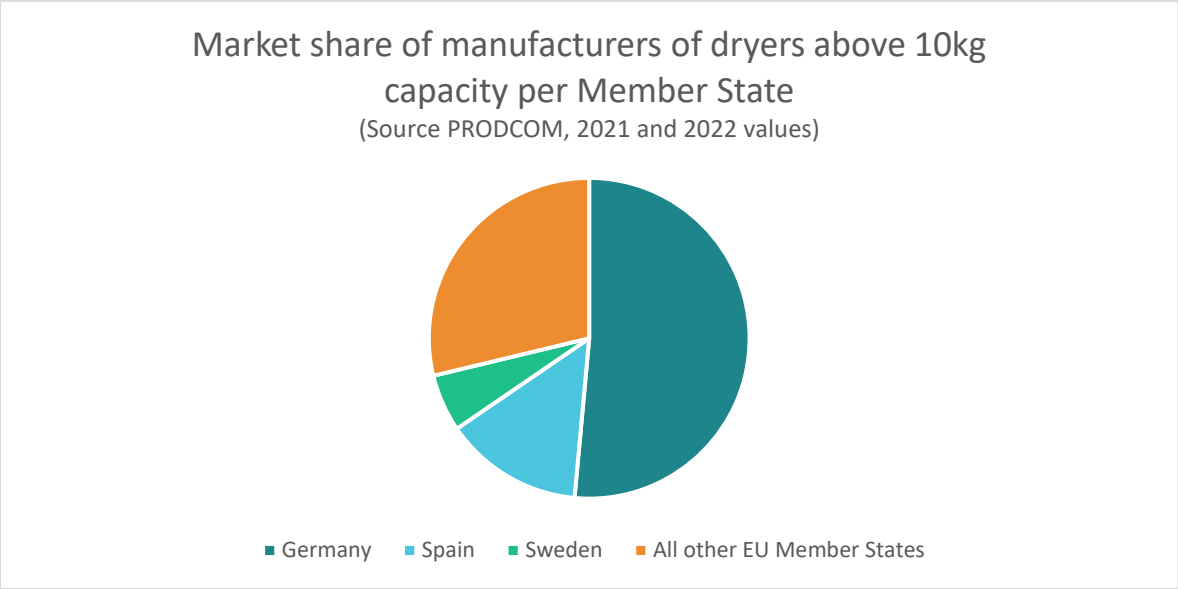

Figure 4-5: Market share of manufacturers of dryers above 10kg capacity per Member State.

Source: Eurostat (PRODCOM), 2021 and 2022 data

Table 4-11: 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	:	:	:	:	:
Denmark	0	0	0	0	0

[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
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

Non-household washing machines and dryers have a unit value which is highly dependent on the specific MS market. **Table 4-12** shows the range of unit values for non-domestic washing machines and dryers as reported by PRODCOM for MS where information is available.

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Table 4-12: 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 MS 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 non-household 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 MS 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).

4.2.1.2. 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 (non-household 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 4-13 below provides the extra-EU import and export values, in MEUR, for these two product categories.

Table 4-13: 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 4-6 below displays these quantitative data in a visual graph for washing machines.

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Figure 4-6: 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 non-household 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 4-7 below displays these quantitative data in a visual graph for dryers.

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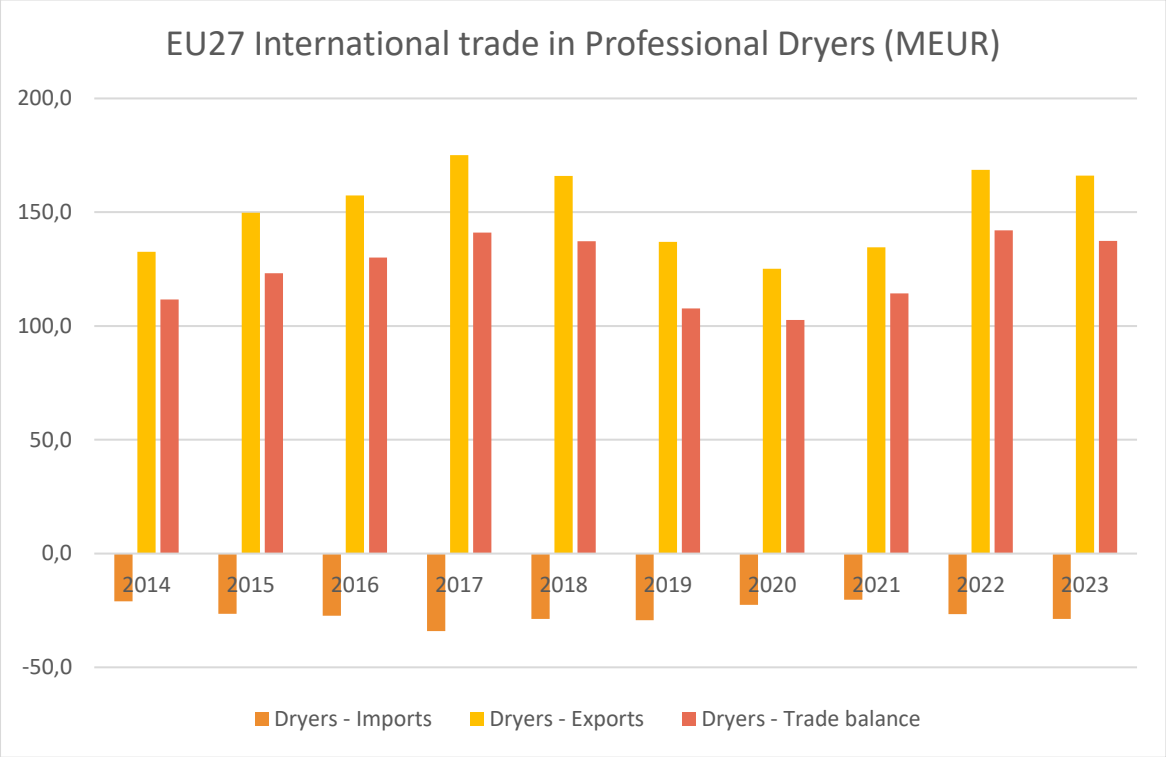

Figure 4-7: International trade of the EU27 of Drying machines, of a dry linen capacity > 10 kg, 2014-2023 (in MEUR) - COMEXT data.

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.

4.2.1.3. 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 9**), mainly manufacturers, is therefore presented in the next section.

4.2.2. Market and stock data

Based on the initial product definition in Task 1, seven categories have been defined for non-household washing machines and seven categories for non-household dryers, which can be 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.

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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].

4.2.2.1. Market structure

The non-household 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 non-household washer extractors and washing machines. Manufacturers of small capacity appliances sold through intermediate dealers/retailers generally do not track where many of their products end up.
- Many non-household laundry appliances are also directly sold by the manufacturer to the customer, especially larger capacity machines (heavy duty 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 semi-professional (partly programmable) and professional (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 MS 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 professional 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.

4.2.2.2. Manufacturers

The B2B nature of the non-household 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 non-household washing machine and dryer market in the EU (see **Table 4-14**).

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

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Table 4-14: Non-exhaustive list of non-household 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
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 it 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 MS 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 non-household washing machines.

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

4.2.2.3. Sales

The aim of this section is to assess the sales volume (number of units sold) for different types of semi-professional and professional 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 WM7 “Washing tunnel machines” and D7 “Pass-through (transfer) tumble dryer”, being manufactured in the EU, based on information gathered

from 4 major manufacturers[39]. These 4 manufacturers represent ca. 80 % of the EU capacity, and manufactured in 2023 a total of:

- Batch-loaded washers 65,000 units
- Batch-loaded tumble dryers 55,000 units
- 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 4-15** below.

Table 4-15: Non-household Laundry Appliances - Number of batch-loaded units manufactured in the EU.

Category of non-household 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 D4 to D3 inclusive)	69,000
Batch-loaded drying cabinets (product types D1 to D3 inclusive)	10,000

Source: estimate based on data gathered by APPLiA)

These figures are to be compared to the PRODCOM data provided above in **Table 4-8** for washing machines and in **Table 4-9** 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 to retain 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 4-16** below.

[39] Alliance Laundry, Electrolux Professional, Girbau, Miele Professional

Table 4-16: Number of batch-loaded washing machines manufactured in the EU27.

Product type*	Estimated number of units sold (2009 figures)[40]	Share of total number of batch-loaded units (computed from 2009 figures)	Estimates of share of number of batch-loaded units (APPLiA data, 2024)[41]	Estimated number of batch-loaded units (computed from APPLiA data, 2024)
Washing machines				
WM1: Semi-professional washer extractor	25,000	31.9 %	25-35 %	20,250 – 28,350
WM2: Professional washer extractor, <15 kg	45,500	58.0 %	50-60 %	40,050 – 48,600
WM3: Professional washer extractor, 15-40 kg	6,200	7.9 %	5-10 %	4,050 – 8,100
WM4: Professional washer extractor, >40 kg	210	0.3 %	0-1 %	0 – 810
WM5: Professional washer dryer	200	0.3 %	0-1 %	0 – 810
WM6: Professional barrier washer	850	1.1 %	1-2 %	810 – 1,620
WM7: Washing tunnel machine	250			
Total washing machines	78,710			81,100[42]

* To facilitate comparability, the categories, mentioned in this table, represent ones used in the LOT 24 study from 2011
Source: estimate based on APPLiA and on PRODCOM data and reminder of outcomes of 2011 study

[40] 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

[41] 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.

[42] 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.

Table 4-17: Number of batch-loaded dryers manufactured in the EU27.

Product type*	Estimated number of units sold (2009 figures)[43]	Share of total number of batch-loaded units (computed from 2009 figures)	Estimates of share of number of batch-loaded units (APPLiA data, 2024)[44]	Estimated number of batch-loaded units (computed from PRODCOM and APPLiA data, 2024)
Dryers				
D1: Semi-professional dryer, condenser	3,200	8.4 %	20-25 %	7,000 – 9,000
D2: Semi-professional dryer, air vented	4,300	11.3 %	0	0
D3: Professional cabinet dryer	10,700	28.2 %	separate estimation	10,000[45]
D4: Professional tumble dryer, <15 kg	16,000	42,1 %	50-60 %	16,000 – 19,000
D5: Professional tumble dryer, 15-40 kg	3,500	9.2 %	10-20 %	3,200 –6,400
D6: Professional tumble dryer, >40 kg	300	0.8 %	0-5 %	0 – 1,600
D7: Pass-through (transfer) tumble dryer	1,200			
Total dryers	39,200			32,000 tumble dryers[46] + 10,000 cabinet dryers

* To facilitate comparability, the categories, mentioned in this table, represent ones used in the LOT 24 study from 2011

Note the stability between 2009 figures and updated 2024 figures

Light red: strong change between 2009 figures and updated 2024 figure

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

[43] 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

[44] 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.

[45] Separate estimate provided by APPLiA in the stakeholder consultation of 2024.

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

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

- Among washing machines: Semi-professional and Professional washer-extractors below 15 kg capacity (WM1 and WM2);
- Among dryers: Semi-professional and Professional tumble-dryers below 15 kg capacity, 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.

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.

4.2.2.4. Sales by customer

In the US in the late 1990s, the consumers of professional laundry equipment with the largest market share were hotels, hospitals and contract laundry services that serve commercial and institutional customers.[47] 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. Professional 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 4-18** and

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

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Table 4-19). The presentation of the market shares for each type of appliance is based on global market research and stakeholders' feedback.

Table 4-18: Target customer segments of professional washing machines by product category.

Product type*	Market share of customer segments	Dominant customer segment
WM1: Semi-professional washer extractor	**CCL+AHL: 60 %** HPL: 25 % HH: 10 % HN: 5 % CIL: ~0 % SP: ~0 %	**Coin & Card Laundry + Apartment Household Laundry**
WM2: Professional washer extractor, <15 kg	**CCL+AHL: 50 %** HPL: 25 % HH: 10 % HN: 5 % CIL: 5 % SP: 5 %	**Coin & Card Laundry + Apartment Household Laundry**
WM3: Professional washer extractor, 15-40 kg	CCL+AHL: 0 % **HPL: 65 %** HH: 10 % HN: 15 % CIL: 5 % SP: 5 %	**Hospitality Laundry**
WM4: Professional washer extractor, >40 kg	CCL+AHL: 0 % HPL: 35 % HH: 5 % HN: 5 % **CIL: 50 %** SP: 5 %	**Commercial Industrial Laundry**
WM5: Professional washer dryer	CCL+AHL: 35 % **HPL: 65 %** HH: 0 % HN: 0 % CIL: 0 % SP: 0 %	**Hospitality Laundry**
WM6: Professional 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

Table 4-19: Target customer segments of professional dryers by product category.

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

Product type*	Market share of customer segments	Dominant customer segment
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

The tables show that industrial users (CIL) are purchasers of heavy-duty appliances (professional washer extractors >40 kg, washing tunnel machines, professional 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 professional barrier washers.

The sharp decline between 2009 and 2023 in the numbers of units sold in the product types WM1 and D1 to D3, identified above (**Section 4.2.2.3**), can be associated with the fact that these product types are predominantly sold to customers belonging to the segments Coin & Card Laundry (CCL) + Apartment Household Laundry (AHL), i.e. to the customer segments in competition with the direct ownership of household appliances.

Similarly, the strong rise between 2009 and 2023 in the numbers of units sold in the product types WM3 and D5, identified above (**Section 4.2.2.3**), can be associated with the fact that these product types are predominantly sold to customers belonging to the segment Hospitality Laundry (HL), itself related to the rise in the economic sector of tourism.

It is expected that the variation between MS on the type of professional 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 semi-professional or professional 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.

4.2.2.5. Lifetime

The technical lifetime of products is measured in number of cycles. Based on stakeholder feedback, the typical lifetime duration for professional machines is provided in the **Table 4-37** and **Table 4-38** in **Section 4.3.2** 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.

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

4.2.2.6. Stock

The number of professional 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 4.2.1**), 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 4-20: Approximation of the stock of professional 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

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(*) = 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.

4.2.3. Market trends

4.2.3.1. General market trends

As described in the § 4.2.2, the market for professional laundry appliances has experienced a **moderately high growth rate** over the last decade of **+3.8 % / year CAGR**, with a strong post-Covid recovery at +13.9 % / 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[48] 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[49], 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[50];
- 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[51].

[48] 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

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

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

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

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4.2.3.2. Volume of laundry being processed by non-household laundry appliances

A study of 2014[52] 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 professional 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 *professional* 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 **professional** 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 %).

4.2.3.3. Employment figures

In the 2024 survey, only one company provided information on the number of employees of its business unit manufacturing professional 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 professional laundry appliances.

One company in the 2024 survey provided a breakdown of its employees between the different functions in the business unit, provided in **Table 4-21** below.

Table 4-21: Share of employees per function in the business unit manufacturing of professional laundry appliances (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 %

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

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Total	**100 %**

4.2.3.4. 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.

4.2.3.5. Product specific trends – development of professional laundry appliances, 2010-2030

Customer requirements

In general, the owners of professional 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 professional laundry appliances in the recent decades have been in the following areas:

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- **Heat pump technology** within professional 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 optimized 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 professional laundry appliances

Table 4-22 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 4-22: Presence of technical features related to sustainability in current (2024) professional laundry appliances and trends for the future.

Sustainability indicator	Technical feature related to sustainability	Current (2024) presence in Professional 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

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Sustainability indicator	Technical feature related to sustainability	Current (2024) presence in Professional Laundry Appliances and future trends
	Additional warm/hot water connection	Very common
	Gas-operated heating	Common for dryers in south EU
	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 professional 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

Sustainability indicator	Technical feature related to sustainability	Current (2024) presence in Professional Laundry Appliances and future trends
	Use of recycled materials	Increasing, due to sustainability requirements
	Reduced wear & stress imposed on textiles	Integrated into the washing programmes
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 professional 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).

4.2.4. Customer expenditure database

Based on the defined product categories for professional 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 professional 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.);

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- Maintenance and repair costs: the costs incurred by the owner of the professional 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 professional machine.

4.2.4.1. 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 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 professional laundry equipment is a business-to-business 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).

Professional washing machines – Prices in the 2011 study

In the 2011 study, the semi-professional washer extractors (WM 1) tended to start at 1,000 Euros and could cost up to 5,500 Euros. The price range of professional 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.

Professional dryers – Prices in the 2011 study

Similarly, the same structure of the market applied to professional 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

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

Table 4-23 below provides the average price of professional laundry appliances, as they can be calculated from PRODCOM data[53], for the Member States and the years, between 2009 and 2023, where the available data enables a calculation. Empty cells correspond to missing data.

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

Table 4-23: Average prices of professional 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

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Table 4-24: Average prices of professional 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

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The data computed from PRDOCOM 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 4-25** below providing price estimates of professional laundry appliances per segment in 2023.

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Table 4-25: Estimate of the unit prices of professional 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: Semi-professional washer extractor	800 - 4,400	2,136
WM2: Professional washer extractor, <15 kg	4,000 - 28,000	4,000
WM3: Professional washer extractor, 15-40 kg	4,000 - 28,000	12,200
WM4: Professional washer extractor, >40 kg	75,000 – 255,000	88,125
WM5: Professional washer dryer	N/A	12,000
WM6: Professional barrier washer	22,500 – 180,000	57,375
WM7: Washing tunnel machine	420,000 - 750,000	585,000
Dryers		
D1: Semi-professional dryer, condenser	640 – 2,800	1,576
D2: Semi-professional dryer, air vented	640 – 2,800	1,344
D3: Professional cabinet dryer	2,800 – 16,000	2,800
D4: Professional tumble dryer, <15 kg	2,800 – 16,000	3,200
D5: Professional tumble dryer, 15-40 kg	2,800 – 16,000	5,700
D6: Professional 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

4.2.4.2. 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.

4.2.4.3. 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 professional 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 MS 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 (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 non-household washing machines and dryers, as results from the computations made in Task 4 – Technologies, and more specifically in the **Section 4.4.1.2** and **4.4.2.4**.

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[54].

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.

The tables below (**Table 4-26** to **Table 4-28**) hence present the price of electricity at two dates:

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

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- 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 Life-Cycle Costing exercise will hence need to make assumptions about the future evolution in the price of electric energy.

Table 4-26: 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
Slovenia	0.1551	0.2340
Spain	0.2322	0.2433

Member State	Electricity price in EUR / kWh (excluding VAT and other recoverable taxes and levies). Band IA (annual consumption below 20 MWh)	
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 4-27: 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
Romania	0.1143	0.1726
Slovakia	0.1510	0.2264

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)	
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 4-28: 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
Portugal	0.1066	0.1149

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)	
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 Task 4 – Technologies, and more specifically in the **Section 4.4.2.4**, 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 4-29** and **Table 4-30**) are provided for the first semester of 2021 and the first semester of 2024.

Table 4-29: 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
Finland	0.0752	0.0862
France	0.0492	0.1033

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)	
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 4-30: 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
Finland	0.0602	0.0808
France	0.0422	0.0912

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)	
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)[55], set up by the World Bank, provides an international benchmark for the price of water, by obtaining data from utilities. **Table 4-31** 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).

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

Table 4-31: 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.

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

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.

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 4-32** below.

Table 4-32: 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 non-household products, i.e. those relevant for our study, provided by AISE (same source) does not provide the breakdown per category. The overall market for professional laundry detergents 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 4.2.3.2**).

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**.

4.2.4.4. Maintenance and service costs

Stakeholders have commented that service contracts are usually included as part of the purchase of professional 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 life cycle costs of professional 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.

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These values will be used to estimate the life cycle costs of the appliances later in the study.

A study[56] in the US also assessed the annual repair and maintenance costs of professional 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 4-33**.

Table 4-33: Repair and maintenance costs over lifetime of professional laundry equipment. [56]

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

4.2.4.5. 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 professional laundry machines can be refurbished and resold as second-hand products by dealers. These products generally are given some new elements (drive belts, doors...) as was described as the most common items to fail in the maintenance section. Professional 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.

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

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

4.2.4.6. Inflation and interest rates

Table 4-34 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[57].

Table 4-34: 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 4-8 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.

[57] 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

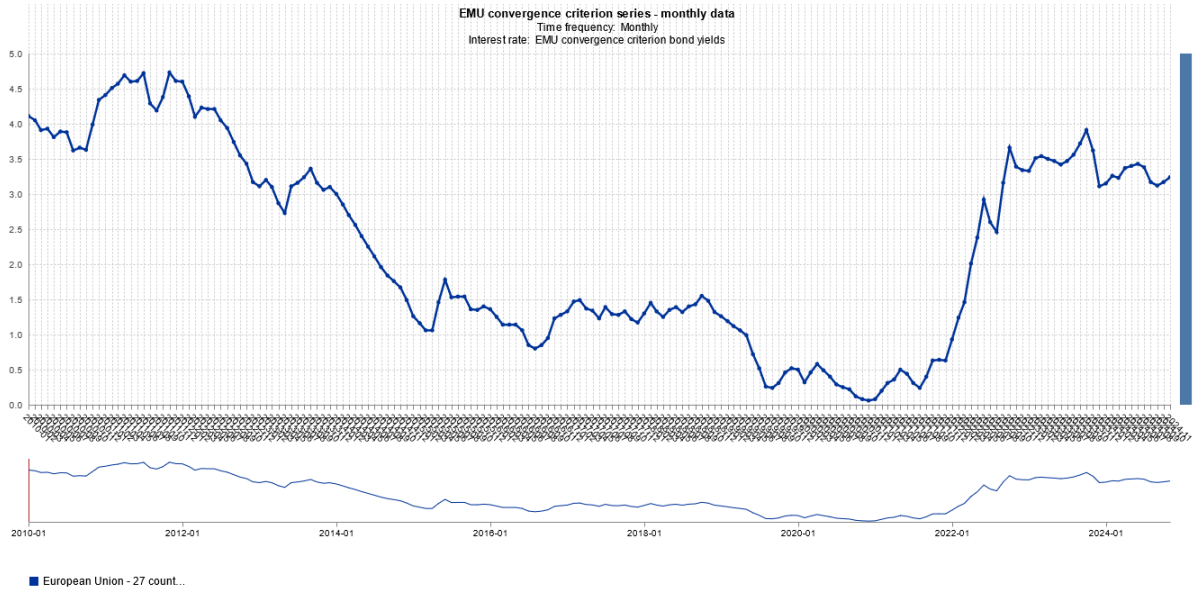

Figure 4-8: Long-term interest rates in the EU27 (2010-2024), in percentage points / year.

Source: Eurostat (2025) EMU convergence criterion series - monthly data Online data code: irt_lt_mcby_m, available at:
https://ec.europa.eu/eurostat/databrowser/view/irt_lt_mcby_m__custom_14906987/default/table?lang=en

4.3. Task 3 – Users

Consumer behaviour can be influenced by product design, making it a relevant input for assessing a product's environmental impact and life cycle costs. The objective of 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 industrial and commercial 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 Task 1. (see **Section 4.1**).

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 4.3.2** 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

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dryer category, the total amount of cleaned and dried laundry per year for each product category is calculated (**Section 4.3.3**).

In **Section 4.3.4**, 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 4.3.5**, measures to optimise user behaviour and consumption parameters in **Section 4.3.6**, and infrastructure parameters in **Section 4.3.7**. Finally, **Section 4.3.8** gives information about the end-of-life behaviour, i.e. repair-, maintenance and disposal practice.

4.3.1. 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 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 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 tasks 3 and 4. In these cases, the extrapolation of a 10 % efficiency increase in comparison to the 2011 data has been retained.

4.3.2. Typical capacity and use intensity

There is a wide variety of non-household washing machines and dryers in terms of performance parameters and washing efficiency. These fall into a number of different product categories (see Task 1 in **Section 3.1**) 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

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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 Task 1 differ in their intended usage scenarios, these categories are assigned to key market / customer areas (see Task 2 in **Section 4.2**).

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Table 4-36 give an overview of the main applications of these product categories thus providing a first indication of a possible use intensity of non-household washing machines and dryers.

Table 4-35: Key market segments of non-household washing machines according to spatial requirements and operator skills.

Product category	Key market segment	Spatial requirements	Filling ratio[58]	Main operator / user type	Life time
WM1: Semi professional 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: Professional 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: Professional 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: Professional barrier washer	Healthcare Laundry (HCL)	Medium amount of space necessary. Customised user premisses 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.

[58] The applicable filling ratio depends on the density of the laundry to be washed/dried

Table 4-36: Key market segments of non-household dryers according to spatial requirements and operator skills.

Product category	Key market segment	Spatial requirements	Filling ratio[58]	Main operator / user type	Life time
D1: Semi professional 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: Professional 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: Professional 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.

Semi-professional and small size professional 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. Semi-professional 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 (cf. **Section 4.2**). 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 non-household laundry appliances has 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.

4.3.3. 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. Tables 3 and 4 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 and 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 consultation was then used to calculate the annual amount (in tons) of cleaned or dried laundry for each product category. This serves as

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the basis for calculations of annual energy consumption. The consumption of water and detergent under both ideal and real-world conditions is also considered. A particular focus is cast on the data from the most relevant customer segment (indicated in bold in the following tables).

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4.3.3.1. Intensity of use of Washing machines

Table 4-37: 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 Semi-professional 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 Professional 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 Professional 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 Professional 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	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 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
* main customer segments for each category marked bold

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4.3.3.2. Intensity of use of Dryers

Table 4-38: 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 Semi professional 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 Professional 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 Professional 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.

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
D4 Industrial Pass-through (transfer) tumble dryer	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 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
* main customer segments for each category marked bold

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

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4.3.3.3. 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. Non-household 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 professional laundry 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.

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

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- 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 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). 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 2011 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

4.3.4. 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);

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- 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 4-39 and **Table 4-40** 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 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 4-39: 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: Semi-professional washer extractor	0.13 (0.13 – 0.32)	8 (7 – 13)	15 (15 – 18)
WM2: Professional washer extractor	0.17 (0.14–0.50)	12 (10–18)	17 (8–20)
WM3: Professional washer dryer	0.7	9 (8–12)	13 (8–20)
WM4: Professional 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 4-40: Specific energy consumption of an average current device of different dryer categories under ideal conditions.

Dryer category	Energy consumption (range) kWh/kg laundry
D1: Semi-professional tumble dryer	0.54
D2: Professional tumble dryer	0.65 (0.40–0.95)
D3: Professional 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 4-37** and **Table 4-38**, the following **Table 4-41** and **Table 4-42** 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 4-41: Annual energy, water and detergent consumption of different non-household 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: Semi-professional washer extractor	7	910	56,000	105
WM2: Professional washer extractor	69	11,730	828,000	1,173
WM3: Professional washer dryer	7.4	5,180	66,600	96
WM4: Professional 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 4-42: Annual energy consumption of different professional dryer categories under ideal conditions.

Category	Dried laundry	Energy consumption
	tons/year	kWh/year
D1: Semi-professional tumble dryer	6.5	3,380
D2: Professional tumble dryer	15 - 168	71,160
D3: Professional 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.

4.3.5. User behaviour in practice

In the technical information sheets of commercial 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 4-37** and **Table 4-38**);
  - 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.

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4.3.5.1. 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 semi-professional 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 for 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 non-household 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 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 semi-professional 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).

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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 4-43 and **Table 4-44** 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 non-household 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 4-43: Programme selection of non-household 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: Semi-professional washer extractor	35–55 min	60 %	40 °C

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Type of appliance	Duration of the typically used washing programme	Share of the typically used washing programme	Temperature of the typically used washing programme
WM2: Professional washer extractor	35–55 min	60 %	60 °C
WM3: Professional washer dryer	75 min (wash+dry) 50 min (wash)	60 %	60 °C
WM4: Professional barrier washer	60 min (programmable)	60 %	60 °C
WM5: Industrial continuous tunnel washers	30 min	>90 %	>60 °C

Table 4-44: Programme selection of non-household 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: Semi-professional tumble dryer	30–45 min	100 %	70 °C
D2: Professional tumble dryer	30–45 min	100 %	70 °C
D3: Professional 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 non-household washing machines and dryers can influence the energy, water and detergent and laundry aid consumption. There are following main reasons for the maloperation of non-household 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 non-household washing machines and dryers used by manual programme settings, manual dosage and rather untrained personnel, the error rate might be higher than in 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 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 non-household machines and dryers, the consumption of low-power mode is negligible due to the optimised machine performance. Therefore, in the case of non-household washing machines and dryers, the low-power mode plays a less important role to reduce power consumption.

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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 4-45** and **Table 4-46** below show the typical time and power consumption of in low-power mode.

Table 4-45: Typical time in low-power mode(s) consumption of non-household washing machines.

Washing machine category	Time in low-power modes per day	low power modes consumption (in kWh/h)
WM1: Semi-professional washer extractor	120 min	~0.003
WM2: Professional washer extractor	60 min	~0.003
WM3: Professional washer dryer	60 min	~0.003
WM4: Professional barrier washer	negligible	negligible
WM5: Industrial continuous tunnel washer	negligible	negligible[59]

n.a. = no information available

Source: manufacturers' data

Table 4-46: Typical time in low-power mode(s) consumption of non-household dryers.

Dryer category	Time in low-power mode per day	Low-power mode consumption (in kWh/h)
D1: Semi-professional tumble dryer	180 min	~0.0025
D2: Professional tumble dryer	n.a.	n.a.
D3: Professional cabinet dryer	180 min	~0.003
D4: Pass-through (transfer) tumble dryer	negligible	negligible[59]

n.a. = no information available

Source: manufacturers' data

4.3.6. Measures to optimise user behaviour and consumption parameters

According to the analysis of 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.

[59] 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 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.

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/rinse aid 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 Task 6.

4.3.7. Infrastructure

This section aims at identifying opportunities and obstacles linked to the local infrastructure which can influence the choice of non-household washing machines and dryers.

4.3.7.1. 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.

Non-household 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.

4.3.7.2. 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.

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For heating processes in laundries, different energy sources can be used[60]: electricity, steam, hot water, natural or propane gas, and thermo oil[61] (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 Task 6.

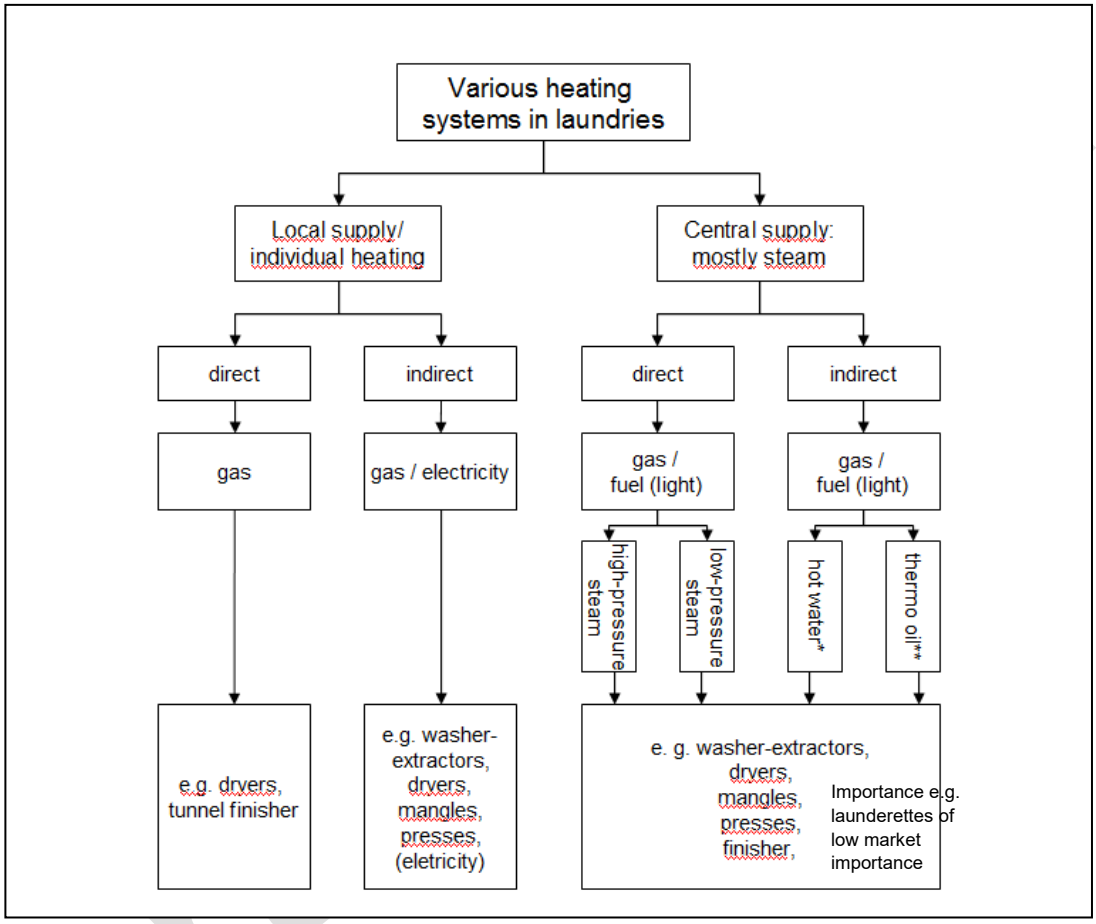

Figure 4-9: Various heating systems in laundries.

Source: BDEW, http://www.gewerbegas-online.de/index.php?id=262

[60] 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.

[61] 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.

Regarding the internal or external heating[62] 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.

Table 4-47: Energy Sources for water heating in non-household 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: Semi-professional washer extractor	60	0	<5	35
WM2: Professional washer extractor	5 - 55	2 - 18	8	35
WM3: Professional washer dryer	100	0	0	0
WM4: Professional barrier washer	5	0	95	0
WM5: Industrial continuous tunnel washers	0	2	95	3

Source: own assumptions based on Lot 24 study (2011)

[62] **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 4-48: Energy Sources for heating in new professional 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: Semi-professional dryer	100	0	0	0
D2: Professional tumble dryer	45	50	5	0
D3: Professional cabinet dryer	100	0	0	0
D4: Pass-trough (transfer) tumble dryer	0	90	10	0

Source: own assumptions based on Lot 24 study (2011).

Washer-dryers, semi-professional dryers and 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

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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.

4.3.8. 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 non-household devices are rather repaired than replaced due to the relatively high purchase costs of non-household washing machines and dryers. At a certain point, however, the user will replace the machine with a new one.

It is standard practice for non-household 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 (semi-professional). 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 non-household 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, non-household 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 semi-professional 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.

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4.4. Task 4 – Technologies

Task 4 pertains the technical analysis of industrial and commercial 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) (Task 5) as well as the identification of the improvement potential (Task 6).

4.4.1. Technical analysis of non-household 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.

Main operating principles of non-household washing machines

The following table gives an overview of the washing machine categories identified in Task 1 and their main characteristics. A more detailed description can be found in Task 1.

Table 4-49: Categorisation of non-household washing machines.

Product category	Key market segment	Main operator / user type	Filling ratio	Type of loading	Product dimensions	Application
WM1: Semi-professional 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-Professional
WM2: Professional washer extractor	Hospitality Laundry (HPL) / >40 kg also Commercial Industrial Laundry (CIL)	Non- and trained personnel	1.9-1:12		Dimensions are rather variable de-pending on amount / type of textiles to be washed and dried spatial possibilities	Commercial/ >40 kg also Industrial
WM3: Professional washer dryer						
WM4: Professional 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 non-household 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 non-household washing machines.

Table 4-50: Share of material categories (according to MEErP) for the different categories of non-household 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) galvanized steel	0.8 %-50 %	27 %	70 %	5 %	10 %
Cast iron	15.2 %-9 %	17 %	4 %	8 %	5 %
Polypropylene (PP)	10.9 %				
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 %	

Materials-category	WM1	WM2	WM3	WM4	WM5
Electronics (control)	0.2 %-2 %	3. %	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: Semi-professional washer extractor – reflecting WM1 and WM2 in the 2011 study, for WM2 plastics are summed together under other plastics unless otherwise specified

WM2: Professional washer extractor

WM3: Professional washer dryer

WM4: Professional 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[63] 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.

4.4.1.1. 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 EcoReport tool, only the mean volume of the final product is required.

Table 4-51: Average volume of the final packaged product of the different categories of non-household washing machines.

Washing machine category	Average volume of the final packaged product	Source of information
WM1: Semi-professional washer extractor	0.75–1.14 m³	According to Lot 24
WM2: Professional washer extractor	4.3 m³ - 30,21 m³	Stakeholder provided data (2024)
WM3: Professional washer dryer	1.61–2.42 m³	According to Lot 24
WM4: Professional barrier washer	14,92 m³	Stakeholder provided data (2024)

[63] Data submitted in the consultation launched to collect data for task 5.

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Washing machine category	Average volume of the final packaged product	Source of information
WM5: Industrial continuous tunnel washers64	Up to 156 m³	Stakeholder provided data (2024)

4.4.1.2. 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 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 non-household washing machines (see 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 washing machines

This section exemplifies how much energy is used for the different washing phases in a typical non-household washing process.

The energy consumption of non-household 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 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.

Washing machine category	Percentage of energy consumed for water heating
WM1: Semi-professional washer extractor	79 %
WM2: Professional washer extractor	87 %
WM3: Professional washer dryer	80 %
WM4: Professional barrier washer	88 %
WM5: Industrial continuous tunnel washers[65]	95 %

[64] Corresponds to the average volume of the machine as the distribution is realised without packaging.
[65] Only the average volume of the machine due to the distribution ensued without packaging.

Typical composition of detergents and laundry aids for non-household 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 4-10: Example of a modular detergent system and wash programme for blue work wear.

Energy, water and detergent consumption

A commercial 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 Task 1).

It is essential to consider the specific requirements of non-household 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 previously outlined in Task 3, the energy, water and detergent consumption of non-household 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 non-household washing machines during the use phase. The 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 washing machine categories.

Category WM1: Semi-professional washer extractor

The following data are based on cold water connection of the washing machines.

Table 4-53: Energy, water and detergent consumption of a semi-professional washer extractor.

	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: Professional washer extractor

The following data are based on cold water connection of the washing machines.

Table 4-54: Energy, water and detergent consumption of a professional washer extractor.

	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: Professional washer dryer

Table 4-55: Energy, water and detergent consumption of a professional 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 %

	Energy	Water	Detergent
Specific consumption operation (real life user behaviour)	0,88	11	16
Annual consumption (real life)	6,475 kWh	81,400 litres	120 kg

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3984 **Category WM4: Professional barrier washer**

3985 **Table 4-56: Energy, water and detergent consumption of a professional barrier washer**
3986 **(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

3987 **Category WM5: Industrial continuous tunnel washers**

3988 **Table 4-57: Energy, water and detergent consumption of a professional washing tunnel**
3989 **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)	0.3 kWh/kg laundry	5.4 litres/kg laundry	8 g/kg laundry
Real-life user behaviour			
Additional consumption through partial workload	+ 0 %	+ 0 %	+ 0 %

	Energy	Water	Detergent
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 non-household washing machine categories

The summary below encompasses the real-life operation patterns described in the previous sections. The following **Table 4-58** summarises the annual energy, water and detergent consumption to be used as input data for Task 5 (environmental impact assessment of base cases).

Table 4-58: Annual energy, water and detergent consumption (real life conditions) of all non-household washing machine categories.

Category	Energy consumption	Water consumption	Detergent / laundry aid consumption
	kWh/year	litres/year	kg/year
WM1: Semi-professional washer extractor	1,200	76,500	145
WM2: Professional washer extractor	42,337	1,749,600	2,265
WM3: Professional washer dryer	6,660	90,000	126
WM4: Professional barrier washer	23,000	970,000	1,100
WM5: Washing tunnel machine	1,450,000	24,786,000	37,180

4.4.1.3. Technical analysis of the use phase (system)

Non household washing machines are in use in a variety of businesses, including hotels, clinics, healthcare facilities, self-service laundries, and numerous other locations (see 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 non-household 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 4-59** 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 4-59: 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)

4.4.1.4. Technical analysis of the end-of-life phase

This section provides information regarding the end-of-life management of non-household 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. Semi-professional and smaller washing machines may also be dismantled by certified scrap dealers.

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Table 4-60: Disposable fraction of non-household washing machines that is not recovered.

Washing machine category	Fraction of products not recovered %
WM1: Semi-professional washer extractor	5
WM2: Professional washer extractor	5
WM3: Professional washer dryer	5
WM4: Professional barrier washer	~1
WM5: Industrial continuous tunnel washers	~1

4.4.2. Technical analysis of non-household dryers

4.4.2.1. 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 bill of materials (BOM) for each technology.

Main operating principles of non-household dryers

The following table gives an overview of the dryer categories identified in Task 1 and their main characteristics. A more detailed description can be found in Task 1.

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4036 **Table 4-61: Categorisation of non-household dryers.**

Product category	Key market segment	Main operator / user type	Filling ratio	Type of loading	Product dimensions	Application
D1 Semi-professional 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 Professional tumble dryer				Hangers, front loading	Dimensions are very variable de-pending on amount / type of textiles to be dried and spatial possibilities	Commercial
D3 Professional cabinet dryer	Hospitality Laundry (HPL)	Trained personnel		front loading manual or automatic		
D4 Industrial Pass-through (transfer) dryer	Commercial Industrial Laundry (CIL)	Trained personnel	1:20 - 1:25	Pass-through, Automatically, loading and unloading, doors on opposite sides		Industrial

4037 ## Overview of all non-household dryer categories

4038 In the following table an overview of the shares of the material categories according to MEErP
4039 (incl. packaging material) is shown for the different categories of non-household dryers.

4040 **Table 4-62: Share of material categories (according to MEErP) for the different**
4041 **categories of non-household 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 %

Materials-category	D1	D2	D3	D4
Misc.	1 %	1 %	1 %	1 %

D 1: Semi-professional tumble dryer
D 2: Semi-professional tumble dryer
D 3: Professional cabinet dryer
D 4: 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.

4.4.2.2. 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 4-63: Average volume of the final packaged product of the different categories of non-household dryers.

Dryer category	Average volume of the final packaged product
D 1: Semi-professional tumble dryer	0.53 m³
D 2: Professional tumble dryer	1.14–1.90 m³
D 3: Professional cabinet dryer	1.76 m³
D 4: Industrial Pass-through (transfer) tumble dryer[66]	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 %).

4.4.2.3. 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 Task 3, different processes consume energy during a typical working day of non-household dryers. The following input parameters were specified to define the respective energy consumption of non-household dryers during the use phase. The parameters have already been compiled and discussed in 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.

[66] Corresponds to the average volume of the machine as the distribution is realised without packaging

Based on input from single manufacturers, the lifetimes of D1 and D2 appliances ranges between 10 to 20 years.

4.4.2.4. Ratio of energy use in non-household 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 non-household 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.

Table 4-64: Share of the average energy consumption in the different categories of non-household dryers (Source: information provided by manufacturers).

Dryer category	Percentage of energy for air heating
D1 Semi-professional tumble dryer	95 %
D2 Professional tumble dryer	85 – 92 %
D3 Professional 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 non-household 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.

Categories D1: Semi-professional tumble dryers

Table 4-65: Energy consumption of semi-professional 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 %

Dryer Category	Condenser dryer	Air vented dryer
	Energy	Energy
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**	

4084

4085 ## Category D2: Professional tumble dryer

4086 **Table 4-66: Energy consumption of professional 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: Cabinet dryer

Table 4-67: Energy consumption of professional 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 4-68: 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 4-69 summarises the annual energy consumption to be used as input data for Task 5 (environmental impact assessment of base cases).

Table 4-69: Annual energy consumption (real life conditions) of all dryer categories.

Category	Energy consumption kWh/year
D1: Semi-professional tumble dryer	4,147
D2: Professional tumble dryer	71,160
D3: Professional cabinet dryer	5,418
D4: Industrial pass-through (transfer) tumble dryer	816,000

4.4.2.5. 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 Task 3). This section presents an overview of the manner in which diverse ambient conditions can impact the energy consumption of non-household 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.

4.4.2.6. 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 semi-professional and smaller dryers will have an average lifetime of 10 to 15 years. Industrial machines are used as intensively as professional (category D3–D6) and semi-professional machines of categories D1–2, and therefore have a longer lifespan. The average lifetime is estimated to

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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. Semi-professional dryers may also be dismantled by certified scrap dealers.

As previously outlined in Task 3, the majority (ca. 95 %) of materials contained in non-household 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 non-household 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 4-70: Landfill (fraction of products not recovered) in % of non-household dryers (based on stakeholder input).

Dryer category	Landfill (fraction of products not recovered) %
D1: Semi-professional tumble dryer	5
D2: Professional tumble dryer	5
D3: Professional cabinet dryer	5
D4: Industrial pass-through (transfer) tumble dryer	~1

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5. Task 5 – Environment and Economics (Base Case LCA and LCC)

5.1. Objectives of 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 Methodology for the Ecodesign of Energy-related Products (MEErP). Additionally, the BC approach will be critically assessed in 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. 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 life cycle cost 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 Life Cycle Assessment (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 EcoReport tool (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.

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Life Cycle Cost (LCC)

As part of the study, the Life Cycle Costs 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 LCC

This assessment incorporates updates introduced to the MEErP process based on the review and the new aspects resulting from the Ecodesign for Sustainable Products Regulation (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 5-1.**

Table 5-1: 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 analysis in Task 5 will assess the impact of assumptions on the results, ensuring consistency and reliability.

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Study outcomes

The LCA and LCC calculations for the Base Cases (BCs) are rooted in the findings of Tasks 1 to 4. Together, the BCs serve as essential reference points for the subsequent stages of the study, including Task 6 (design options) and Task 7 (scenarios).

Acknowledging the inherent uncertainties, this study provides the most robust and reliable estimates to date regarding the environmental impacts and life cycle costs of professional laundry machines within the EU.

5.2. Definition of Base Cases

This subsection defines and describes the Base Cases, 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 non-household 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 5-2**). This approach ensures both a detailed representation of the market and analytical clarity. Specific details per BC are provided in **Table 5-8** to **Table 5-11**. The main sources of the data used in the BC definition are the following two reports:

- 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 5-2: Overview of Base Cases for non-household washing machines and dryers.

Washing machines	Dryers
WM1: Semi-professional washer extractor	**D1:** Semi-professional tumble dryer
WM2: Professional washer extractor	**D2:** Professional tumble dryer
WM3: Professional washer dryer	**D3:** Professional cabinet dryer
WM4: Professional barrier washer	**D4:** Industrial pass-through (transfer) tumble dryer
WM5: Industrial continuous tunnel washers	

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4236 **Table 5-3: Overview of Base Case WM1: Semi-professional 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 4-53
Lifetime (years)	5.6	Average cycles per lifetime (5,000-15,000)
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
Water consumption (m3/cycle)	0.04	Real life conditions
Detergent consumption (kg per cycle)	0.08	Annual detergent consumption (real life conditions) / number of cycles per year
Cycle time (hours)	0.75	Duration of the typically used washing programme

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4238 **Table 5-4: Overview of Base Case WM2: Professional 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 4-37
Product weight (kg)	210.45	(Graulich et al., 2011)
Dominant market segment	Commercial Laundry (CL)	Task 1-4, Table 4-54
Lifetime (years)	15.3	Average cycles per lifetime (30,000-80,000)

Description	Characteristic	Comments (Sources)
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)
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
Water consumption (m^3/cycle)	0.30	Real life conditions
Detergent consumption (kg per cycle)	0.42	Annual detergent consumption (real life conditions) / number of cycles per year
Cycle time (hours)	0.75	Duration of the typically used washing programme

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4240 **Table 5-5: Overview of Base Case WM3: Professional 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 4-37
Product weight (kg)	382	(Graulich et al., 2011)
Dominant market segment	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	Task 1-4, Table 4-55
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)

Description	Characteristic	Comments (Sources)
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
Water consumption (m^3/cycle)	0.05	Real life conditions
Detergent consumption (kg per cycle)	0.07	Annual detergent consumption (real life conditions) / number of cycles per year
Cycle time (hours)	1.25	Duration of the typically used washing programme

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4242 **Table 5-6: Overview of Base Case WM4: Professional 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 4-37
Product weight (kg)	1,003.5	(Graulich et al., 2011)
Dominant market segment	Healthcare Laundry (HCL)	Task 1-4, Table 4-56
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
Water consumption (m^3/cycle)	0.37	Real life conditions

Description	Characteristic	Comments (Sources)
Detergent consumption (kg per cycle)	0.41	Annual detergent consumption (real life conditions) / number of cycles per year
Cycle time (hours)	1	Duration of the typically used washing programme

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4244 **Table 5-7: 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 4-37
Product weight (kg)	12,120	(Graulich et al., 2011)
Dominant market segment	Commercial Industrial Laundry (CIL)	Task 1-4, Table 4-57
Lifetime (years)	13.7	
Average price (€)	585,000	Based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices.
Cycles per year	3,000	Cycles per day * Number of working days per year (Graulich et al., 2011)
Annual sales (mln units per year)	0.00025	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	Real life condition
Water consumption (m^3/hour)	7	Real life conditions
Detergent consumption (kg per hour)	10.20	Annual detergent consumption (real life conditions) / number of cycles per year
Cycle time (hours)	0.75	Duration of the typically used washing programme

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4246 **Table 5-8: Overview of Base Case D1: Semi professional 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

Description	Characteristic	Comments (Sources)
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)
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
Cycle time (hours)	0.67	Duration of the typically used drying programme

Table 5-9: Overview of Base Case D2: Professional 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 4-38
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 4-66
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.

Description	Characteristic	Comments (Sources)
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
Cycle time (hours)	0.67	Duration of the typically used drying programme

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4250 **Table 5-10: Overview of Base Case D3: Professional cabinet dryer.**

Description	Characteristic	Comments (Sources)
Base Case description	Base Ccase 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 4-38
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 4-67
Lifetime (years)	41.7	Average cycles per lifetime (30,000-80,000)
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 * Number of working days per year (Graulich et al., 2011)
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
Cycle time (hours)	2.16	Duration of the typically used drying programme

4251 **Table 5-11: 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 4-38
Product weight (kg)	2,870.88	(Graulich et al., 2011)
Dominant market segment	Commercial Industrial Laundry (CIL)	Task 1-4, Table 4-68
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.
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
Cycle time (hours)	0.33	Duration of the typically used drying programme

4252 ## 5.3. Product-specific inputs

4253 In this section, the specific inputs for the ERT are described per life cycle stage of the Base
4254 Cases. Detailed input tables per Base Case are in **Annex V**: Inputs for LCA / LCC per Base
4255 Case

4256 ### 5.3.1. Raw materials

4257 The life cycle phase Raw Materials is the production of all materials of the product, according
4258 to the Bill of Materials (BoM, see **Annex V**: Inputs for LCA / LCC per Base Case). For all raw
4259 material inputs, the default ERT recycled content was modelled. For several raw materials, no
4260 specific dataset was available, and a proxy dataset was used instead (**Table 4-12**).

4261 **Table 5-12: 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

Missing dataset	Proxy modelled
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.

5.3.2. Packaging

Packaging per Base Case was modelled in the ERT based on the specific input data for each Base Case. For some Base Cases, no data was available. For several datasets, a proxy was used (**Table 5-13**).

Table 5-13: 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

5.3.3. 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 Base Case 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 5-14**).

Table 5-14: 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)	

Missing dataset	Proxy modelled
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 Base Case to the nominal rated capacity of each Base Case (Yuan et al., 2016).

5.3.4. 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 5-15**) as no stakeholder specific data was available.

Table 5-15: 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

5.3.5. 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 Task 1 – 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 5-16** and **Table 5-17**. Detailed data input and calculations can be found in **Annex V**: Inputs for LCA / LCC per Base Case.

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Table 5-16: 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 5-17: 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
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 Tasks 1-4 of the current preparatory study and provided in the 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 Base Case 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 %.

5.3.6. Maintenance and repair

Maintenance & Repair was modelled for all Base Cases with the default value of 1 % spare parts of raw materials inputs.

5.3.7. End-of-Life (EoL)

The End-of-Life (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).

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5.3.8. Life cycle costs (LCC)

For the economic input parameters, data was derived from stakeholders, previous study or literature data. The specific inputs are provided per Base Case 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 5-18** and **Table 5-19**). 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 **Table 5-12**). 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 Base Cases. An overview of the calculation is provided in **Annex V, Annex V: Inputs for LCA / LCC per Base Case**

Table 5-18: 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 5-19: 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

5.4. Base Case Environmental Impact Assessment

In this section, the life cycle assessment results for each Base Case are presented, followed by a contribution analysis of the main contributors to the life cycle environmental impact for each Base Case, and an interpretation of these results.

The environmental impacts of the Base Cases were calculated using the MEErP ERT (version 1.6) and the data inputs presented in the previous section and **Annex V: Inputs for LCA /**

LCC per Base Case 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
- 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)

A detailed breakdown of the results is provided in **Annex V: Inputs for LCA / LCC per Base Case**

5.4.1. Results overview LCA

Table 5-20 and **Table 5-21** contain an overview of the total life cycle impact for washing machines and dryers respectively. It can be observed from the tables that Base Cases WM5 and D4 have the highest energy use for washing machines and dryers respectively. As a consequence, WM5 and D4 also have the highest impact across all impact categories, whereas Base Cases 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, 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).

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Additionally, the ERT calculates the results per Base Case per year of use. This data is provided per Base Case and life cycle in **Annex VI – Results of LCA / LCC per Base Case** and the totals in **Table 5-22** and **Table 5-23.** In general, Base Case WM5 still shows the highest impact per year of use, although the difference between Base Cases is slightly lower.

Table 5-20: 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

Environmental aspect	Unit	WM1	WM2	WM3	WM4	WM5
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 5-21: 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 5-22: 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						

Environmental aspect	Unit	WM1	WM2	WM3	WM4	WM5
Electricity	kWh	4,847	141,376	202,743	56,905	57,487
Thermal energy	MJ	8,451	344,551	0	1,096,870	4,131,000
PEF Impact categories						
Climate change, total	kg CO_2 eq	4.86E+03	1.47E+05	1.06E+05	1.03E+04	3.83E+05
Ozone depletion	kg CFC-11 eq	8.13E-05	2.42E-03	4.18E-04	9.61E-05	3.17E-03
Human toxicity, cancer	CTUh	1.01E-05	1.90E-04	5.53E-05	1.56E-05	4.05E-04
Human toxicity, non-cancer	CTUh	6.50E-05	2.11E-03	7.07E-04	1.22E-04	2.82E-03
Particulate matter	disease incidence	3.13E-04	8.61E-03	5.47E-03	7.84E-04	1.16E-02
Ionising radiation, human health	kBq U235 eq	1.08E+03	3.16E+04	3.77E+04	9.60E+02	2.33E+04
Photochemical ozone formation, human health	kg NMVOC eq	1.04E+01	3.06E+02	2.14E+02	2.42E+01	4.91E+02
Acidification	mol H+ eq	2.08E+01	5.87E+02	5.06E+02	7.24E+01	8.24E+02
Eutrophication, terrestrial	mol N eq	4.34E+01	1.25E+03	7.96E+02	8.35E+01	1.68E+03
Eutrophication, freshwater	kg P eq	2.42E-01	7.68E+00	1.37E+00	3.45E-01	1.13E+01
Eutrophication, marine	kg N eq	7.03E+00	2.07E+02	8.90E+01	1.15E+01	2.85E+02
Ecotoxicity, freshwater	CTUe	4.26E+04	1.24E+06	6.05E+05	6.33E+04	1.52E+06
Land use	pt	1.30E+05	1.81E+06	1.46E+06	1.44E+05	2.93E+06
Water use	m^3 water eq. of deprived water	1.00E+04	3.56E+05	8.34E+04	1.70E+04	4.45E+05
Resource use, minerals and metals	kg Sb eq	5.78E-02	1.33E+00	1.59E+00	4.18E-01	2.81E+00
Resource use, fossils	MJ	7.66E+04	2.29E+06	1.77E+06	1.51E+05	5.83E+06

Table 5-23: 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	23,248	1,060,935	5,421	2,244,364
Thermal energy	MJ	0	1,804,120	0	68,801,684

Environmental aspect	Unit	D1	D2	D3	D4
PEF Impact categories					
Climate change, total	kg CO_2 eq	1.19E+04	5.64E+05	2.35E+03	5.42E+06
Ozone depletion	kg CFC-11 eq	3.88E-06	1.72E-04	8.49E-07	6.22E-04
Human toxicity, cancer	CTUh	1.01E-05	9.30E-05	4.28E-07	5.94E-04
Human toxicity, non-cancer	CTUh	5.48E-05	1.61E-03	8.46E-06	7.07E-03
Particulate matter	disease incidence	6.44E-04	1.51E-02	8.48E-05	5.32E-02
Ionising radiation, human health	kBq U235 eq	4.25E+03	1.91E+05	9.70E+02	4.81E+05
Photochemical ozone formation, human health	kg NMVOC eq	2.46E+01	8.14E+02	4.05E+00	4.55E+03
Acidification	mol H+ eq	6.56E+01	1.45E+03	8.26E+00	5.54E+03
Eutrophication, terrestrial	mol N eq	8.67E+01	2.89E+03	1.49E+01	1.16E+04
Eutrophication, freshwater	kg P eq	2.51E-02	1.59E+00	4.79E-03	2.77E+01
Eutrophication, marine	kg N eq	8.13E+00	2.78E+02	1.41E+00	1.29E+03
Ecotoxicity, freshwater	CTUe	5.72E+04	2.09E+06	1.09E+04	6.40E+06
Land use	pt	1.91E+05	2.09E+06	1.19E+04	5.54E+06
Water use	m^3 water eq. of deprived water	3.72E+03	1.54E+05	7.90E+02	3.87E+05
Resource use, minerals and metals	kg Sb eq	2.63E-01	5.83E-01	1.00E-02	9.46E+00
Resource use, fossils	MJ	1.99E+05	9.56E+06	4.06E+04	8.53E+07

5.4.2. 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 Base Case. Furthermore, a contribution analysis is performed in the two highest contribution life cycle stages, namely use stage and raw materials production, per Base Case.

5.4.2.1. WM1: Semi-professional washer extractor

The detailed results for WM1 Base Case are presented in **Annex V, WM1: Semi-professional 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 majority of the lifetime impact of the semi-professional washer extractor is derived from the use phase (>80 % for most impact categories) followed by the raw materials input (**Figure 5-1)** 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 5-1**).

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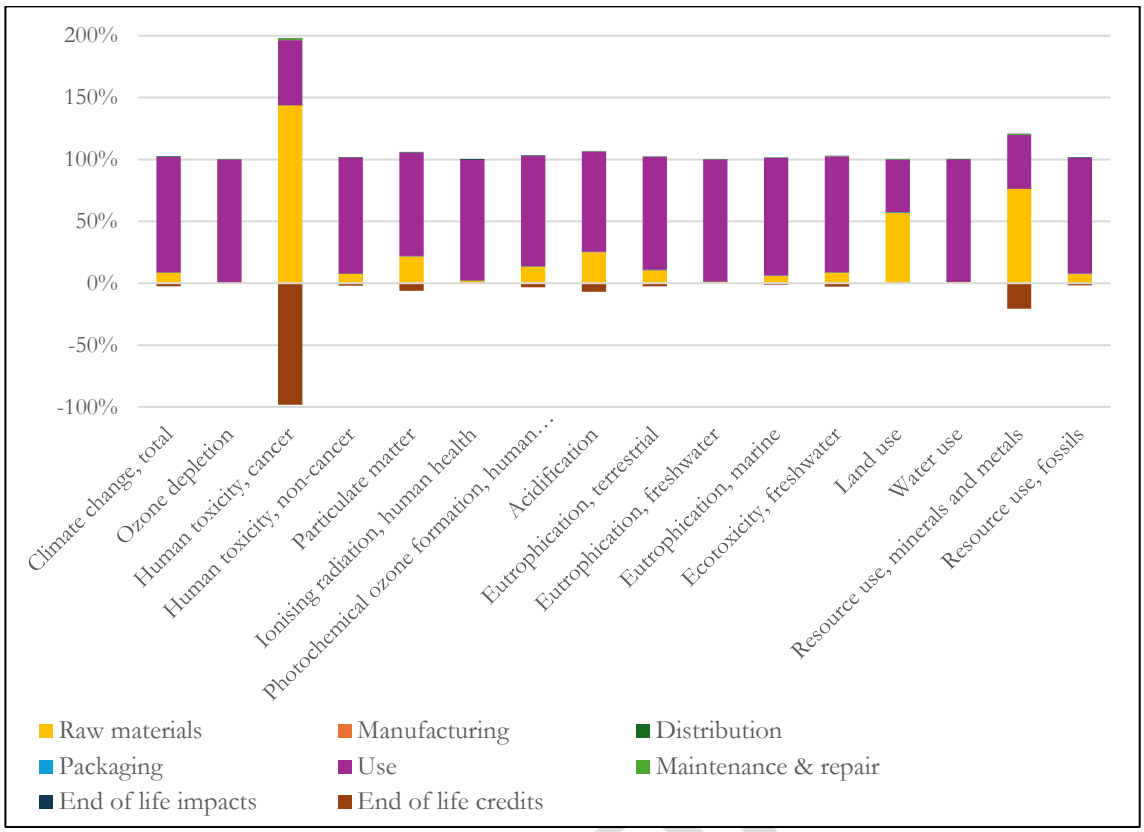

Figure 5-1: Contribution analysis (including EoL credits), WM11.

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 5-2**).The major contribution of the raw materials to most impact categories is from the production of electronics (controller board) and stainless steel (**Figure 5-3**). 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 5-3**).

In the End-of-Life (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 5-1**) 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.

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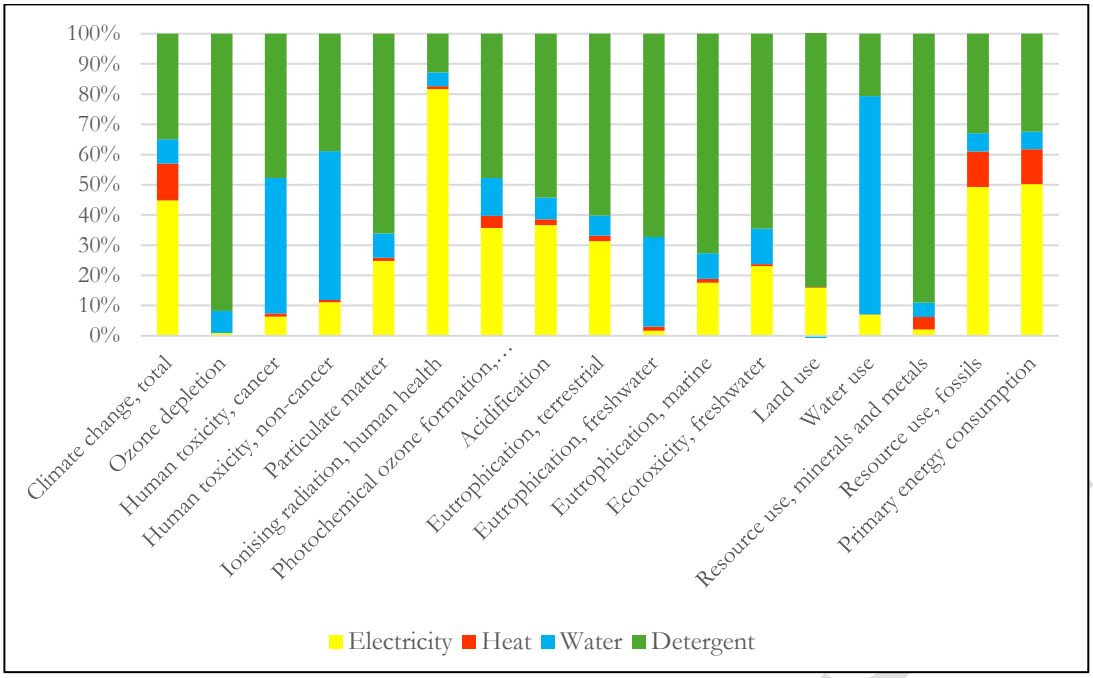

Figure 5-2: Contribution analysis – Use phase, WM1.

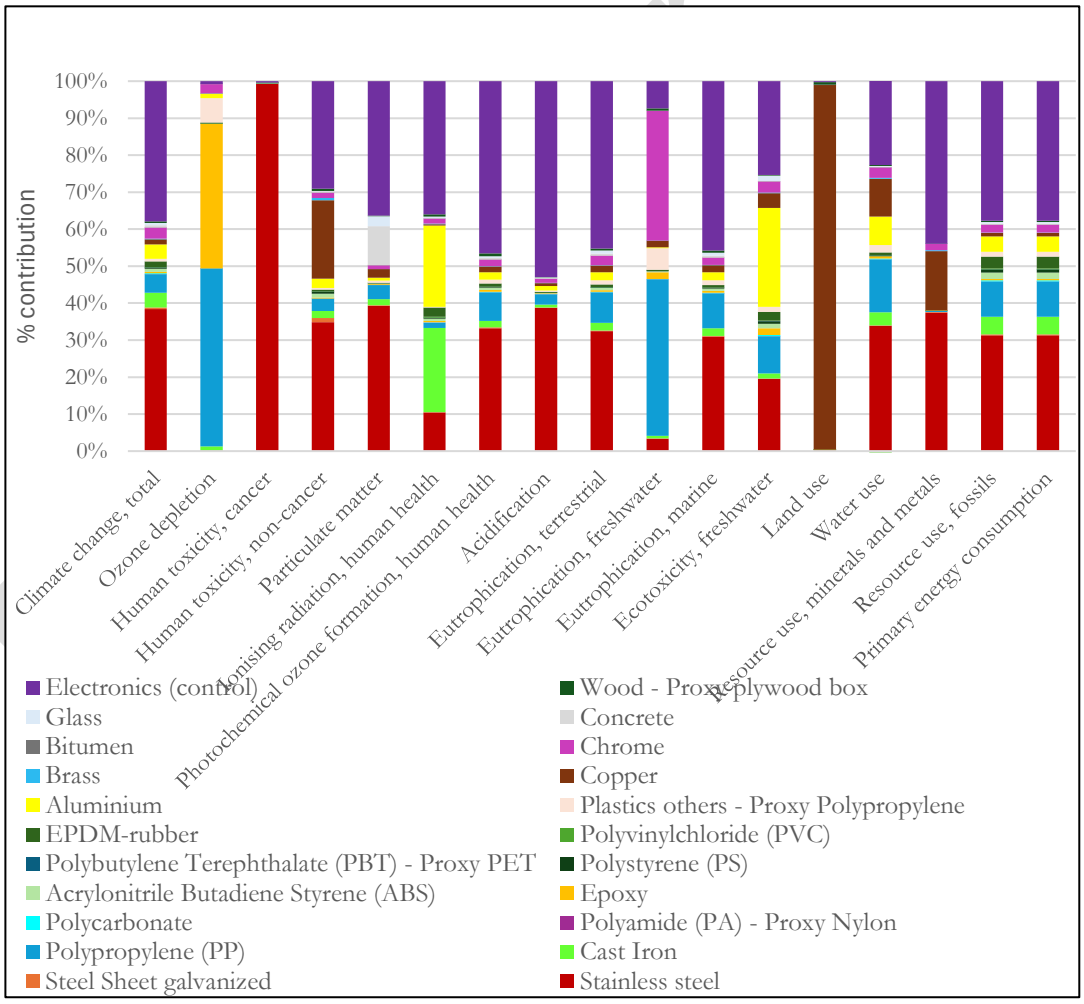

Figure 5-3: Contribution analysis – Raw materials, WM1WM2: Professional washer extractor.

The detailed results for WM2 Base Case are presented in **Annex V, WM2: Professional 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 majority of the lifetime impact of the professional washer extractor is derived from the use phase (>90 % for most impact categories) followed by the raw materials input (**Figure 5-4**). 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 5-4**).

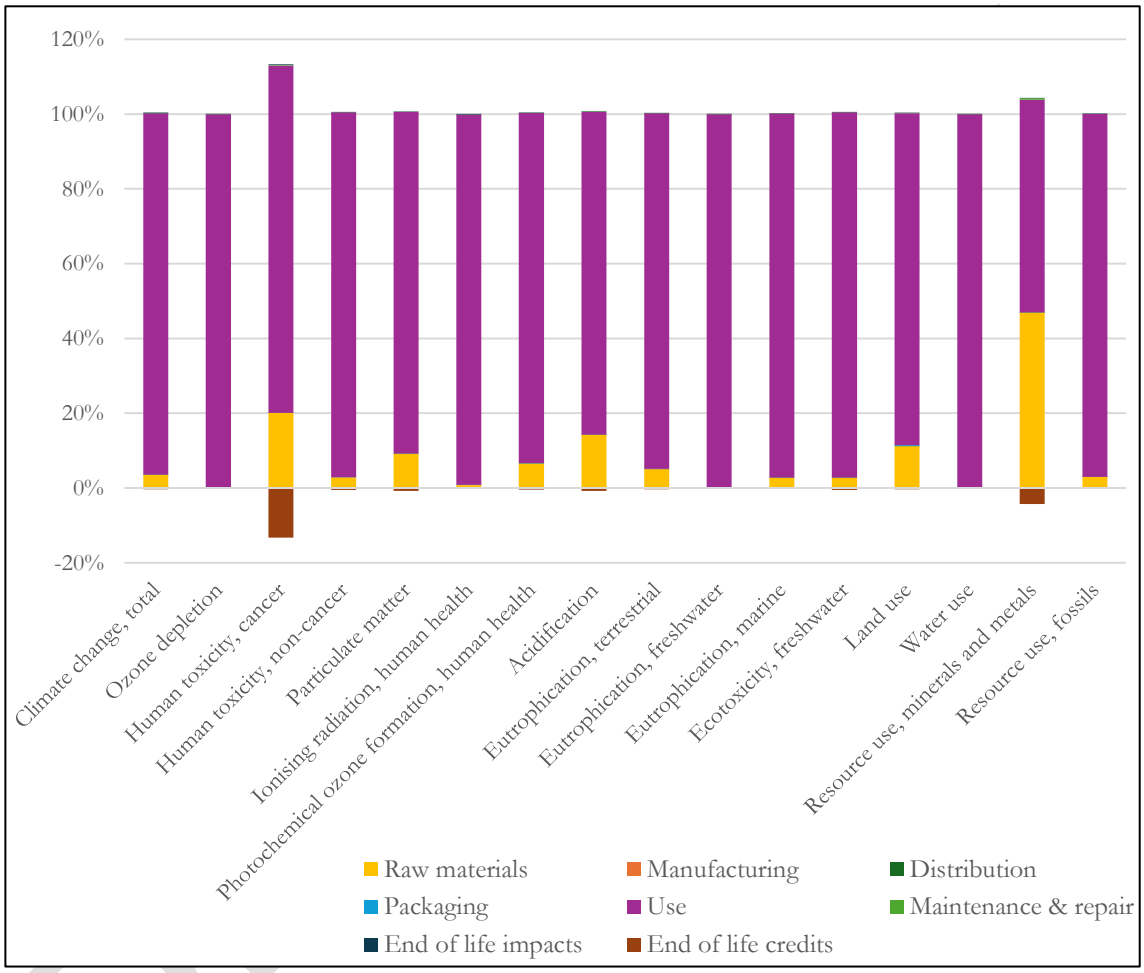

Figure 5-4: Contribution analysis (including EoL credits), WM2.

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 5-5**).

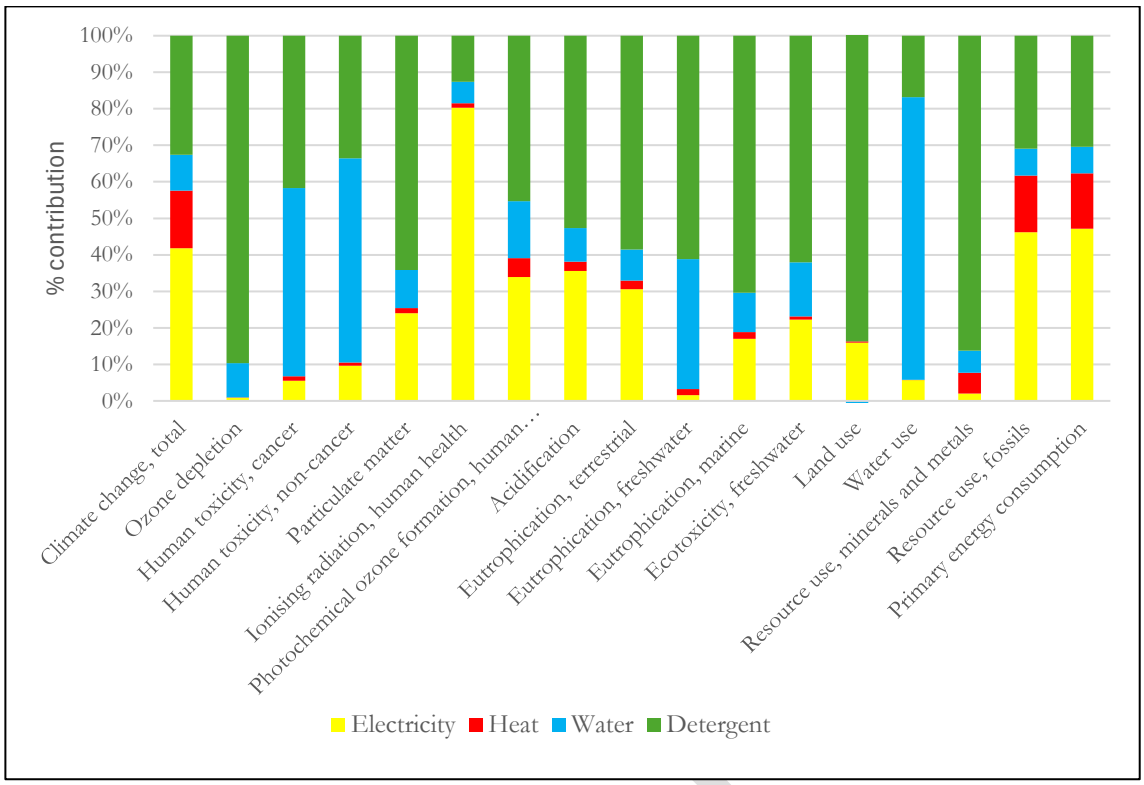

Figure 5-5: Contribution analysis – Use phase, WM2.

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board) (**Figure 5-6**). 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 End-of-Life (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 5-4**) 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.

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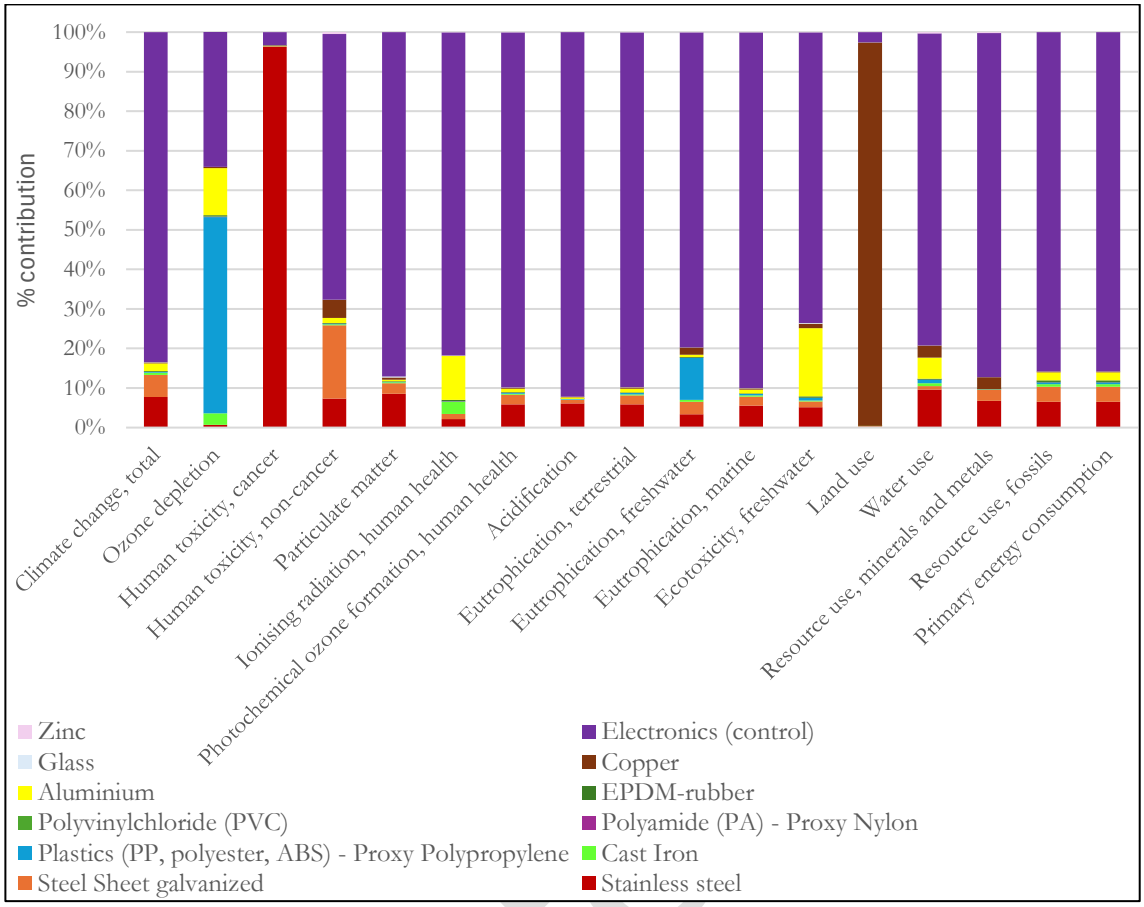

Figure 5-6: Contribution analysis – Raw materials – WM2.

5.4.2.2. WM3: Professional washer dryer

The detailed results for WM3 Base Case are presented in **Annex V,**

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WM3: Professional 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 majority of the lifetime impact of the professional washer dryer is derived from the use phase (>90 % for most impact categories) followed by the raw materials input (**Figure 5-7**). 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 5-7**).

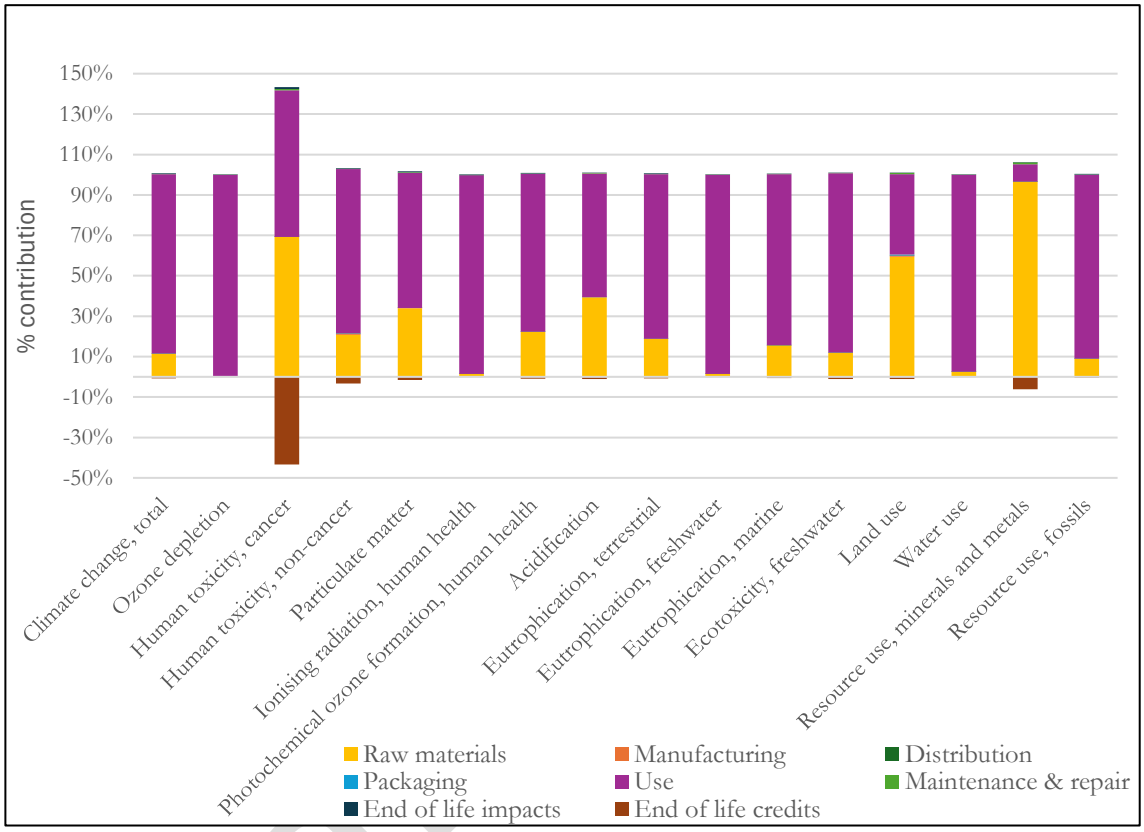

Figure 5-7: Contribution analysis (including EoL credits), WM3.

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 5-8**).

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board). However, for the impact categories "Human toxicity, cancer" and "Land use", the dominant contributors are stainless steel and copper, respectively (**Figure 5-9**). Polypropylene is the second highest contributing raw material to the impact category "Ozone depletion".

In the End-of-Life (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 5-7**) 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.

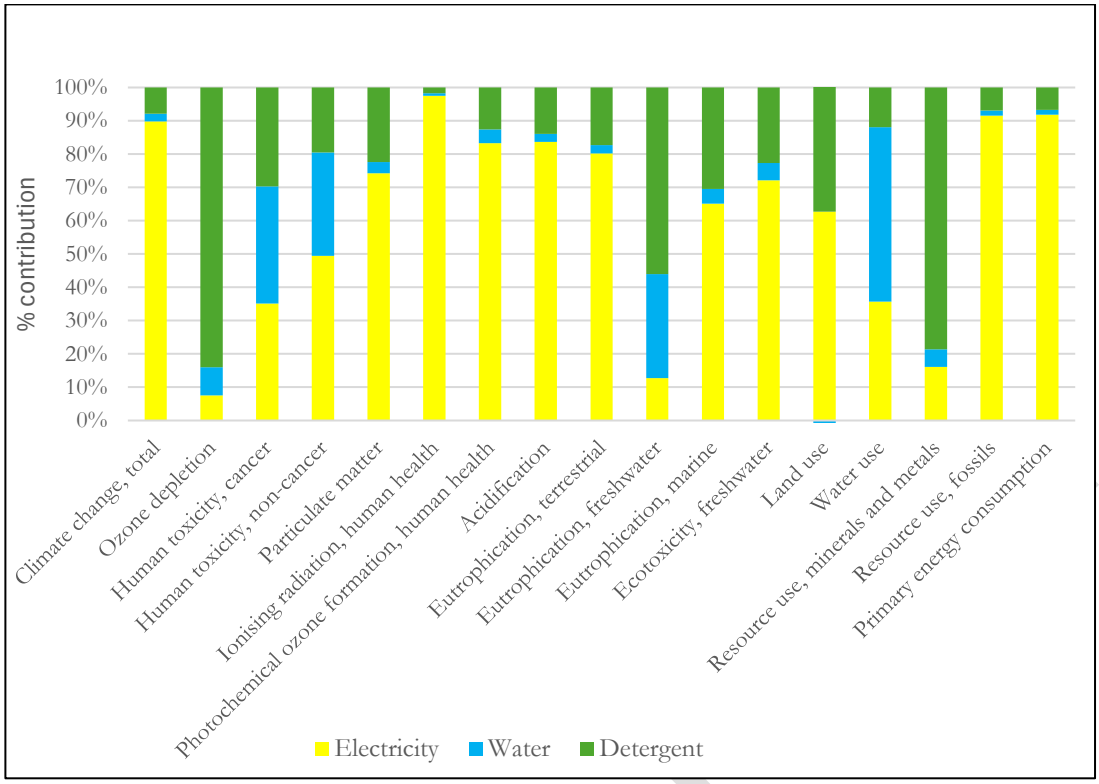

Figure 5-8: Contribution analysis – Use phase, WM3.

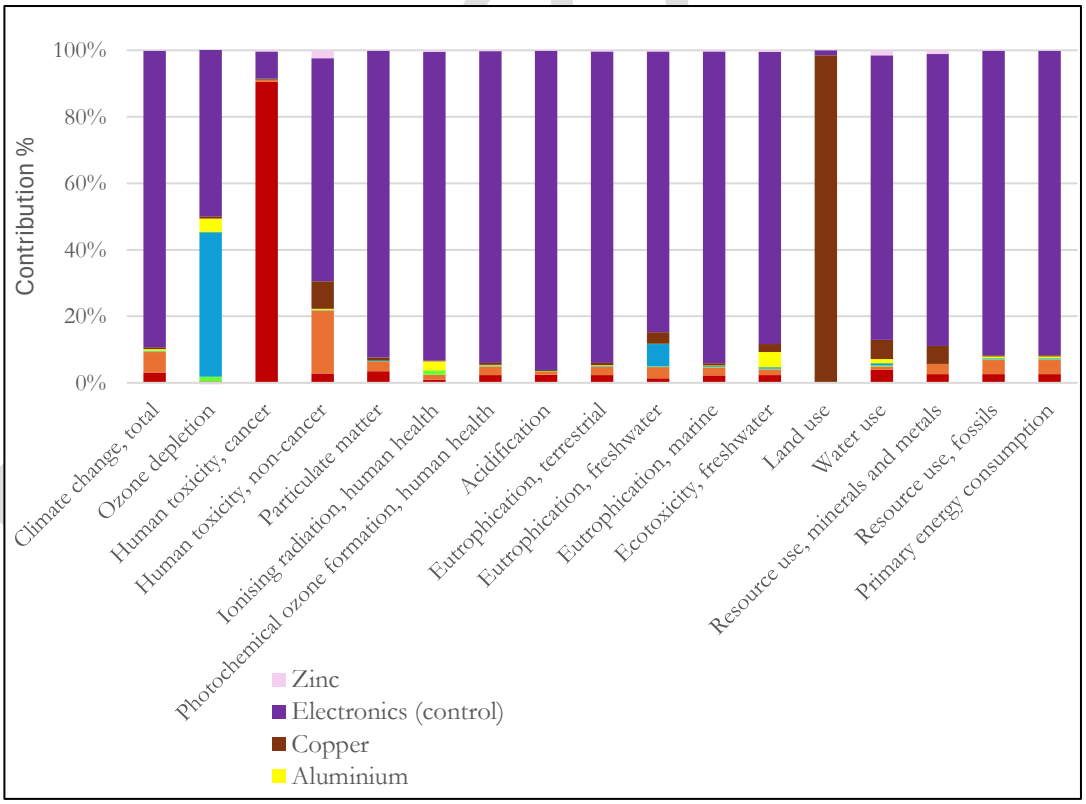

Figure 5-9: Contribution analysis – Raw materials, WM3.

5.4.2.3. WM4: Professional barrier washer

The detailed results for WM4 Base Case are presented in **Annex V, WM4: Professional 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 majority of the lifetime impact of the professional barrier washer is derived from the use phase and the raw materials input (to different degrees for the various impact indicators (**Figure 5-10**).

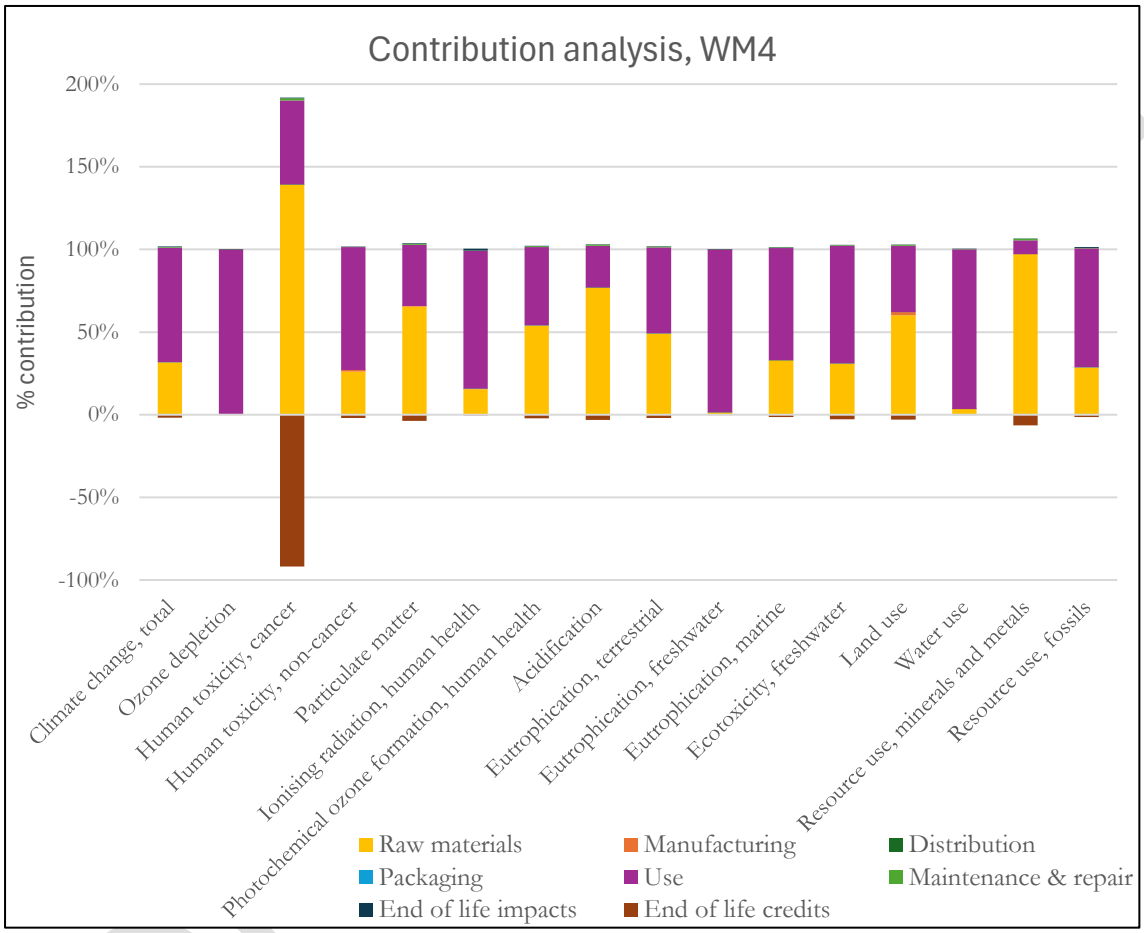

Figure 5-10: Contribution analysis (including EoL credits), WM4.

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 5-11)**.

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board). However, for the impact categories “Human toxicity, cancer” and “Land use”, the dominant contributors are stainless steel and copper, respectively (**Figure 5-12**). Polypropylene is the second highest contributing raw material to the impact category “Ozone depletion”.

In the End-of-Life (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 5-10**) 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.

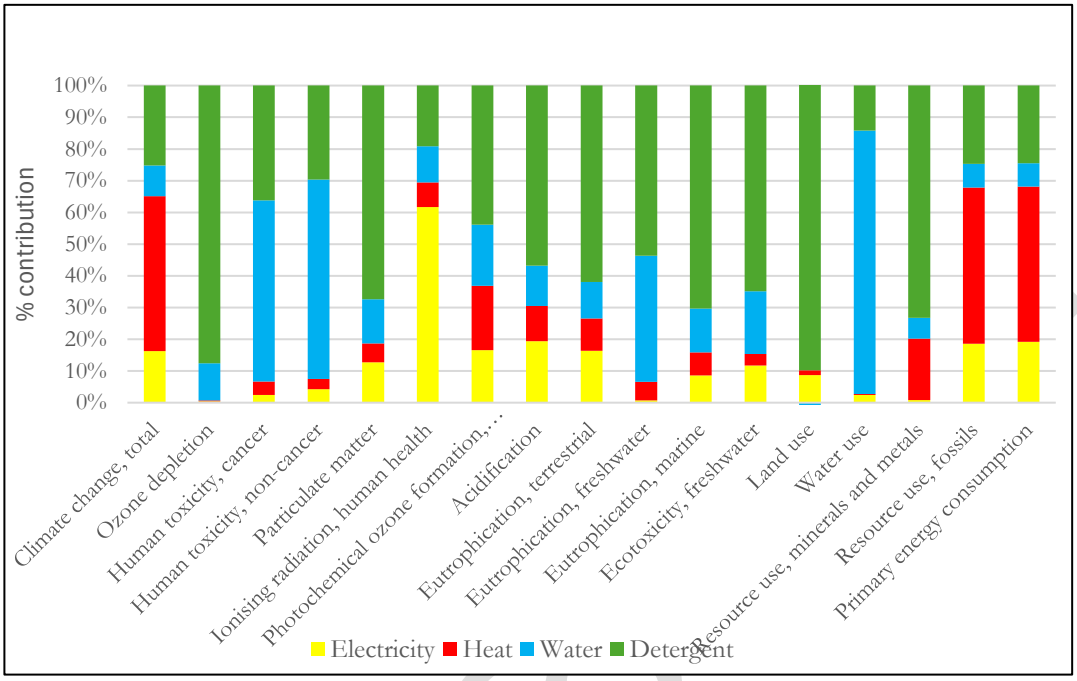

Figure 5-11: Contribution analysis – Use phase, WM4.

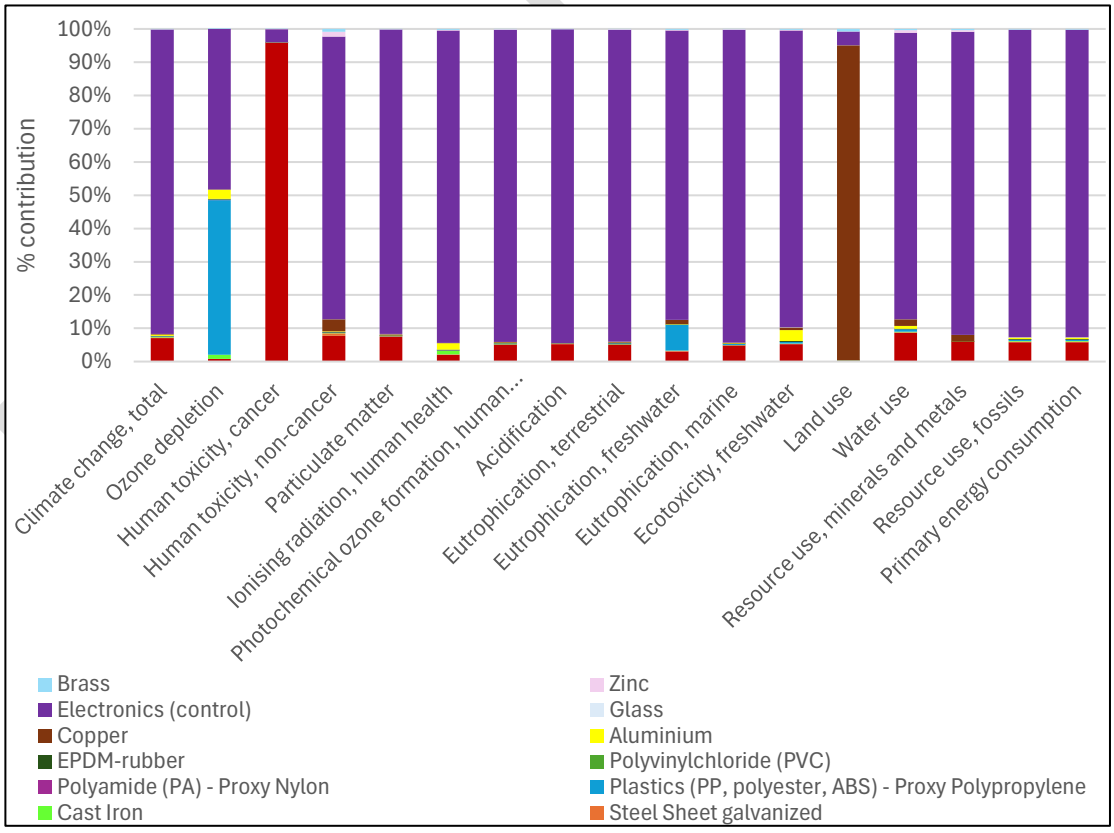

Figure 5-12: Contribution analysis – Raw materials, WM4.

5.4.2.4. WM5: Industrial continuous tunnel washers

The detailed results for WM5 Base Case are presented in **Annex V, 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 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 5-13**). 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 5-13**).

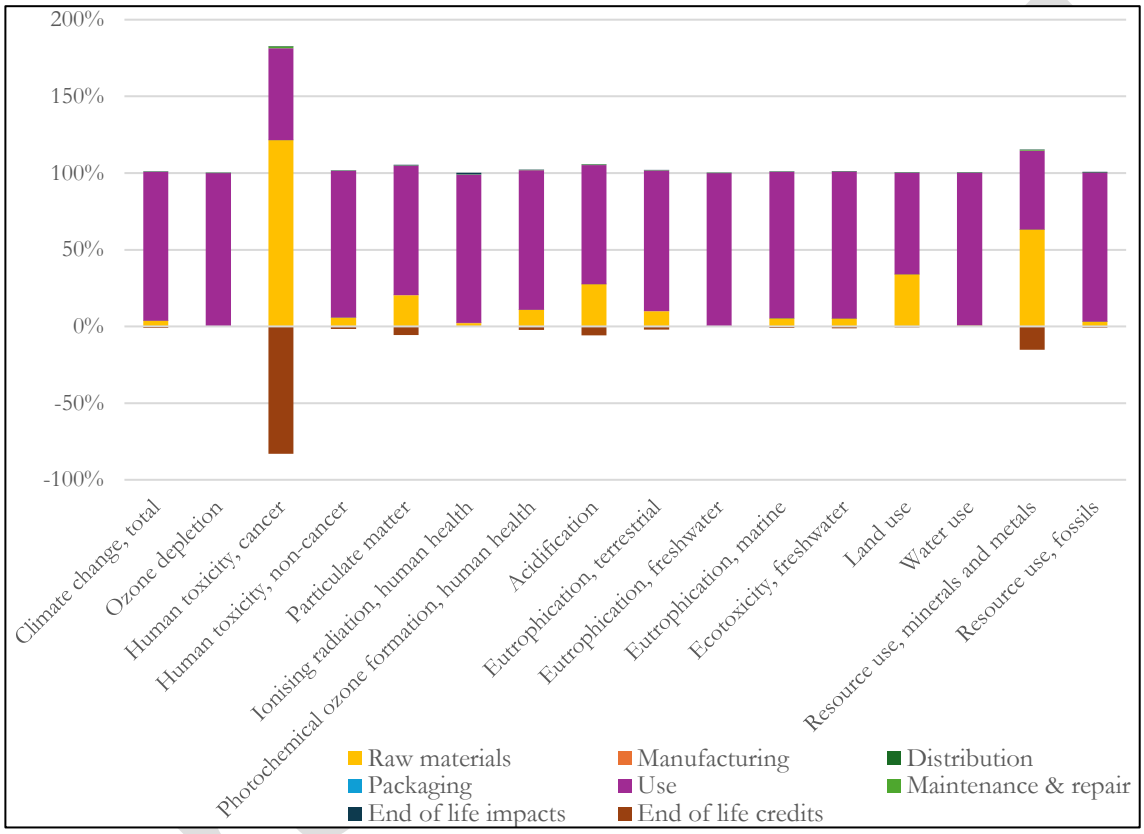

Figure 5-13: Contribution analysis (including EoL credits), WM5.

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 contributes the most (**Figure 5-14**). 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) and stainless steel. However, for the impact categories "Human toxicity, cancer" and "Land use", the dominant contributors are stainless steel and copper, respectively (**Figure 5-15**).

In the End-of-Life (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 5-13**) 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.

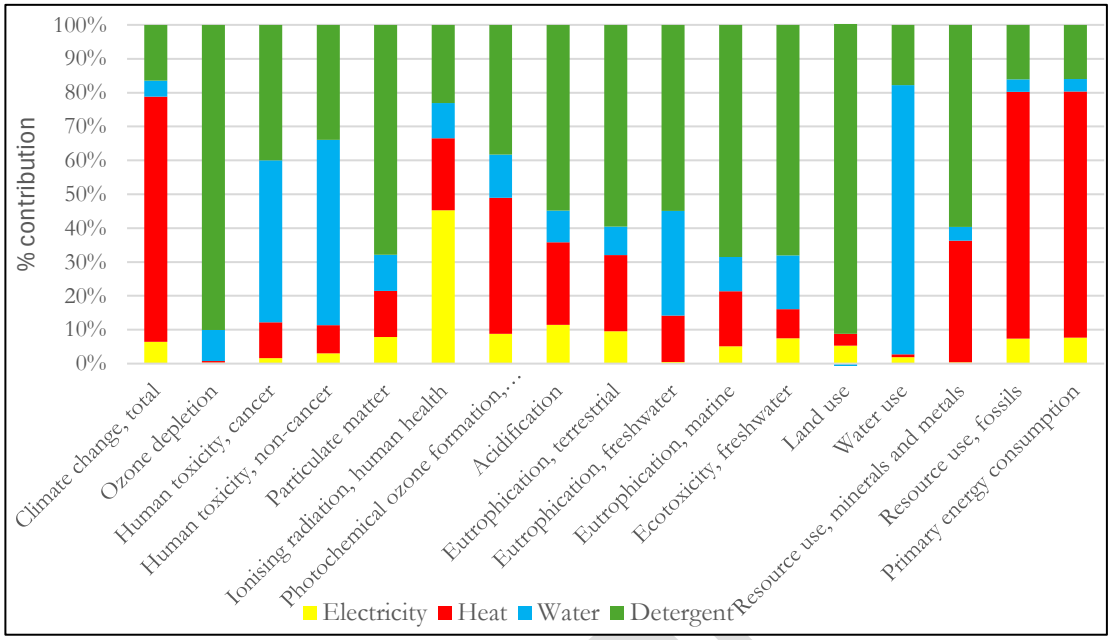

Figure 5-14: Contribution analysis – Use phase, WM5.

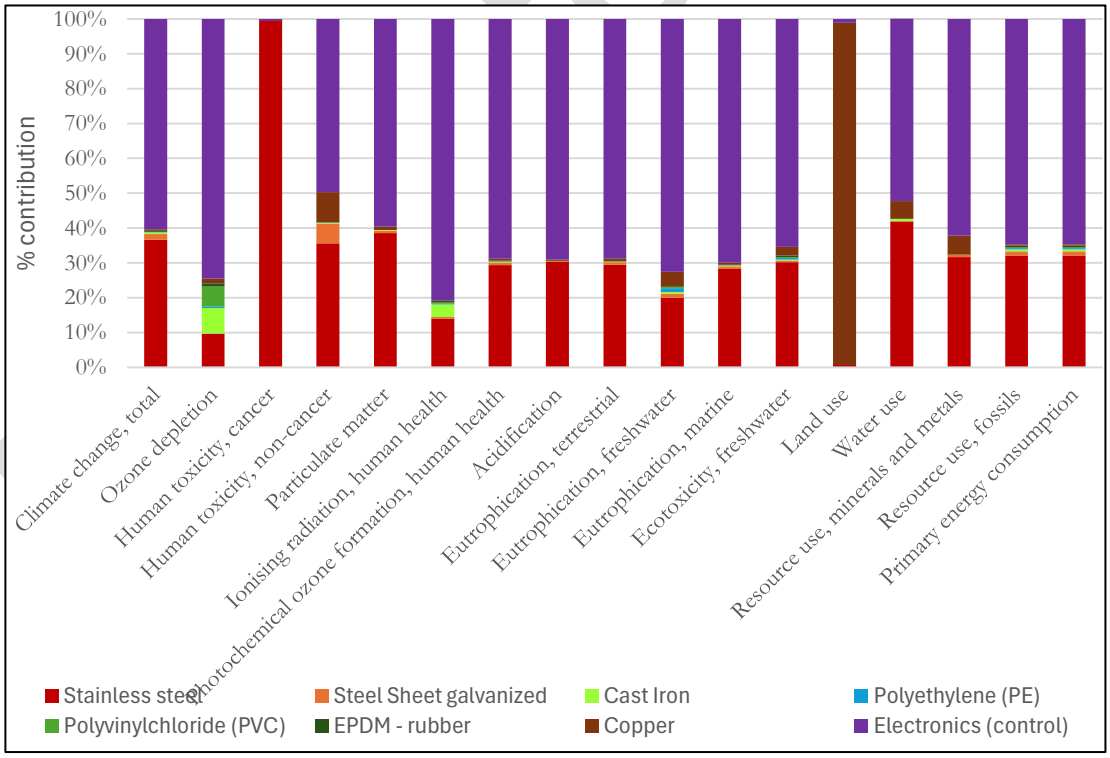

Figure 5-15: Contribution analysis – Raw materials, WM5.

5.4.2.5. D1: Semi-professional tumble dryer

The detailed results for D1 Base Case are presented in **Annex V, D1: Semi-professional 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 majority of the lifetime impact of the semi-professional tumble dryer is derived from the use phase and the raw materials input (to different degrees for the various impact indicators (**Figure 5-16**).

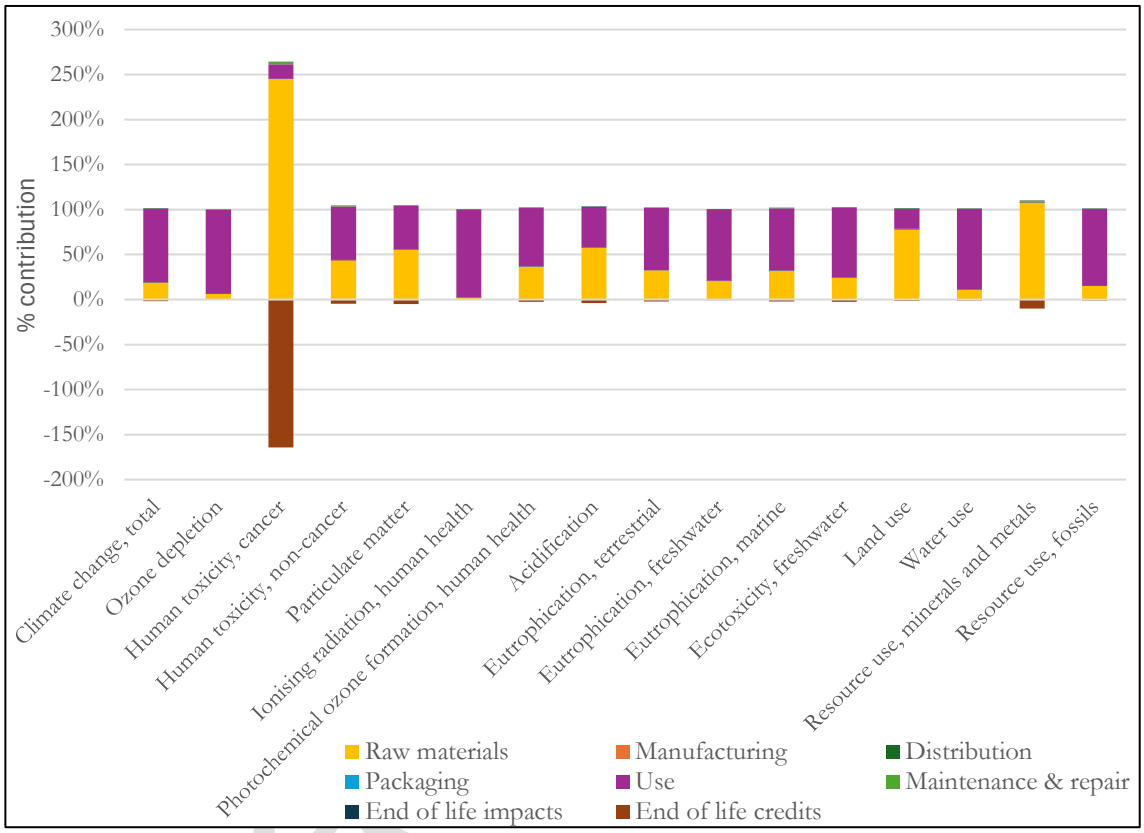

Figure 5-16: Contribution analysis (including EoL credits), D1.

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) (**Figure 5-17**). 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 galvanized steel.

In the End-of-Life (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 5-16**) 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.

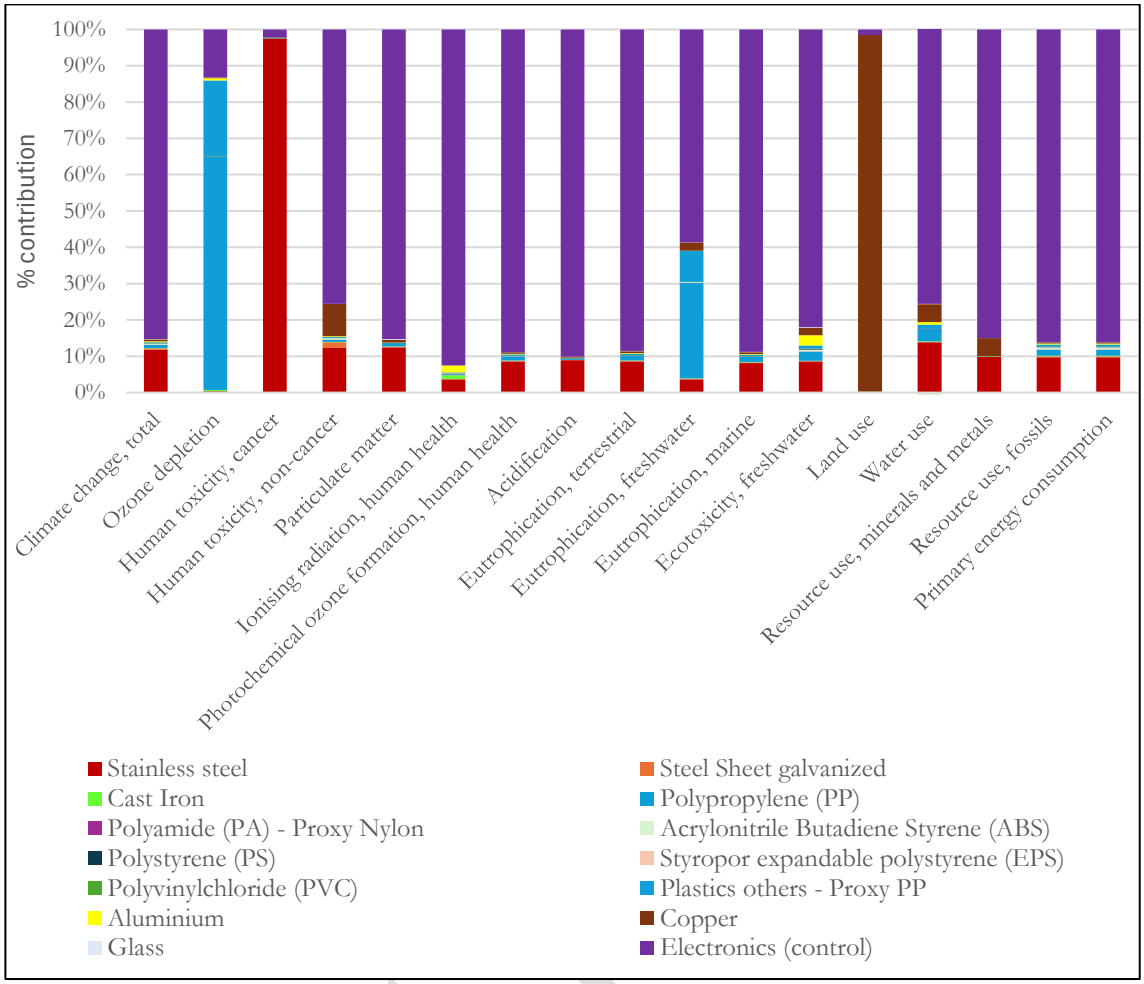

Figure 5-17: Contribution analysis – Raw materials, D1.

5.4.2.6. D2: Professional tumble dryer

The detailed results for D2 Base Case are presented in **Annex V, D2: Professional 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 majority of the lifetime impact of the professional tumble dryer is derived from the use phase (>90 % for most impact categories) followed by the raw materials input (**Figure 5-18**). 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 5-18**).

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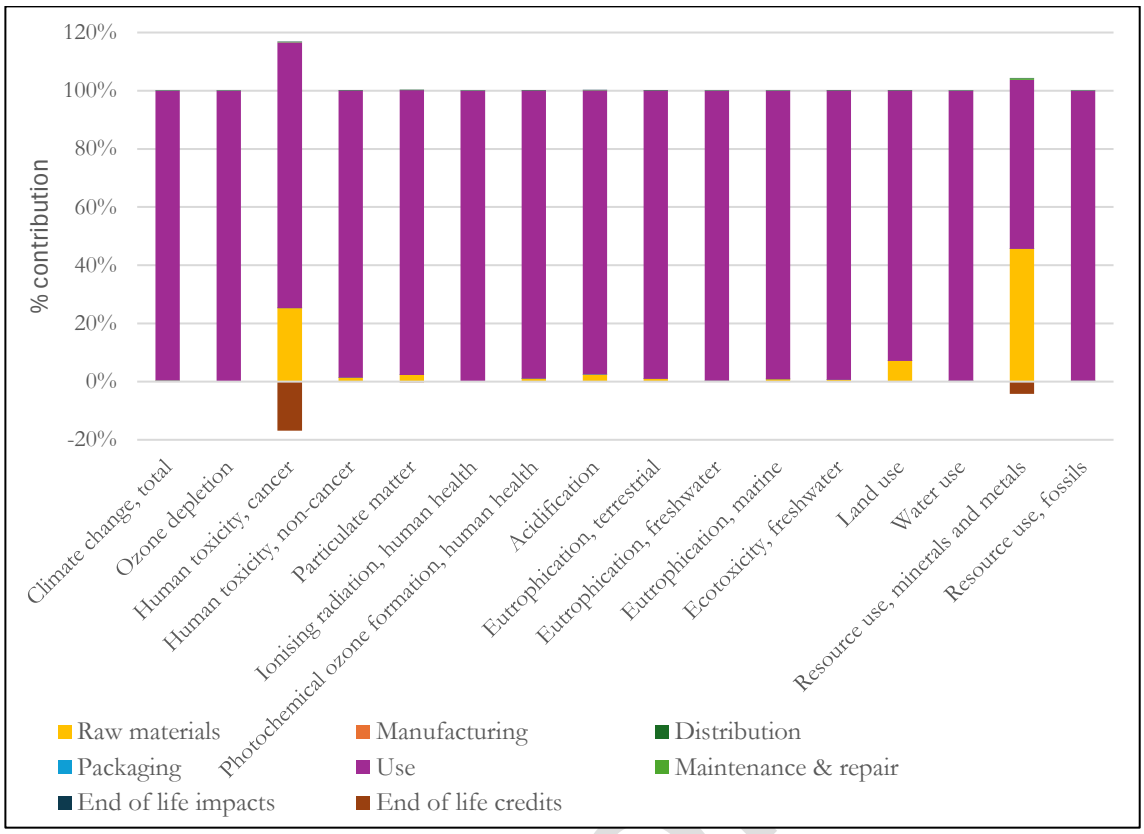

Figure 5-18: Contribution analysis (including EoL credits), D2.

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 5-19**).

The major contribution of the raw materials is from the production of electronic (controller board). However, for the impact categories “Ozone depletion”, “Human toxicity, cancer” and “Land use”, the dominant contributors are polypropylene, stainless steel and copper, respectively (**Figure 5-20**).

In the End-of-Life (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 5-18**) 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.

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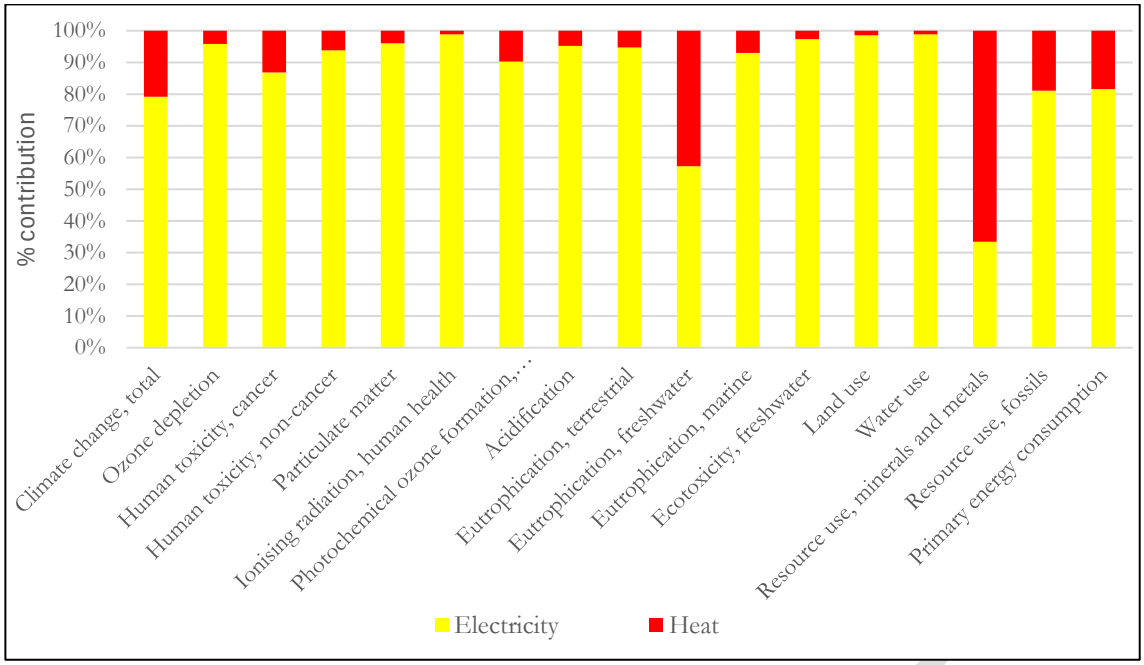

Figure 5-19: Contribution analysis – Use phase, D2.

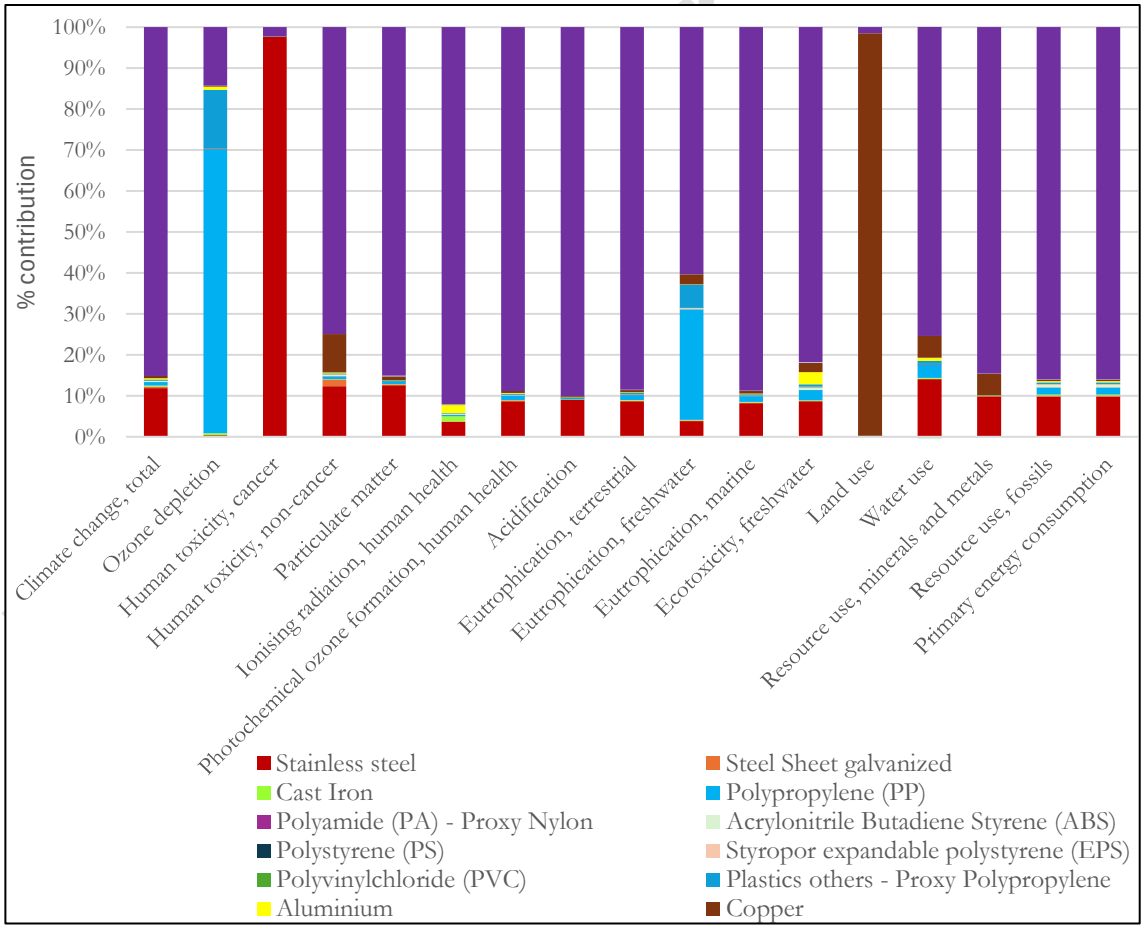

Figure 5-20: Contribution analysis – Raw materials, D2.

5.4.2.7. D3: Professional cabinet dryer

The detailed results for D3 Base Case are presented in **Annex V, D3: Professional 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 majority of the lifetime impact of the professional cabinet dryer is derived from the use phase (>90 % for most impact categories) followed by the raw materials input **(Figure 5-21**), 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 5-21**).

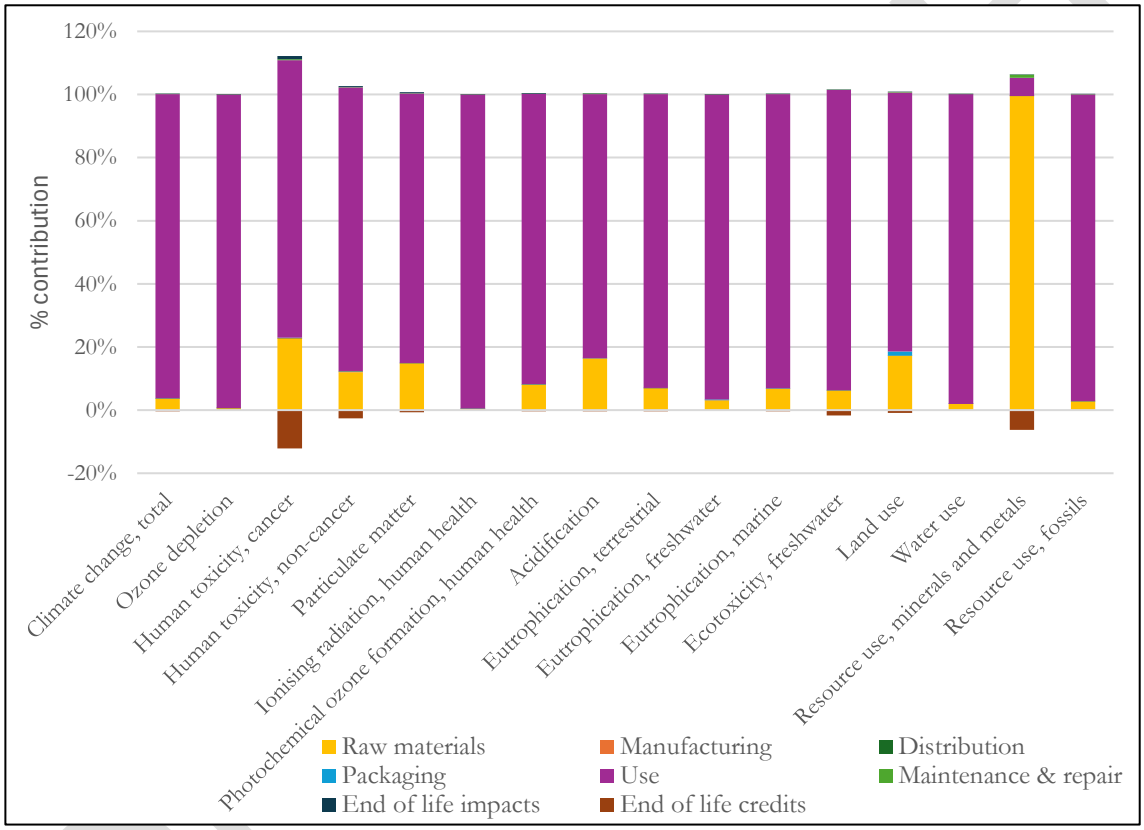

Figure 5-21: Contribution analysis (including EoL credits), D3.

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) (**Figure 5-22**). 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 End-of-Life (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 5-21**) 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.

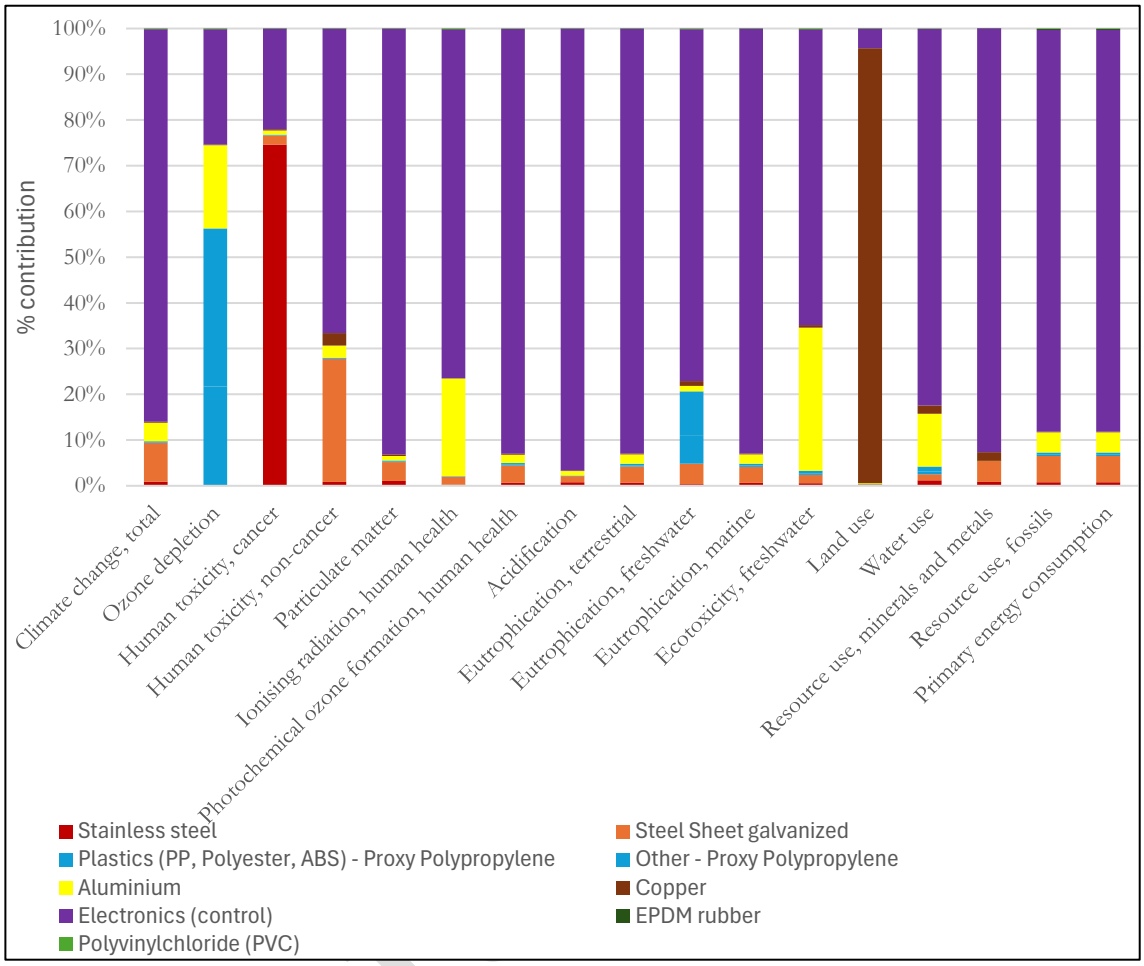

Figure 5-22: Contribution analysis – Raw materials, D3.

5.4.2.8. D4: Industrial pass-through tumble dryer

The detailed results for D4 Base Case are presented in **Annex V, 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 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 5-23).**

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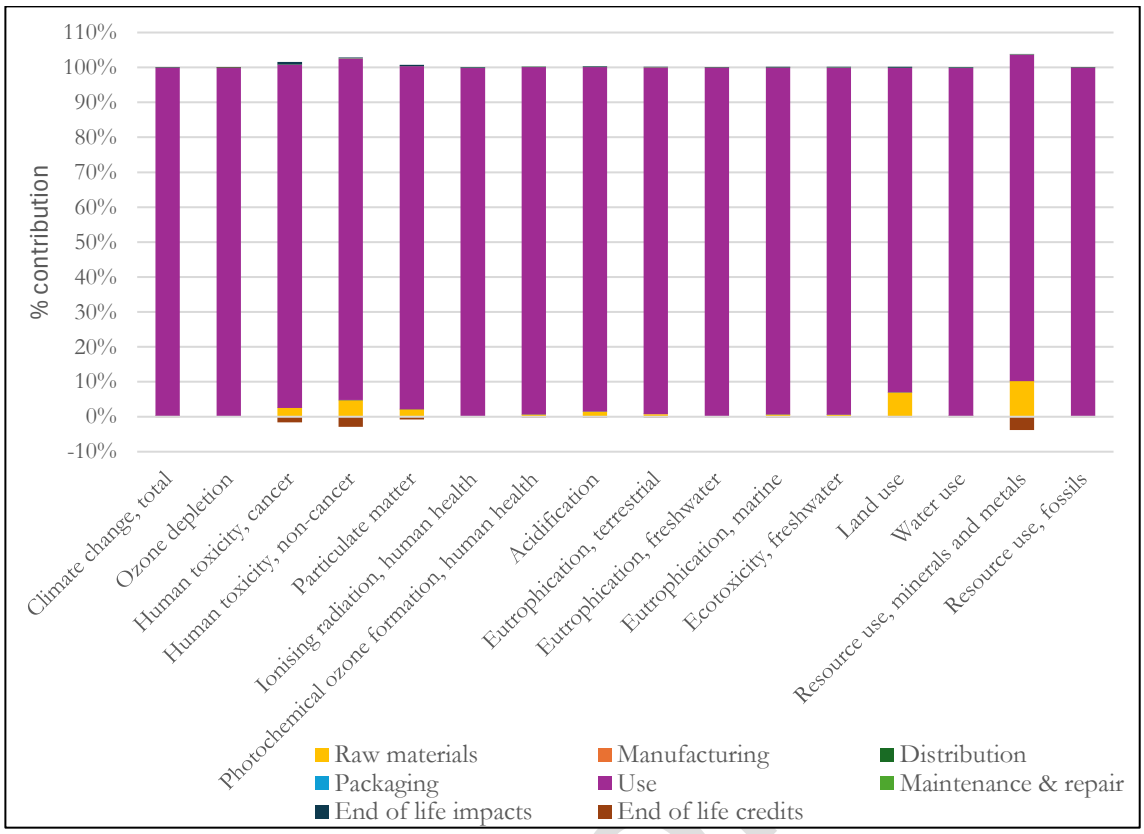

Figure 5-23: Contribution analysis (including EoL credits), D4.

In the use phase, electricity and heat use contribute to different degrees for the various impact indicators (**Figure 5-24**).

The major contribution of the raw materials to most impact categories is from the production of electronics (controller board) and galvanised steel. However, for the impact categories "Human toxicity, cancer" and "Land use", the dominant contributors are stainless steel and copper, respectively (**Figure 5-25**).

In the End-of-Life (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 5-23)** 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 life time impact of D4.

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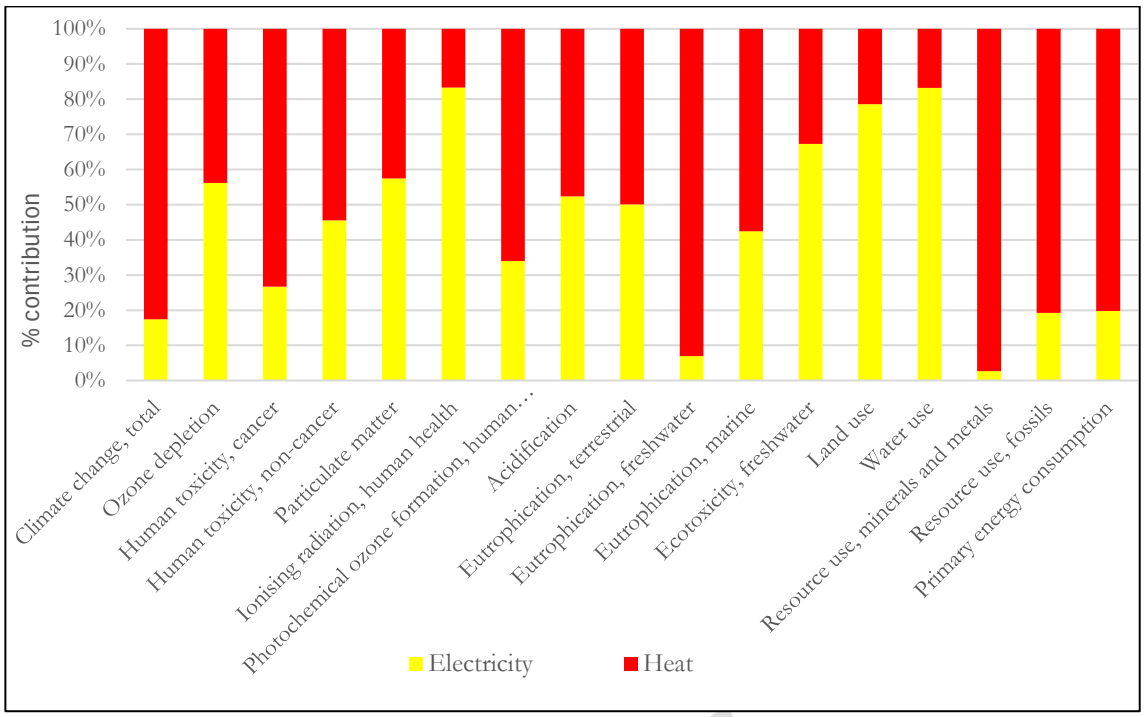

Figure 5-24: Contribution analysis – Use phase, D4.

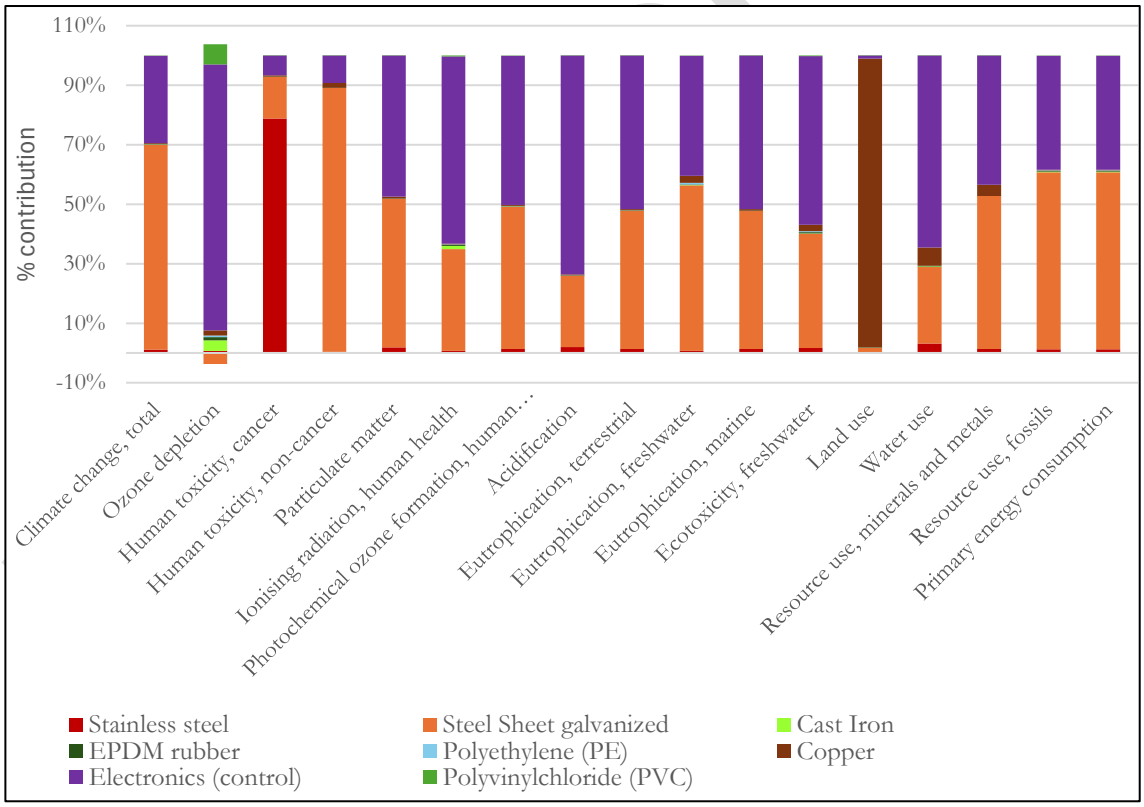

Figure 5-25: Contribution analysis – Raw materials, D4.

5.5. Base Case Life Cycle Cost for customers

In this section, the life cycle costs for each Base Case are presented, followed by a contribution analysis per Base Case of the main contributors to the life cycle costs.

5.5.1. Results overview LCC

The life cycle costs of each Base Case 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 5-24** for washing machines, **Table 5-25** for dryers; per Base Case in **Annex V**. For all Base Cases, the repair & maintenance costs were included as a percentage of the purchase price as indicated in Task 2, **Section 4.2.4.2** and **Section 4.2.4.4**. 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 Life Cycle Costs (LCC) of the product, including running costs discounted to their net present value (between € 900 – 622,000 and € 930 – 75,000 for washing machines and dryers respectively).

Clearly, the life cycle costs for Base Case WM5 are the highest of all Base Cases, 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 life cycle costs, 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 5-24: Total life cycle costs 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**
Purchase and installation costs	EUR/year	408	2,432	417	3,610	57,219

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Product item	Unit	WM1	WM2	WM3	WM4	WM5
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 5-25: Total life cycle costs 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

5.5.2. Contribution analysis LCC

A contribution analysis was performed to analyse the main contributors to the total costs per year per Base Case. 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.

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5.5.2.1. WM1: Semi-professional washer extractor

For Base Case 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 5-26**). 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.

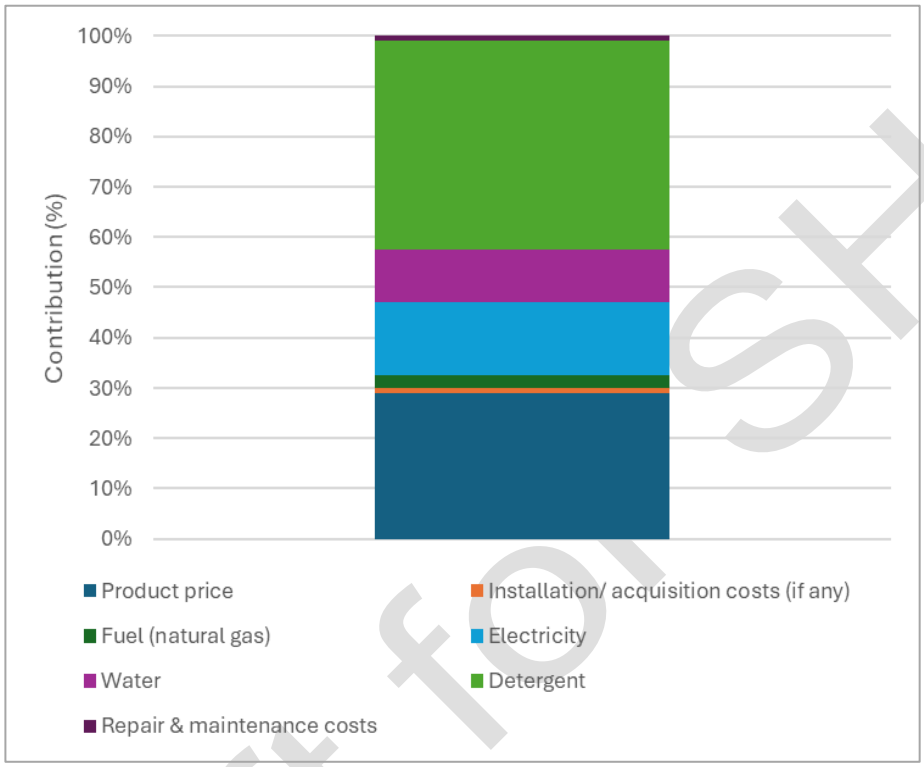

Figure 5-26: Cost contribution (per year), WM1.

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5.5.2.2. WM2: Professional washer extractor

For Base Case 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 5-27**). 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.

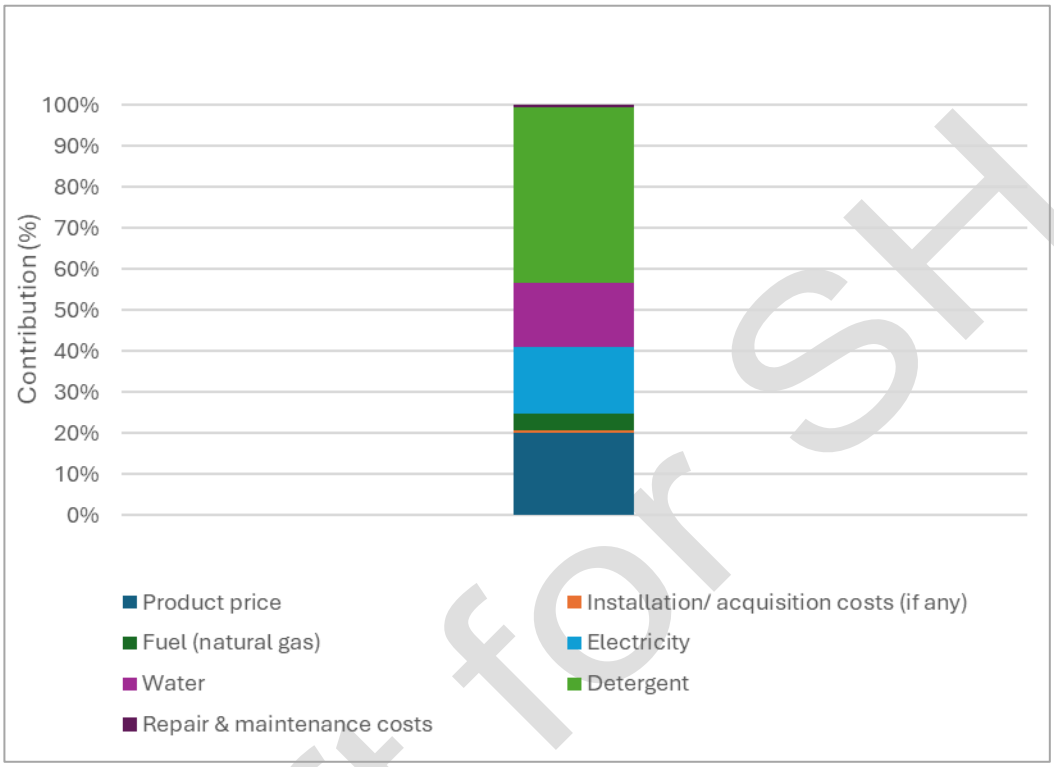

Figure 5-27: Cost contribution (per year), WM2.

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5.5.2.3. WM3: Professional washer dryer

For Base Case 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 5-28**. 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.

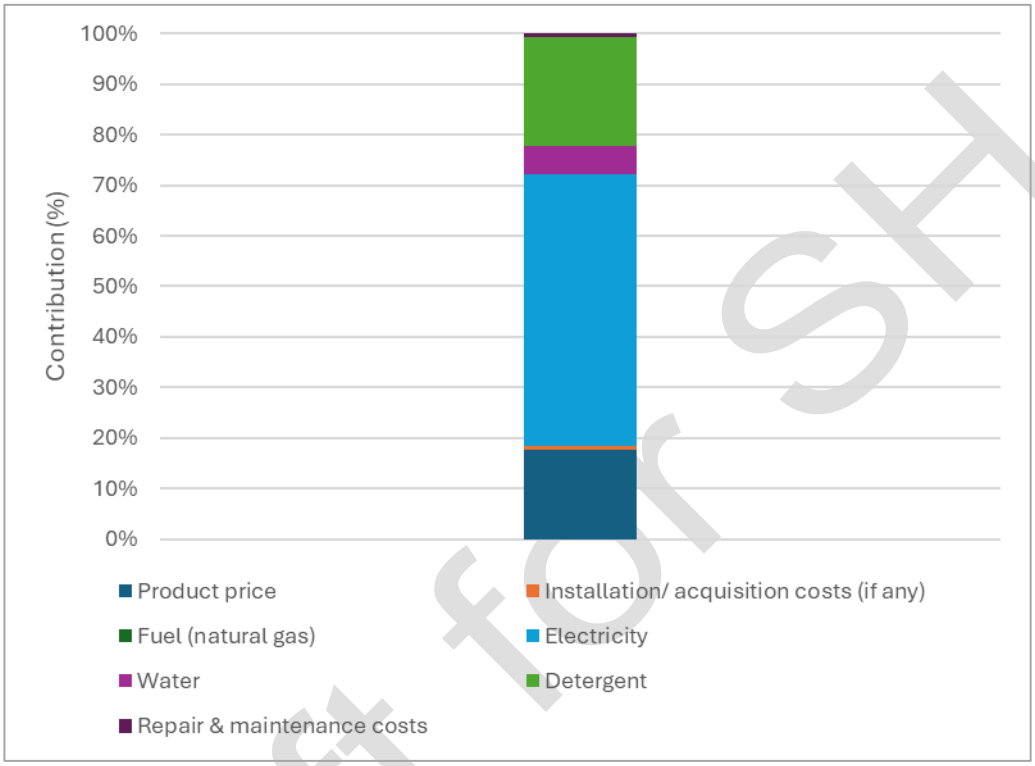

Figure 5-28: Cost contribution (per year), WM3.

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5.5.2.4. WM4: Professional barrier washer

For Base Case 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 5-29**). 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.

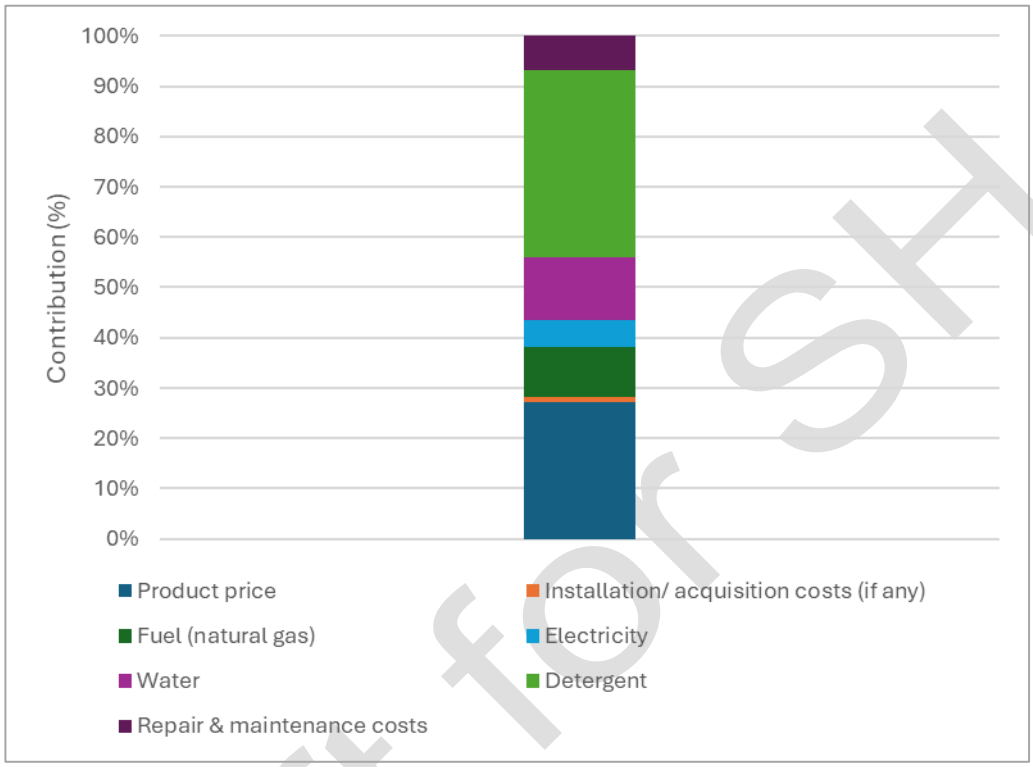

Figure 5-29: Cost contribution (per year), WM4.

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5.5.2.5. WM5: Industrial continuous tunnel washers

For Base Case 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 5-30**). 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.

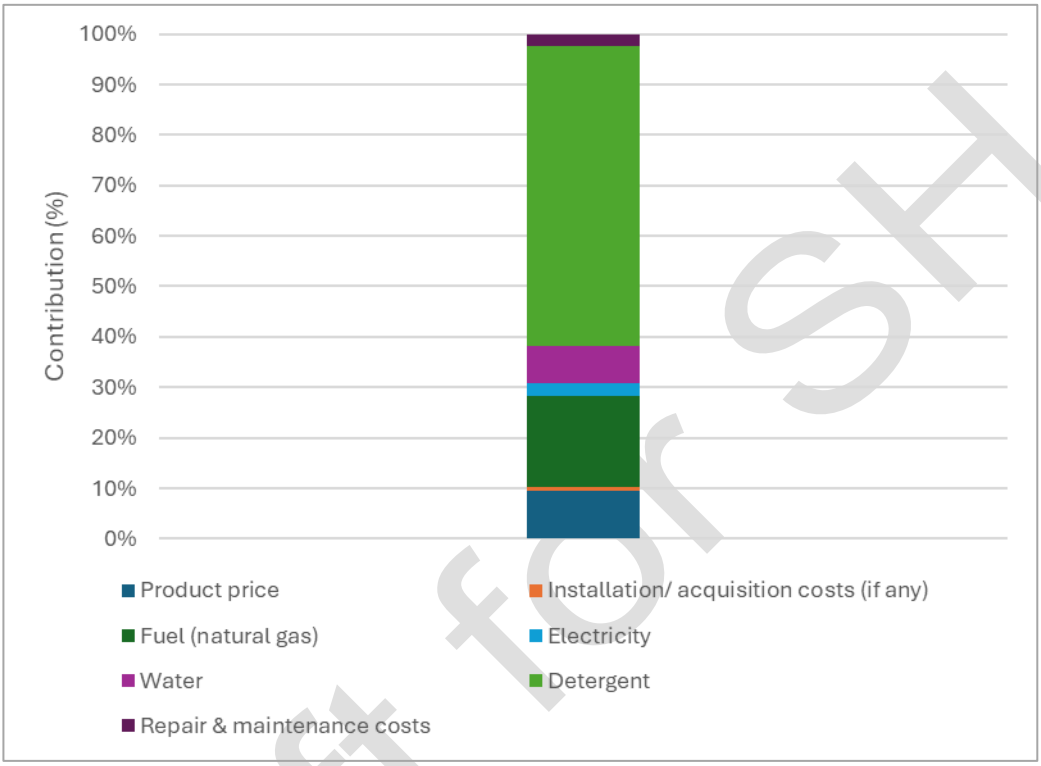

Figure 5-30: Cost contribution (per year), WM5.

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5.5.2.6. D1: Semi-professional tumble dryer

For Base Case 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 5-31**). As the only running costs are for electricity, the remaining costs are from Installation and repair & maintenance.

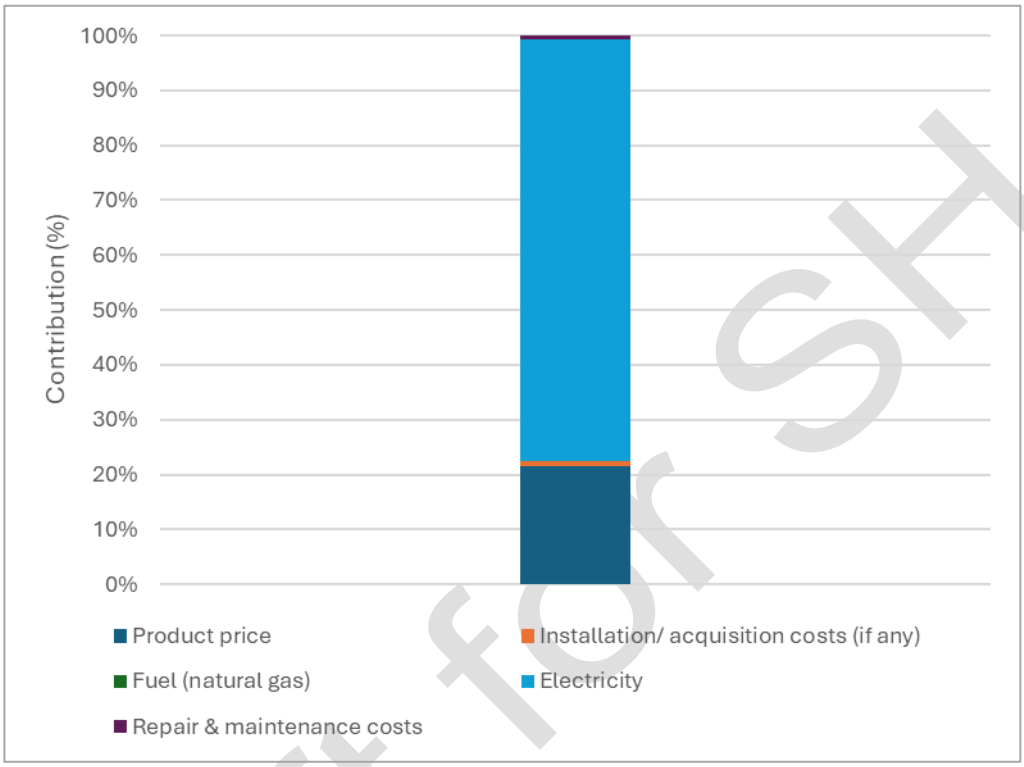

Figure 5-31: Cost contribution (per year), D1.

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5.5.2.7. D2: Professional tumble dryer

For Base Case 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 5-32**). 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.

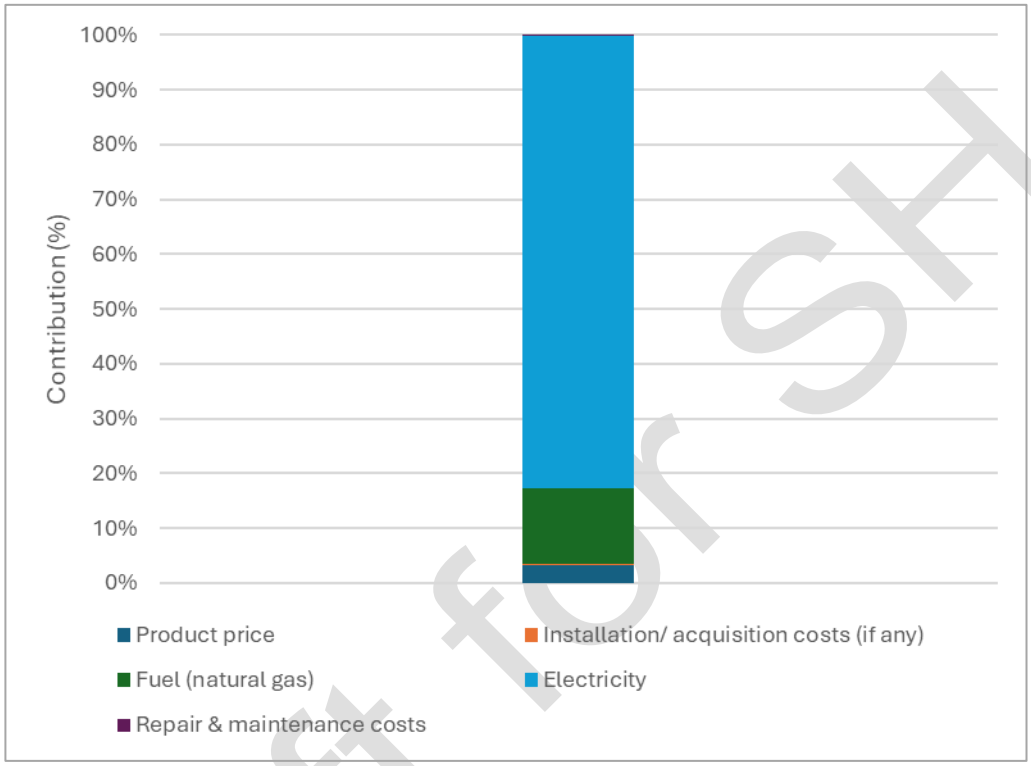

Figure 5-32: Cost contribution (per year), D2.

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5.5.2.8. D3: Professional cabinet dryer

For Base Case 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 5-33**). Installation costs and repair & maintenance costs make up the rest of the total.

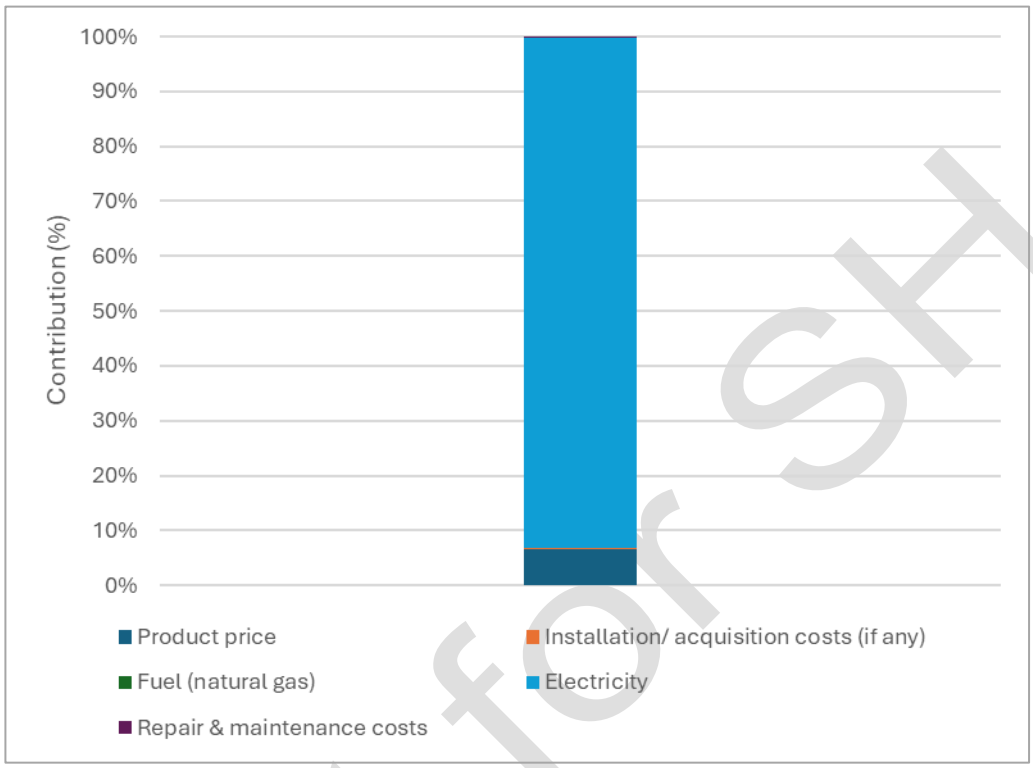

Figure 5-33: Cost contribution (per year), D3.

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5.5.2.9. D4: Industrial pass-through tumble dryer

For Base Case 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 5-34**). The remaining costs are from installation and repairs & maintenance.

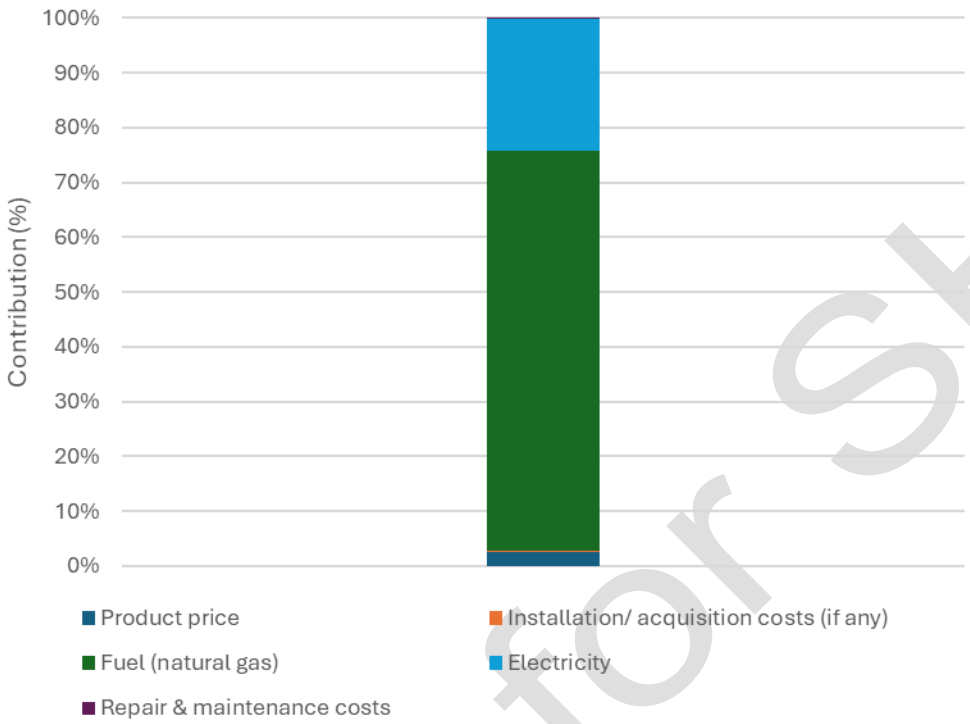

Figure 5-34: Cost contribution (per year), D4.

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5.6. EU Totals

In this section, the 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 5-26)** to obtain the impact of all new products of the Base Case in the reference year in the EU and the impact of the total stock of the Base Case. All data on EU level per Base Case are provided in the **Annex VI – Results of LCA / LCC per Base Case**, with a summary in the sections below.

Table 5-26: 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
D4	mln. Units	0.027

5.6.1. Life cycle assessment (LCA)

As summary tables, **Table 5-27** and **Table** 5-28 provide a comparison between all Base Cases in their environmental impact (expressed with the PEF impact categories) and the energy consumption of the EU stock. From this table it can be observed that the Base Cases 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 5-20** and **Table 5-21**), as well as the large amount of annual sales of the Base Case WM2 product, which, consequently, leads to large stock accumulation.

Regarding the environmental impact, the Base Cases 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 Base Cases and the number of annual sales. Specifically, Base Cases 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 Base Case on a product level, its annual sales are by far the lowest. This leads to WM5 Base Case 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 Base Case sold in that reference year. For this, the impact per Base Case is multiplied by the annual sales volume. An overview is in

Table 5-29and **Table 5-30**. Similar to the EU stock impact, WM2, D2 and D4 have the highest impact, which is related to the higher annual sales volumes.

Table 5-27: 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
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 5-28: 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					
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 5-29: 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						
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 5-30: 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
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

5.6.2. Life cycle costs

Table 5-31 and **Table 5-32** the total annual expenditure for all EU customers (EU27) in the purchase and operation of all Base Case products. 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 5-31**) and from 12.2 to 70 million Euro for the dryers (**Table 5-32**).

In general, the running costs of all Base Cases 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 5-31: 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 5-32: 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**

5.7. Sensitivity analysis

In **Section 5.7.1**, the sensitivity of the previous LCA and LCC results is checked with several sensitivity analyses, for one selected Base Case (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 Base Cases, 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 Base Cases WM1, 2, 3, and 4 (see **Section 5.7.2**) and D1, 2, and 3 (see **Section 5.7.3**); for Base Cases WM5 and D4, no updated data was provided.

5.7.1. 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 Base Case 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 Base Cases 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 in **Table 5-33.**

Table 5-33: 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)

Scenario #	Product aspect	Life cycle stage	Assumptions for the modelling change
S6	Repairability	Maintenance and Repair	% of spare parts at 20 %
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 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 1-3). 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 regards 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 Base Case in water and detergent (**Figure 5-30**).

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 5), a total reduction for all life cycles together was around 5 % for “Resource use, minerals and metals”, although specifically for certain life cycles separately (Raw Materials, End-of-Life, Maintenance & Repair as well as Manufacturing & Assembly) higher reductions can be observed, ranging from 4 – 12 %. Thus, with regards 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 (-26 %) for the impact category “Human toxicity, cancer”, 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 5-33.** 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 End-of-Life stage (between 71 %-97 %) due to 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 "Ionising radiation, human health"), thus not altering the overall results of the product impact.

In Scenario 9, 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" versus the dataset without condensing capacity of the 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"). Indeed, the heat impact reduced up to 24 % depending on the impact category, however on the total impact, the reduction was a maximum of 7 % ("Photochemical ozone formation, human health" and "Climate change"). Therefore, a conservative assumption was made in the current LCA results with the non-condensing boiler dataset, and more specific information from stakeholders may provide better insight in the dataset to use for modelling.

In conclusion, although the data 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.

5.7.2. Sensitivity analysis for washing machines WM1-WM4 based on updated stakeholder data

A sensitivity analysis on several data input parameters was conducted for Base Cases 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.

5.7.2.1. Sensitivity analysis for WM1

The revised input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 5-34.** Regarding the detergent consumption, a middle value of the provided range was used.

Table 5-34: Sensitivity analysis parameters for WM1.

Parameter	Unit	Reference: Base Case Task 5 report	Sensitivity: APPLiA update 2025
Nominal rated capacity	kg	7	8
Lifetime	years	6	10
Lifetime	cycles	10,080	11,250

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Parameter	Unit	Reference: Base Case Task 5 report	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 professional, Cotton 60 for semi professional; (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 5-35)**, and the life cycle costing impact results (**Table 5-36**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference Base Case (original results). The updated APPLiA data result in higher impacts in all PEF impact categories compared to the reference Base Case. 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 5-35: 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 5-36: Sensitivity analysis life cycle costing impact compared to original results for WM1.

Cost categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Life time 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**

5.7.2.2. Sensitivity analysis for WM2

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 5-37.** Regarding the detergent consumption, a middle value of the provided range was used.

Table 5-37: 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

Parameter	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
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 professional, Cotton 60 for semi professional; (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 5-38**), and the life cycle costing impact results (**Table 5-39**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference Base Case (original results).

Table 5-38: 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 5-39: 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 – 58 %. Given that detergent and water consumption are the highest contributors across most of the impact categories (see **Section 5.4.2.2**), this observation can be attributed mainly to the lower data for water and detergent use of the APPLiA update compared to the reference Base Case. 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.

5.7.2.3. Sensitivity analysis for WM3

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 5-40.** Regarding the detergent consumption, a middle value of the provided range was used.

Table 5-40: 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

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Parameter	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
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 professional, Cotton 60 for semi professional; (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 5-41**), and the life cycle costing impact results (

Table 5-42) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference Base Case (original results).

Table 5-41: 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 5-42: Sensitivity analysis life cycle costing impact compared to original results for WM3.

Cost categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Life time 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.

5.7.2.4. Sensitivity analysis for WM4

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 5-43.** Regarding the detergent consumption, the middle value of the provided range was used.

Table 5-43: 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

Parameter	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
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 professional, Cotton 60 for semi professional; (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 5-44**), and the life cycle costing impact results (**Table 5-45**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference Base Case (original results).

Table 5-44: 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 %
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 5-45: Sensitivity analysis life cycle costing impact compared to original results for WM4.

Cost categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Life time 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.

5.7.3. Sensitivity analysis for dryers D1-D3 based on updated stakeholder data

5.7.3.1. Sensitivity analysis for D1

Several input parameters suggested by APPLiA (2025) have been used in the sensitivity analysis as shown in **Table 5-46**. The updated values are interpreted as representing the technical state of the art of commercial dryers.

Table 5-46: 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 5-47**), and the life cycle costing impact results (**Table 5-48**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference Base Case (original results).

Table 5-47: 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 %
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 5-48: Sensitivity analysis life cycle costing impact compared to original results for D1.

Cost categories	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Life time 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**

5.7.3.2. Sensitivity analysis for D2

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 5-49**. The updated values are interpreted as representing the technical state of the art of commercial dryers.

Table 5-49: 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
Customer price indication in EU	euro	8,700	6,000

The consumption data and environmental impact results (**Table 5-50**), and the life cycle costing impact results (**Table 5-51**) for the sensitivity analysis are presented below, including the difference (%) between the reference case (original results).

Table 5-50: 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 5-51: Sensitivity analysis life cycle costing impact compared to original results for D2.

Cost category	Unit	Reference: Base Case	Sensitivity (APPLiA update 2025)
Life time 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 – 47 %. Given that energy consumption is the highest contributor across most of the impact categories (see **Section 5.4.2.7**), this observation can be attributed mainly to the lower data for energy use of the APPLiA update compared to the reference Base Case. 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.

5.7.3.3. Sensitivity analysis for D3

Several input parameters suggested by APPLiA have been used in the sensitivity analysis as shown in **Table 5-52**. The updated values are interpreted as representing the technical state of the art of commercial dryers.

Table 5-52: 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	42	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 5-53**), and the life cycle costing impact results (**Table 5-54**) for the sensitivity analysis of the APPLiA update 2025 are presented below, including the difference (%) to the reference Base Case (original results).

Table 5-53: 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 %

5017 **Table 5-54: Sensitivity analysis life cycle costing impact compared to original results**
5018 **for D3.**

Cost categories	Unit	Reference: Base Case	Sensitivity (BAT 2025)
Life time expectancy	years	41 (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**

5019 Notes: (a) The original estimate of a lifetime expectancy of 41 years was adopted from a previous study.
5020 Stakeholders have deemed this far too high. It has thus been adjusted. (b) The present value factor is used over a
5021 41-year period in this LCC, which results in low result of annual electricity costs. Present costs are 1,245 €/year.
5022 (c) 2.27 times higher cycle count per year compared to the Base Case.

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5.8. Conclusions

5.8.1. Conclusions on the LCA and LCC assessment

The life cycle environmental impact (LCA) and life cycle costing (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 Base Cases 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). Electronics used in the production of the controller board are the most significant contributors to overall impact categories. Additionally, 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 Base Cases. 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 Base Cases 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 Base Cases 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 1), which ranks stakeholder input as higher quality than the initial Base Case 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 Base Case information for subsequent tasks.

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5.8.2. Conclusions on Substances of Concern assessment

This section of the report describes the Substances of Concern identification Task, which is a new task running parallel with the life cycle environmental impact and life cycle costing 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[67], CLP[68], POP[69], WFD/SCIP[70], WEEE[71], RoHS[72]) 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 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 (Art. 7 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 Harmonized 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 PMT/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.

67 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)

68 Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures (CLP, 2008)

69 Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants

70 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

71 Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) (2012)

72 Directive 2011/65/EU of the European Parliament and of the Council of of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS, 2011)

Draft for CSF

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 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 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.**

Draft for SH

6. MEErP Task 6 – Design Options for Ecodesign requirements

6.1. Objectives of MEErP Task 6

The aim of Task 6 in the MEErP is to identify and evaluate Ecodesign Options for commercial and industrial laundry appliances. The assessment of the EcoDesign Options builds on the results of Task 5, in particular the identification of the relevant environmental impact and improving potentials identified during the Life Cycle Analysis (LCA). It also takes into account the monetary consequences in terms of Life Cycle Cost (LCC) to the customer, their environmental costs and benefits, and the search for the Least Life Cycle Cost (LLCC) solution and Design Options reflecting Best Available Technology (BAT) as identified in Task 4.

The ecodesign option(s) refer to the respective categories of commercial and industrial laundry appliances as defined in 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 Base Cases, which serves the attribution of quantified parameters as an input for the environmental and cost assessment (Task 5) as well as the evaluation of Design Options. The Design Options are aligned with:

- Design Options horizontally being applicable to all products in scope;
- Product (Base Case) specific Design Options.

The objective of evaluating Design Options (DO) is to identify possible environmental improvement potentials in the context of the hotspots of environmental impact identified in 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 Design Options 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 Best Available Technology. The Design Options considered in Task 6 are evaluated from the perspective of their possible environmental impact rather than their technical and economic feasibility. This means that only such Design Options 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 Design Options 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 Design Options .

It is worth noting that the evaluation of Design Options 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 (Task 7) rather than to predetermine future legal requirements.

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6.1.1. Introduction to the evaluation of Design Options using the MEErP

The Methodology for Ecodesign of Energy-related Products (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 least life-cycle cost (LLCC) and best available technologies (BAT). This ensures that design decisions not only meet regulatory requirements but also promote sustainability and cost-effectiveness.

The evaluation of Design Options within MEErP is prepared by several tasks, including the definition of product scope (Task 1), market analysis (Task 2), use-phase and technical analysis of existing products (Task 3 & 4), as well as the life-cycle assessment (LCA) and life-cycle-costing (LCC) in the succeeding (Task 5). The revised MEErP methodology (2024) introduces refinements to better align with the EU's Green Deal objectives, emphasising aspects related to climate neutrality, circularity, and Substances of Concern (SoC) related to the product group under study. The work process for developing Design Options remains structured around seven core tasks, with 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 EcoReport tool. The latter helps to quantify the improvement potential of environmental impact against the Base Cases. 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.

According to the MEErP, Task 6 of the preparatory study encompasses in principle the following sections:

- **Introduction and Objectives**
- **Identification Design Options**: Based on findings of the Lot 24 study (2011) and the insights from Tasks 1–5 of this study, DOs that could help improving energy efficiency, material use, reparability, recyclability, or durability are mapped. Additionally, information collected during the stakeholder consultation is taken into account.
- **Feasibility assessment of selected Design Options**.
- **Quantification of environmental impact and comparison of design option against Base Cases:** The updated EcoReport tool is used to model the environmental performance of each design option.
  An LCA of DOs is performed relative to the Base Case LCA established in Task 5 to determine:
  - Environmental benefits;
  - Cost savings or increases;
  - Feasibility and market readiness.
- **Analysis of Least Life Cycle Costs (LLCC) and Best Available Technology (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.
  - BNAT (Best Not-yet Available Technology): Promising long-term innovations not yet market-ready.

draft for stakeholder consultation

- **Discussions on Design Options** not assessed using the EcoReport tool 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.

6.2. Overview of Design Options

The following sections provide an overview of Design Options for commercial and industrial laundry machines. As a starting point, the Design Options consider the Best Available Technologies (BAT) and Best Not Yet Available Technologies (BNAT) presented in the Lot 24 study (2011). The Design Options from 2011 have been reviewed and commented on by stakeholders in the course of the 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 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 (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 present analysis is primarily based on literature data, supplemented by data extrapolated from technical performance parameters or assumptions on their functional feasibility.

6.2.1. 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, which significantly cuts down energy use 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 usage and reliability through smart sensors,

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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.

6.2.1.1. Best Available Technologies (commercial and industrial washing machines)

The list of Design Options presented in the Lot 24 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 6-1** shows the 2011-BAT for washing machines and **Table 6-2** shows one BNAT that was considered a possible design option in 2011. For each design option, a brief description is provided (for more detailed explanation, see Lot 24 study (2011). Moreover, the present state of adoption (ca. 13 years later) is indicated, based on information provided by stakeholders.

Table 6-1: Review of in 2011 Best Available Technologies (BAT) for commercial and industrial washing machines, based on Lot 24 study (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: **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**
Ozone technology	M 1.6	Reduced energy, water, detergent consumption	The same drawbacks are still valid 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
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: **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 6-2: 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 6-3** specifies the Design Options considered as BAT in the present study.

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5263 **Table 6-3: Selection of PRESENT Best Available Technologies as Design Options (DO)**
5264 **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) **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); **Considered as a design option**
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* EP0848099A1 – Drum for a Laundry Treatment Machine EP1974083A1 – Laundry Drum **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
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

5265 For a technical description, please see Graulich et al. (2011)

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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[73].

[73] 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

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Spare parts availability for motors and fans

Spare parts availability for motors and fans 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 spare part availability for motors of a certain type (used in commercial and industrial washing machines and dryers) 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."

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, 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, should they apply to machines placed on the market before 2022.

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6.2.1.2. Present Best Not Yet Available Technologies (BNAT commercial and industrial washing machines)

Table 6-4: 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. **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 **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
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 emerging innovation in commercial laundry systems that enhances fabric cleaning by using high-frequency sound waves. 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 especially valuable in healthcare, hospitality, and industrial settings where hygiene and textile preservation are critical. While still in the early stages of

widespread adoption, ultrasonic cleaning is gaining attention for its potential to improve sustainable laundry practices.[74]

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 30–50 %, 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).

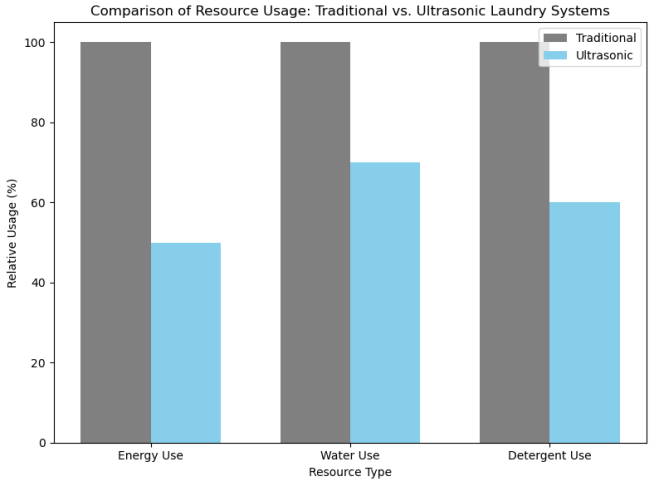

Figure 6-1: Comparison between ultrasonic cleaning and traditional washing methods in commercial laundry.

Source: (Sethi 2021)

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).

[74] Junhee, C. et al. (2016): Ultrasonic washing of textiles. https://doi.org/10.1016/j.ultsonch.2015.07.018

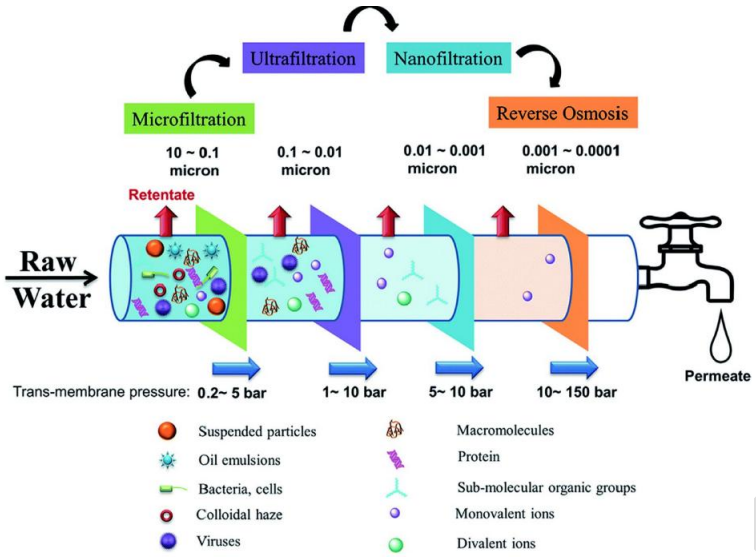

Figure 6-2: Nanofiltration technology in commercial laundry.

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).

6.2.2. Design Options for commercial and industrial dryers

6.2.2.1. Best Available Technologies (dryers)

The list of Design Options 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 6-5** shows the 2011-BAT for dryers and **Table 6-6** shows three BNAT that were considered possible Design Options in 2012. For each design option, a brief description is provided (for more detailed explanation, see Lot 24 study (2012)). Moreover, the present state of adoption (ca. 13 years later) is indicated, based on information provided by stakeholders.

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5406 **Table 6-5: Review of in 2011 Best AVAILABLE Technologies for commercial and**
5407 **industrial dryers, based on Lot 24 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. It is forbidden to use the combustible climate neutral refrigerants, in a higher amount, that is needed for larger machine. Other non-combustible climate neutral refrigerants are at the moment not in the stage of development to be introduced for next coming 5-10 years. 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

5408 * For a technical description, please see Graulich et al. (2011)

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5410 **Table 6-6: Review of in 2011 Best NOT yet Available Technologies for non-domestic dryers in**
5411 **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
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 & 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.

5412 Source: Graulich et al. (2011)

5413 Based on the above and additional information reviewed by the consultant**, Table 6-7** specifies
5414 the Design Options considered as BAT in the present study.

Table 6-7: 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 6-5	adopted and updated from 2011 study* **considered as a design option**
Load control	D-DO2	See Table 6-5	adopted and updated from 2011 study* **considered as a design option**
Modulating Gas Dryers	D-DO3	See Table 6-6	TRL: 8 – 9 **considered as a design option**
Drum construction	DO-D4	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 **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 high-volume laundry facilities (e.g., 50 loads/day), where substantial annual cost savings are possible.

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.

6.2.2.2. Present Best NOT Yet Available Technologies (BNAT commercial and industrial dryers)

Table 6-8 details Design Options that have not yet matured and that are thus considered as BNAT. These Design Options will not be analysed further.

Table 6-8: 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.

6.2.3. Summary of the selection of Design Options for commercial and industrial laundry appliances

A summary of the selected Design Options in MEErP Task 6 is specified in **Table 6-9** below for commercial and industrial washing machines and in **Table 6-10** for commercial and industrial dryers.

Table 6-9: 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 6-3	WM1-4
Load control	WM-DO2	See Table 6-3	WM1
Smart detergent dosing	WM-DO3	See Table 6-3	WM1-4
Ozone technology	WM-DO4	See Table 6-3	WM2-4
Drum construction / perforation design	WM-DO5	See Table 6-3	WM1-4
Extended time of spare part availability and repair support	WM-DO6	See Table 6-3	WM1-5
Ultrasonic cleaning technology	WM-DO7	See Table 6-9	WM1-5
Nano-Fibre Filtration Systems	WM-DO8	See Table 6-9	WM1-5 *

* For technical reasons, WM-DO8 is not 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 6-10: 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 6-6	D1, D3
Smart load control	D-DO2	See Table 6-6	D1, D3
Modulating Gas Dryers	D-DO3	See Table 6-7	D4
Drum construction/ perforation design	D-DO4	See Table 6-7	D1, D2
Extended time of spare part availability and repair support	DO-D5	See Table 6-3	D1-4

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6.2.4. 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 Bills of Materials (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 Design Options MEErP Task 6.
6) 1 May 2025 – 30 May 2025: Additional online consultation of meeting participants to collect information on Substances of Concern (SoC) as well as feedback on BAT/BNAT and Design Options.

6.2.4.1. Stakeholder consultation feedback

The information received as a result of the stakeholder consultations is very 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 Base Cases and that should have been used to analyse the Design Options is considered highly uncertain.

The analysis of Design Options 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 parameters used in the analysis thus do not represent the actual expected environmental improvement but rather a hypothetical range of potential improvement. 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 Design Options for the Bills of Material (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

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the BoM are based on technical assumptions rather than measured data. Neither was data provided regarding costs of Design Options, thus, LCC calculations could not be undertaken on the basis of primary data.

6.3. Base Cases for the assessment of Design Options

The following section is dedicated to the presentation of the key input parameters for the nine Base Cases (BC) of commercial and industrial laundry appliances, and in addition their Design Options (DO).

Task 6 reflects the definition of categories as set out in Task 1 and builds on the Base Cases as defined in the previous 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 6-11**). 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 6-11: 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:** Cabinet dryer
WM4: Commercial barrier washer	**D4:** Industrial pass-through (transfer) tumble dryer
WM5: Industrial continuous tunnel washers	

6.3.1. Input parameters for Design Options of commercial and industrial washing machines

The following sub-sections summarise the initial performance parameters of the reference Base Case 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 Base Cases 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 Base Case information for the subsequent tasks. Therefore, here in Task 6 the presumed changes of parameters due to implemented Design Options refer to the updated Base Cases based on APPLiA's 2025 input.

Table 6-11 above specifies the details of the Design Options 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.

Table 6-12 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 2025 and the assumed changes in performance that the application of the various DOs is expected to result in. The average price is estimated at 2,100 in consideration of the new data provided by APPLiA. For washing machine category WM1, the design option WM-DO1 (heat recovery) is expected to affect the weight and composition of the appliance, adding 3 kg of stainless steel to the composition. WM-DO6 (extended time of spare part availability and repair support) is expected to increase the appliance lifetime by an average of 5 years. Design Options WM-DO1 (heat recovery), WM-DO2 (load control), WM-DO5 (drum construction) and WM-DO7 (ultrasonic cleaning) are all expected to affect the energy consumption at different levels. For each of the Design Options, the expected decrease is detailed below, whereas the accumulative effect is estimated to account for a 20 % reduction of energy consumption. Design option WM-DO2 (load control) is expected to reduce the water consumption by -15 % to -25 %, WM-DO3 (smart detergent dosing) by 50 % and WM-DO7 (ultrasonic cleaning) by 30 %, assuming a combined reduction of 15 % or to 0.06 m^3/cycle. The detergent consumption of this category is expected to decrease cumulatively by 20 % or to 70 g/cycle as a result of WM-DO2 (load control) and WM-DO3 (smart detergent dosing).

Table 6-12: 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	WM-DO1: **+3 kg stainless steel** [a]
Lifetime (years)	5.6	10	WM-DO6: +5 **= 15** [a]
Average price (€)	2,136	2,000	**2,100** [a]
Cycles per year	1,800	1,125	unchanged
Annual sales (mln units per year)	0.0243	unchanged	0.0162
Energy consumption wash (kWh/cycle)	0.7	1.28	**= 1.02** non-cumulative average of -20 % due to: WM-DO1: -30 % to -90 % [b] WM-DO2: -14 % to -25 % [c] WM-DO5: -10 % to -30 % [a] WM-DO7: -30 % to -50 % [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)	0.04	0.07	**= 0.06** non-cumulative average of -15 % due to: WM-DO2: -15 % to -25 % (c) WM-DO3: approx. -50 % (d) WM-DO7: approx. -30 % (e)
Detergent consumption (kg per cycle)	0.079	0.088	**= 0.07** non-cumulative average of -20 % due to: WM-DO2: -20 % to -30 % (b) WM-DO3: up to -20 % (a) WM-DO7: -30 % to -50 %(e)
Cycle time (minutes)	45	79	unchanged

Sources: (a) estimate/assumption; (b) (Aquatherm, 2025); (c) (Hangxing Washing Machinery, 2025; Miele & Cie. KG, 2015); (d) (Laudry and Cleaning News International, 2016); (e) Sethi 2021

Table 6-13 shows the initial performance parameters for commercial washer extractors (WM2) 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 Design Options is expected to result in. For WM2, WM-DO1 (heat recovery) is expected to affect the weight and composition of the appliance, adding 8 kg of stainless steel to the composition. WM-DO6 (extended time of spare part availability and repair support) is expected to increase the appliance lifetime by an average of 5 years. The average price including Design Options is estimated at 9,500 in comparison to the updated BC data provided by APPLiA. Design Options WM-DO1 (heat recovery), WM-DO2 (load control), WM-DO4 (ozone technology), WM-DO5 (drum construction) and WM-DO7 (ultrasonic cleaning) are all expected to affect the energy consumption at different levels. For each of the DOs, the expected decrease is detailed below, whereas the accumulative effect is estimated to account for a 10 % reduction of energy consumption or a total of 6.5 kWh/cycle. WM-DO2 (load control) is expected to reduce the water consumption by between -10 % to -30 %, WM-DO4 (ozone technology) by between -10 % to -45 % and WM-DO5 (drum construction) by between -40 % to -80 % making up for an combined reduction of 10 % or a total of 0.23 m^3/cycle. The detergent consumption of this category is expected to decrease by 20 % as a result of WM-DO2 (-20 %), WM-DO3 (-20 % to -40 %) and WM-DO4 (-30 % to -50 %) or a total of 255 g/cycle.

Table 6-13: 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

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Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Product weight (kg)	211	523; due to absence of more detailed data, the initial parameters of the reference BC were taken	WM-DO1: **+8 kg stainless steel** (a)
Lifetime (years)	15.3	10	WM-DO6: +5 **= 15** (a)
Average price (€)	34,775	9,000	**9,500** (a)
Cycles per year	3,600	3,000	unchanged
Annual sales (mln units per year)	0.02	0.05	0.036
Energy consumption wash (kWh/cycle)	4.2	7.25	**= 6.53** non-cumulative average of -10 % due to: WM-DO1: -15 % to -50 % (b) WM-DO2: - 5 % to -30 % (c) WM-DO4: -30 % to -50 % (d) WM-DO5: -10 % to -30 % (a) WM-DO7: -30 % to -50 % (a)
Water consumption (m^3/cycle)	0.30	0.26	**= 0.23** non-cumulative average of -10 % due to: WM-DO2: -10 % to -30 % (e) WM-DO4: -10 % to -45 % (f) WM-DO5: -40 % to -80 % (g)
Detergent consumption (kg per cycle)	0.422	0.319	**= 0.255** non-cumulative average of -20 % due to: WM-DO2: -20 % (a) (h) WM-DO3: -20 % to -40 % (i) WM-DO4: -30 % to -50 % (j)
Cycle time (hours)	0.75	0.78	unchanged

Sources: (a) estimate/assumption; (b) (Aquatherm, 2025); (c) (Cardis et al.; Hangxing Washing Machinery, 2025; Miele & Cie. KG, 2015) (d) (Cardis et al.); (e) (Hasek, 2014; Miele & Cie. KG, 2015; Pacific Gas and Electric Company, 2009) (f) (Hasek, 2014) (g) (American Cleaning Institut, 2005, 2010) (i) (Jay, 2025; PSG Hydro) (j) (Weeter, 2017)

Table 6-14 shows the initial performance parameters for commercial washer dryers (WM3) 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 Design Options is expected to achieve. For WM3, WM-DO1 (heat recovery) is expected to affect the weight and composition of the appliance, adding 10 kg of stainless steel to the composition. Design option WM-DO6 (extended availability of spare parts and repair support) is expected to increase the appliance lifetime by an average of 5 years. The average price is estimated at 13,500 in consideration of the new data provided by APPLiA. 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. Each of the DOs is expected to lead to an energy consumption reduction with WM-DO3 (smart detergent dosing) decreasing consumption of the washing cycle by up to -5 %, WM-DO4 (ozone technology) by between -50 % to -90 % and WM-DO7 (ultrasonic cleaning) by between -30 % to -50 % (a) and with WM-DO1 reducing between -10 % to -20 % of the energy consumption of the drying function and WM-DO3 reducing 14 % of energy consumption of this function through average gas savings. The accumulative effect is estimated to account for a 20 % reduction of energy consumption or a total of 8.9 kWh/cycle. Four Design Options are expected to reduce the water consumption, with WM-DO3 expected to reduce between -30 % to -50 %, WM-DOW4 by between -20 % to -30 %, WM-DO5 (drum construction) by between -20 % to -30 % and WM-DO7 expected to reduce up to -30 %. This is expected to make up for a combined reduction of 20 % or 0.144 m^3/cycle. The detergent consumption of this category is expected to decrease by 20 % as a result of WM-DO3 (-20 % to -30 %), WM-DO4 (-20 % to -30 %), WM-DO5 (-5 % to -10 %) and WM-DO7 (-30 % to -70 %) or a total of 158 g/cycle.

Table 6-14: 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	WM-DO1: **+10 kg stainless steel** (a)
Lifetime (years)	31.25	10	WM-DO6: +5 **= 15** (a)
Average price (€)	12,200	13,000	**13,500** (a)
Cycles per year	1,760	3,000	Unchanged
Annual sales (mln units per year)	0.000405	unchanged	0.000270

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Energy consumption wash (kWh/cycle or MJ/cycle)	3.68	11.16	**= 8.9** non-cumulative <u>average of -20 %</u> due to: WM-DO3: up to -5 % (a) WM-DO4: -50 % to -90 % (d) WM-DO7: -30 % to -50 % (a) only for drying: D-DO1: -10 % to -20 % (b),(c) D-DO3: **14 % average gas savings** (k)D-DO3: 14 % average gas savings (k)
Water consumption (m^3/cycle)	0.05	0.18	**= 0.144** non-cumulative <u>average of -20 %</u> due to: WM-DO3: -30 % to -50 % (e) WM-DO4: -20 % to -30 % (f) WM-DO5: -20 % to -30 % (g) WM-DO7: up to -30 % (h)
Detergent consumption (kg per cycle)	0.07	0.198	= **0.158** non-cumulative <u>average of -20 %</u> due to: WM-DO3: -20 % to -30 % (i) WM-DO4: -20 % to -30 % (j) WM-DO5: -5 % to -10 % (a) WM-DO7: -30 % to -70 % (a)
Cycle time (hours)	1.25	**1.25**	unchanged

Sources: (a) estimate/assumption; (b) (El Fil & Garimella, 2022); (c) (Goetzler et al., 2016); (d) (BioSure Professional, 2022); (e) (Laundrylux Inc., 2025); (f) (BC Industrial Services, 2017); (g) (Continental Girbau Inc., 2014); (h) (B2BMAP, 2025); (i) (PSG Hydro); (j) (Weeter, 2017); (k) (Scott, 2023b)

Table 6-15 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 Design Options is expected to result in. For WM4, the Design Option WM-DO1 (heat recovery) is expected to affect the weight and composition of the appliance, adding 8 kg of stainless steel to the composition. WM-DO6 (extended availability of spare parts and repair support) is expected to increase the appliance lifetime by an average of 5 years. The average price is estimated at 36,000 in consideration of the new data provided by APPLiA. Design Options WM-DO1 (-10 % to -30 %), WM-DO4 (ozone technology, -60 % to -80 %), WM-DO5 (drum construction, - 5 % to -15 %) and WM-DO7 (ultrasonic cleaning, -40 % to -60 %) are all expected to affect the energy consumption at different levels. For each of the Design Options, the expected decrease is detailed below, whereas the accumulative effect is estimated to account for a

10 % reduction of energy consumption or a total of 4.3 kWh/cycle. The water consumption is estimated to decrease by 10 % or a combined 0.387 m^3/cycle. This is a result of reductions contributed by WM-DO1 (-50 % to -70 %), WM-DO3 (-20 % to -30 %), WM-DO4 (-10 % to -25 %), WM-DO5 (-10 % to -30 %) and WM-DO7 (-30 % to -50 %). The detergent consumption of this category is affected by WM-DO3 (smart detergent dosing, -20 % to -30 %), WM-DO4 (reducing up to -30 %) and WM-DO7 (-30 % to -50 %) making up for a decrease of 20 % or 28 g/cycle.

Table 6-15: 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	WM-DO1: **+8 kg stainless steel** (a)
Lifetime (years)	20.5	10	WM-DO6: +5 **= 15** (a)
Average price (€)	57,375	35,000	**36,000** (a)
Cycles per year	2,200	3,000	unchanged
Annual sales (mln units per year)	0.001215	unchanged	0.000810
Energy consumption wash (kWh/cycle)	7.68	4.8	= **4.32** non-cumulative average of -10 % due to: WM-DO1: -10 % to -30 % (a) WM-DO4: -60 % to -80 % (b) WM-DO5: - 5 % to -15 % (a) WM-DO7: -40 % to -60 % (a)
Water consumption (m^3/cycle)	0.37	0.43	= **0.387** non-cumulative average of -10 % due to: WM-DO1: -50 % to -70 % (b) WM-DO3: -20 % to -30 % (a) WM-DO4: -10 % to -25 % (b) WM-DO5: -10 % to -30 % (c) WM-DO7: -30 % to -50 % (a)
Detergent consumption (kg per cycle)	0.41	0.352	**= 0.28** non-cumulative average of -20 % due to: WM-DO3: -20 % to -30 % (a) WM-DO4: up to -30 % (a) WM-DO7: -30 % to -50 % (a)
Cycle time (hours)	1	0.88	unchanged

Sources: (a) estimate/assumption; (b) (Goetzler et al., 2014); (c) (Miele & Cie. KG, 2013)

Table 6-16 shows the initial performance parameters for industrial continuous tunnel washers (WM5) and the assumed changes in performance that the application of the various Design

Options is expected to result in. For WM5, 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 10 years. The average price is estimated at 590,000, assuming a small increase in relation to the 2011 study assumptions. The different Design Options (WM-DO1: -50 % to -65 %, WM-DO4 (ozone technology): -50 % to -70 %, WM-DO5 (drum construction): up to -40 %, WM-DO7 (ultrasonic cleaning): -30 % to -40 %) will affect the energy consumption at different levels and is estimated to contribute to a total reduction of 5 % of the energy consumption or 363 kWh/cycle. The water consumption is estimated to decrease by 5 % or a combined 6.8 m^3/cycle attributed to an expected 5 % in both WM-DO3 (smart detergent dosing) and WM-DO5. Detergent consumption of this category is affected by WM-DO3 (-10 % to -25 %), WM-DO4 (-20 % to -30 %), WM-DO5 (-10 % to -25 %) and WM-DO7 (up to -50 %) resulting in a decrease of 10 % or 9.2 kg/cycle.

Table 6-16: 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: +10 **= 23.7** [a]
Average price (€)	585,000	**590,000** [a]
Cycles per year	3,000	unchanged
Annual sales (mln units per year)	0.00025	0.000145
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] WM-DO4: -50 % to -70 % [a] [h] WM-DO5: up to -40 % [d] WM-DO7: -30 % to -40 % [e]
Water consumption (m^3/cycle)	7.0	**= 6.7** non-cumulative average of -5 % due to: WM-DO3: up to -5 % [a] WM-DO5: up to -5 % [f]
Detergent consumption (kg per cycle)	10.20	**= 9.18** non-cumulative average of -10 % due to: WM-DO3: -10 % to -25 % [g] WM-DO4: -20 % to -30 % [a] WM-DO5: -10 % to -25 % [a] WM-DO7: up to -50 % [a]
Cycle time (hours)	0.75	unchanged

Sources: (a) estimate/assumption; (b) (Imgon Business Marketing Agency, 2020); (c) (CWS Workwear, 2024); (d) (iwt TECNIPLAST Company); (e) (Hongsonic, 2024); (f) (Girbau, 2024); (g) (U.S. Department of Energy; Vartex, 2025);

6.3.2. 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 Base Cases analysed in 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 Design Options (DO) are implemented.

Table 6-8 details Design Options that have not yet matured and that are thus considered as BNAT. These Design Options will not be analysed further.

Table 6-9 specifies the Design Option 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.

Table 6-17 below shows the initial performance parameters for Base Case 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. For D1, Design Option 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. Design Option D-DO5 (extended spare part availability and repair service) is expected to increase the appliance lifetime by an average of 5 years. DO's D-DO1 (-40 % to -60 %), D-DO2 (load control, -10 % to -30 %), D-DO3 (modulating gas dryers, 14 % average gas savings) and D-DO4 (drum construction, -10 % to -25 %) 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 6-17: 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: +5 **= 15** (a)
Average price (€)	1,460	1,600	**1,650** (a)
Cycles per year	1,800	750	unchanged

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Annual sales (mln units per year)	0.008	0.016	0.00896
Energy consumption drying (kWh/cycle)	2.28	2.16	**= 1.73** non-cumulative average of -20 % due to: D-DO1: -40 % to -60 % (b) D-DO2: -10 % to -30 % (c) D-DO3: 14 % average gas savings (d) D-DO4: -10 % to -25 % (e)
Cycle time (hours)	0.67	2.75	unchanged

Sources: (a) estimate/assumption; (b) (Electrolux Group, 2024; Electrolux Professional, 2023), #; (c) #; (d)

Table 6-18 shows the initial performance parameters for Base Case D2 (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. For D2, the product weight is assumed to remain unchanged. Design Option D-DO (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 6,500 due to the new APPLiA data. DO's D-DO3 (modulating gas dryers, 14 % average gas savings) and D-DO4 (drum construction, -5 % to -15 %) are both expected to affect the energy consumption with the combined effect estimated to account for a 5 % reduction of energy consumption or a total of 22.1 kWh/cycle.

Table 6-18: 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	unchanged
Lifetime (years)	21.6	15	D-DO5: +5 **= 20** (a)
Average price (€)	8,700	6,000	**6,500** (a)
Cycles per year	2,551	2,333	unchanged
Annual sales (mln units per year)	0.0077	0.051	0.03825

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
Energy consumption drying (kWh/cycle)	27.9	23.3	= **22.1** non-cumulative average of -5 % due to: D-DO3: 14 % average gas savings (b) D-DO4: -5 % to -15 % (a)
Cycle time (hours)	0.67	0.5	unchanged

Sources: (a) assumption; (b) (Scott, 2023a); (c) #; (d)

Table 6-19 shows the initial performance parameters for Base Case D3 (cabinet 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. 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 5 years. The average price has been revised to 2,500 due to the new APPLiA data. DO's D-DO1 (-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.

Table 6-19: Design option parameters for D3: 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
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: +5 **= 15** (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	0.0067

Description	Initial parameters: MEErP Task 5 reference Base Case	Revised parameters: updated Base Case (APPLiA update 2025)	Parameters: Change due to DO
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	unchanged

Sources: (a) estimate/assumption; (b) (Electrolux Professional, 2023); (c) #; (d)

Table 6-20 shows the initial performance parameters for Base D4 (industrial pass-through tumble dryers) and the assumed changes in performance that the application of the various Design Options is expected to result in. For D4, the product weight is assumed to be affected by D-DO1 (heat pump), leading to an increase in weight of 35 kg stainless steel and 5 kg copper on average. Design Option 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. Design Option D-DO1 is expected to lead to a reduction in energy consumption between -9 % and -22 %. A reduction of 18 % of the energy consumption has been assumed for calculations or a total of 223 kWh/cycle.

Table 6-20: 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-DO1: **+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	0,001
Energy consumption drying (kWh/cycle)	272	= **223** average of -18 % due to: D-DO1: -9 % to -22 % (b)
Cycle time (hours)	0.33	unchanged

Sources: (a) estimate/assumption; (b) (El Fil & Garimella, 2022);.

6.4. 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 Design Options for each Base Case. All relevant changes to input parameters per option are examined using the EcoReport tool to assess how each option affects the output values across all PEF impact categories. The updated EcoReport tool is used to model the environmental performance of each design option. The LCA of the Design Options (DO`s) is assessed relative to the base case 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 Design Options per appliance category rather than individual impact of Design Options. The DO`s identified in this study can only be meaningfully assessed in combination, as the technical feasibility of implementing individual DO`s within the respective categories of laundry appliances could not be verified in detail. Stakeholders did not provide specific information on this matter. The DO`s were derived from literature and 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 optimization, arguing that commercial and industrial appliances are already operating at the technical/physical limits of their performance and are already optimised in this respect.

By comparing the results for the Design Options against the previously calculated results of base cases in Task 5, the change in environmental impact due to each option can be estimated. However, it should be kept in mind that the environmental improvement potential calculated for the combined consideration of individual DO`s in each category should be understood as a hypothetical space of possibilities, the technical feasibility of which could not be assessed within the scope of this study. It is possible that certain DO`s may conflict with or hinder each other due to technical constraints, making the simultaneous implementation of all DO`s unlikely in practice. Potential conflicts between DO`s in the context of appliance development often arise due to technical, physical, or functional incompatibilities. Therefore, the aggregated ecological potential should be regarded as an optimistic scenario in regard to the environmental improvement potential.

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6.4.1. WM1: Environmental impact of Design Options

Table 6-21: 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	790	-20%
Thermal energy (use phase)	MJ	1,724	1,379	-20 %
Water (use phase)	m^3	83.7	71.1	-15%
Detergent (use phase)	kg	99	79	-20%
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	8.3E+02	6.6E+02	-20 %
Ozone depletion	kg CFC-11 eq.	1.1E-05	8.5E-06	-19 %
Human toxicity, cancer	CTUh	1.3E-06	1.1E-06	-20 %
Human toxicity, non-cancer	CTUh	1.1E-05	8.8E-06	-18 %
Particulate matter	disease incidence	4.5E-05	3.5E-05	-21 %
Ionising radiation, human health	kBq U235 eq.	2.1E+02	1.7E+02	-20 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.6E+00	1.3E+00	-20 %
Acidification	mol H+ eq.	3.1E+00	2.4E+00	-21 %
Eutrophication, terrestrial	mol N eq.	6.5E+00	5.2E+00	-20 %
Eutrophication, freshwater	kg P eq.	3.6E-02	2.9E-02	-18 %
Eutrophication, marine	kg N eq.	1.0E+00	8.1E-01	-20 %
Ecotoxicity, freshwater	CTUe	6.3E+03	5.1E+03	-20 %
Land use	pt	1.5E+04	1.1E+04	-27 %
Water use	m^3 water eq. of deprived water	1.8E+03	1.5E+03	-16 %
Resource use, minerals and metals	kg Sb eq.	6.6E-03	4.9E-03	-26 %
Resource use, fossils	MJ	1.3E+04	1.1E+04	-20 %

6.4.2.

6.4.3. WM2: Environmental impact of Design Options

Table 6-22: 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	11,911	-10%
Thermal energy (use phase)	MJ	32,264	29,040	-10 %
Water (use phase)	m^3	783	705	-10%
Detergent (use phase)	kg	957	766	-20%
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	9.3E+03	-9 %
Ozone depletion	kg CFC-11 eq.	1.0E-04	8.3E-05	-19 %
Human toxicity, cancer	CTUh	9.8E-06	8.4E-06	-15 %
Human toxicity, non-cancer	CTUh	1.1E-04	9.4E-05	-13 %
Particulate matter	disease incidence	5.1E-04	4.2E-04	-17 %
Ionising radiation, human health	kBq U235 eq.	2.7E+03	2.4E+03	-11 %
Photochemical ozone formation, human health	kg NMVOC eq.	2.0E+01	1.7E+01	-14 %
Acidification	mol H+ eq.	3.9E+01	3.2E+01	-17 %
Eutrophication, terrestrial	mol N eq.	7.6E+01	6.4E+01	-15 %
Eutrophication, freshwater	kg P eq.	3.4E-01	2.9E-01	-15 %
Eutrophication, marine	kg N eq.	1.1E+01	9.2E+00	-16 %
Ecotoxicity, freshwater	CTUe	6.9E+04	5.8E+04	-15 %
Land use	pt	1.0E+05	7.9E+04	-20 %
Water use	m^3 water eq. of deprived water	1.8E+04	1.6E+04	-11 %
Resource use, minerals and metals	kg Sb eq.	9.1E-02	6.7E-02	-27 %
Resource use, fossils	MJ	1.6E+05	1.5E+05	-9 %

6.4.4. WM3: Environmental impact of Design Options

Table 6-23: 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	26,785	-20 %
Thermal energy (use phase)	MJ	--	--	--
Water (use phase)	m^3	540	432	-20 %
Detergent (use phase)	kg	594	475	-20 %
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	1.7E+04	1.3E+04	-21 %
Ozone depletion	kg CFC-11 eq.	6.8E-05	5.5E-05	-20 %
Human toxicity, cancer	CTUh	8,7E-06	6.9E-06	-21 %
Human toxicity, non-cancer	CTUh	1.2E-04	9.1E-05	-22 %
Particulate matter	disease incidence	7.8E-04	6.0E-04	-23 %
Ionising radiation, human health	kBq U235 eq.	6.2E+03	4.9E+03	-20 %
Photochemical ozone formation, human health	kg NMVOC eq.	3.2E+01	2.5E+01	-22 %
Acidification	mol H+ eq.	7.1E+01	5.4E+01	-24 %
Eutrophication, terrestrial	mol N eq.	1.2E+02	9.5E+01	-22 %
Eutrophication, freshwater	kg P eq.	2.4E-01	1.9E-01	-20 %
Eutrophication, marine	kg N eq.	1.4E+01	1.1E+01	-21 %
Ecotoxicity, freshwater	CTUe	9.6E+04	7.6E+04	-21 %
Land use	pt	1.8E+05	1.3E+05	-26 %
Water use	m^3 water eq. of deprived water	1.6E+04	1.2E+04	-20 %
Resource use, minerals and metals	kg Sb eq.	1.7E-01	1.1E-01	-31 %
Resource use, fossils	MJ	2.8E+05	2.2E+05	-21 %

6.4.5. WM4: Environmental impact of Design Options

Table 6-24: 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	2,125	-10 %
Thermal energy (use phase)	MJ	45,621	41,062	-10 %
Water (use phase)	m^3	1,277	1,149	-10 %
Detergent (use phase)	kg	1,056	845	-20 %
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	1.4E+04	1.1E+04	-23 %
Ozone depletion	kg CFC-11 eq.	1.2E-04	9.5E-05	-18 %
Human toxicity, cancer	CTUh	2.7E-05	2.0E-05	-25 %
Human toxicity, non-cancer	CTUh	1.9E-04	1.5E-04	-19 %
Particulate matter	disease incidence	1.4E-03	9.6E-04	-29 %
Ionising radiation, human health	kBq U235 eq.	1.1E+03	9.2E+02	-18 %
Photochemical ozone formation, human health	kg NMVOC eq.	3.9E+01	2.8E+01	-27 %
Acidification	mol H+ eq.	1.3E+02	9.1E+01	-31 %
Eutrophication, terrestrial	mol N eq.	1.3E+02	9.6E+01	-27 %
Eutrophication, freshwater	kg P eq.	4.5E-01	3.9E-01	-15 %
Eutrophication, marine	kg N eq.	1.7E+01	1.3E+01	-24 %
Ecotoxicity, freshwater	CTUe	9.2E+04	7.0E+04	-23 %
Land use	pt	2.4E+05	1.7E+05	-30 %
Water use	m^3 water eq. of deprived water	2.6E+04	2.2E+04	-12 %
Resource use, minerals and metals	kg Sb eq.	8.3E-01	5.6E-01	-33 %
Resource use, fossils	MJ	1.9E+05	1.5E+05	-22 %

6.4.6. WM5: Environmental impact of Design Options

Table 6-25: 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.	3.8E+05	3.6E+05	-7 %
Ozone depletion	kg CFC-11 eq.	3.2E-03	2.9E-03	-10 %
Human toxicity, cancer	CTUh	4.1E-04	3.2E-04	-21 %
Human toxicity, non-cancer	CTUh	2.8E-03	2.6E-03	-8 %
Particulate matter	disease incidence	1.2E-02	1.0E-02	-14 %
Ionising radiation, human health	kBq U235 eq.	2.3E+04	2.2E+04	-7 %
Photochemical ozone formation, human health	kg NMVOC eq.	4.9E+02	4.4E+02	-10 %
Acidification	mol H+ eq.	8.2E+02	7.0E+02	-15 %
Eutrophication, terrestrial	mol N eq.	1.7E+03	1.5E+03	-11 %
Eutrophication, freshwater	kg P eq.	1.1E+01	1.0E+01	-8 %
Eutrophication, marine	kg N eq.	2.9E+02	2.6E+02	-10 %
Ecotoxicity, freshwater	CTUe	1.5E+06	1.4E+06	-10 %
Land use	pt	2.9E+06	2.3E+06	-20 %
Water use	m^3 water eq. of deprived water	4.4E+05	4.2E+05	-6 %
Resource use, minerals and metals	kg Sb eq.	2.8E+00	2.1E+00	-25 %
Resource use, fossils	MJ	5.8E+06	5.4E+06	-7 %

6.4.7. D1: Environmental impact of Design Options

Table 6-26: Results for D1: Environmental impact of Design Options compared to Base Case related to kg of dry textiles treated.

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.	9.0E+02	6.9E+02	-23 %
Ozone depletion	kg CFC-11 eq.	2.8E-07	2.2E-07	-21 %
Human toxicity, cancer	CTUh	9.6E-07	7.3E-07	-24 %
Human toxicity, non-cancer	CTUh	4.5E-06	3.4E-06	-25 %
Particulate matter	disease incidence	5.5E-05	4.0E-05	-28 %
Ionising radiation, human health	kBq U235 eq.	3.0E+02	2.4E+02	-20 %
Photochemical ozone formation, human health	kg NMVOC eq.	2.0E+00	1.5E+00	-26 %
Acidification	mol H+ eq.	5.7E+00	4.1E+00	-28 %
Eutrophication, terrestrial	mol N eq.	6.9E+00	5.2E+00	-25 %
Eutrophication, freshwater	kg P eq.	1.9E-03	1.5E-03	-23 %
Eutrophication, marine	kg N eq.	6.4E-01	4.8E-01	-25 %
Ecotoxicity, freshwater	CTUe	4.4E+03	3.3E+03	-24 %
Land use	pt	1.8E+04	1.6E+04	-10 %
Water use	m^3 water eq. of deprived water	2.7E+02	2.1E+02	-22 %
Resource use, minerals and metals	kg Sb eq.	2.6E-02	1.8E-02	-32 %
Resource use, fossils	MJ	1.5E+04	1.1E+04	-22 %

6.4.8. D2: Environmental impact of Design Options

Table 6-27: Results for D2: Environmental impact of Design Options compared to Base Case related to kg of dry textiles treated.

Consumption	Unit	Base Case (APPLiA update 2025)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh	37,537	35,660	-5 %
Thermal energy (use phase)	MJ	63,833	60,643	-5 %
PEF Impact categories	**Unit**	**Base Case (APPLiA update 2025)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	2.0E+04	1.9E+04	-5 %
Ozone depletion	kg CFC-11 eq.	6.1E-06	5.8E-06	-5 %
Human toxicity, cancer	CTUh	3.5E-06	3.3E-06	-8 %
Human toxicity, non-cancer	CTUh	5.8E-05	5.4E-05	-5 %
Particulate matter	disease incidence	5.4E-04	5.1E-04	-6 %
Ionising radiation, human health	kBq U235 eq.	6.8E+03	6.4E+03	-5 %
Photochemical ozone formation, human health	kg NMVOC eq.	2.9E+01	2.7E+01	-5 %
Acidification	mol H+ eq.	5.3E+01	4.9E+01	-6 %
Eutrophication, terrestrial	mol N eq.	1.0E+02	9.8E+01	-5 %
Eutrophication, freshwater	kg P eq.	5.6E-02	5.3E-02	-5 %
Eutrophication, marine	kg N eq.	9.9E+00	9.4E+00	-5 %
Ecotoxicity, freshwater	CTUe	7.4E+04	7.0E+04	-5 %
Land use	pt	7.9E+04	7.3E+04	-8 %
Water use	m^3 water eq. of deprived water	5.5E+03	5.2E+03	-5 %
Resource use, minerals and metals	kg Sb eq.	2.8E-02	2.4E-02	-17 %
Resource use, fossils	MJ	3.4E+05	3.2E+05	-5 %

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6.4.9. D3: Environmental impact of Design Options

Table 6-28: Results for D3: Environmental impact of Design Options compared to Base Case related to kg of dry textiles treated.

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.	5.6E+03	5.0E+03	-11 %
Ozone depletion	kg CFC-11 eq.	2.0E-06	1.8E-06	-10 %
Human toxicity, cancer	CTUh	1.1E-06	1.0E-06	-8 %
Human toxicity, non-cancer	CTUh	2.1E-05	1.8E-05	-14 %
Particulate matter	disease incidence	2.2E-04	1.9E-04	-15 %
Ionising radiation, human health	kBq U235 eq.	2.3E+03	2.0E+03	-10 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.0E+01	8.7E+00	-13 %
Acidification	mol H+ eq.	2.2E+01	1.8E+01	-16 %
Eutrophication, terrestrial	mol N eq.	3.7E+01	3.2E+01	-13 %
Eutrophication, freshwater	kg P eq.	1.1E-02	1.0E-02	-11 %
Eutrophication, marine	kg N eq.	3.4E+00	3.0E+00	-13 %
Ecotoxicity, freshwater	CTUe	2.6E+04	2.3E+04	-12 %
Land use	pt	3.2E+04	3.0E+04	-5 %
Water use	m^3 water eq. of deprived water	1.9E+03	1.7E+03	-11 %
Resource use, minerals and metals	kg Sb eq.	4.1E-02	2.8E-02	-31 %
Resource use, fossils	MJ	9.7E+04	8.6E+04	-11 %

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6.4.10. D4: Environmental impact of Design Options

Table 6-29: Results for D4: Environmental impact of Design Options compared to Base Case related to kg of dry textiles treated.

Consumption	Unit	Base Case (Task 5)	Results with Design Options	% difference
Total electricity consumption (use phase)	kWh / kg	89,760	73,602	-18 %
Thermal energy (use phase)	MJ	2,752,067	2,256,696	-18 %
PEF Impact categories	**Unit**	**Base Case (Task 5)**	**Results with Design Options**	**% difference**
Climate change, total	kg CO_2 eq.	2.2E+05	1.8E+05	-18 %
Ozone depletion	kg CFC-11 eq.	2.5E-05	2.0E-05	-18 %
Human toxicity, cancer	CTUh	2.4E-05	2.0E-05	-17 %
Human toxicity, non-cancer	CTUh	2.8E-04	2.3E-04	-18 %
Particulate matter	disease incidence	2.1E-03	1.7E-03	-18 %
Ionising radiation, human health	kBq U235 eq.	1.9E+04	1.6E+04	-18 %
Photochemical ozone formation, human health	kg NMVOC eq.	1.8E+02	1.5E+02	-18 %
Acidification	mol H+ eq.	2.2E+02	1.8E+02	-18 %
Eutrophication, terrestrial	mol N eq.	4.6E+02	3.8E+02	-18 %
Eutrophication, freshwater	kg P eq.	1.1E+00	9.1E-01	-18 %
Eutrophication, marine	kg N eq.	5.1E+01	4.2E+01	-18 %
Ecotoxicity, freshwater	CTUe	2.6E+05	2.1E+05	-18 %
Land use	pt	2.2E+05	1.9E+05	-14 %
Water use	m^3 water eq. of deprived water	1.5E+04	1.3E+04	-18 %
Resource use, minerals and metals	kg Sb eq.	3.8E-01	3.1E-01	-18 %
Resource use, fossils	MJ	3.4E+06	2.8E+06	-18 %

6.4.11. Further discussion on Design Options not assessed by means of LCA

Concerning the environmental impact of the majority of the considered Design Options, quantification is generally impeded by the absence of primary data with regard to the performance parameters of the respective base cases, in addition to the uncertainty of the improvement potentials of each Design Option 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 DO`s show different improvement potentials depending on the appliance category they are used in. For instance, the implementation of smart load control is only logical within the context of scenarios where mixed laundry and 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 seldom the case, meaning that this DO would be superficial. Therefore, input parameters have been estimated in accordance with the assumed applicability of a DO.

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).

The design option WM-DO8 (Nano-Fibre Filtration Systems) has not been included in the LCA-based analysis because the EcoReport Tool does not address the pollution potential of microplastic as an environmental impact category. Moreover, In the absence of quantitative data concerning the performance of such filters, the level of benefit can only be considered qualitatively. Yet, there are substantial sustainability benefits of using Nano-Fibre Filtration Systems, especially in high throughput systems (e.g. WM2 & WM3) that are not connected to internal waste water recycling systems (typically found in WM5).

Filtering out fragments of synthetic textiles from washing machine waste water offers substantial environmental benefits by reducing the pollution potential of microplastics. These tiny plastic fibres, often released during the laundering of synthetic garments, are too small to be effectively captured by conventional waste water treatment systems and thus frequently end up in rivers, lakes, and oceans. This can be avoided or at least reduced by intercepting these fibres at the source through filtration systems. Avoiding microplastics in effluents subsequently helps maintain cleaner water bodies, supports healthier ecosystems and biodiversity and reduces the risk of microplastics entering the human food chain, contributing to broader efforts to combat plastic pollution on a global scale.

6.5. Impact and costs of selected Design Options

The evaluation of the financial implications of specific design alternatives with the objective of enhancing environmental quality could not be conducted due to the absence of data during the stakeholder consultation. Furthermore, there was an insufficient body of publicly available data on the costs and market prices of commercial and industrial laundry appliances, particularly with regard to industrial appliances (WM5 and D4). Consequently, the assessment of life cycle costs was conducted using the same methodology as the LCA calculation, whereby the impact of DO`s are evaluated in combination for each appliance category.

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6.5.1. WM1: LCC impact of Design Options

Table 6-30: 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
Life time expectancy	years	10	15	+50 %
Product price	EUR	2,000	2,100	+5 %
	EUR/year	200	140	-30 %
Installation/acquisition costs	EUR	80	84	0 %
Natural gas (for heat)	EUR/year	36	28	-23 %
Electricity	EUR/year	209	161	-23 %
Water	EUR/year	145	118	-19 %
Detergent costs	EUR/year	368	282	-23 %
Repair & maintenance costs	EUR	60	63	+5 %
	EUR/year	6.0	4.2	+5 %
Total	**EUR/year**	**973**	**738**	**-24 %**

6.5.2. WM2: LCC impact of Design Options

Table 6-31: 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
Life time expectancy	years	10	15	+50 %
Product price	EUR	9,000	9,500	+6 %
	EUR/year	900	633	-30 %
Installation/ acquisition costs	EUR	360	380	+6 %
Natural gas (for heat)	EUR/year	517	564	-15 %
Electricity	EUR/year	2,755	2,354	-15 %
Water	EUR/year	1,330	1,137	-15 %
Detergent costs	EUR/year	3,175	2,412	-24 %
Repair & maintenance costs	EUR	270	428	+59 %
	EUR/year	27	28.5	0 %
Total	**EUR/year**	**8,739**	**7,153**	**-19 %**

6.5.3. WM3: LCC impact of Design Options

Table 6-32: 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
Life time expectancy	years	10	15	+50 %
Product price	EUR	13,000	13,500	+4 %
	EUR/year	1,300	900	-31 %
Installation/ acquisition costs	EUR	520	540	+4 %
Natural gas (for heat)	EUR/year	0	0	0 %
Electricity	EUR/year	7,199	5,547	-23 %
Water	EUR/year	948	730	-23 %
Detergent costs	EUR/year	2,784	2,145	-23 %
Repair & maintenance costs	EUR	390	405	+4 %
	EUR/year	39	27	0 %
Total	**EUR/year**	**12,322**	**9,385**	**-24 %**

6.5.4. WM4: LCC impact of Design Options

Table 6-33: 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
Life time expectancy	years	10	15	+50 %
Product price	EUR	35,000	36,000	+3 %
	EUR/year	3,500	2,400	-31 %
Installation/ acquisition costs	EUR	1,400	1,440	+3 %
Natural gas (for heat)	EUR/year	953	822	-14 %
Electricity	EUR/year	502	433	-14 %
Water	EUR/year	2,215	1,910	-14 %
Detergent costs	EUR/year	4,892	3,750	-23 %
Repair & maintenance costs	EUR	8,750	9,000	+3 %
	EUR/year	875	600	-31 %
Total	**EUR/year**	**13,076**	**10,011**	**-23 %**

6.5.5. WM5: LCC impact of Design Options

Table 6-34: 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
Life time expectancy	years	13.7	23.7	+73 %
Product price	EUR	585,000	590,000	+1 %
	EUR/year	42,700	24,895	-42 %
Installation/ acquisition costs	EUR	52,650	53,100	+1 %
Natural gas (for heat)	EUR/year	80,465	68,647	-15 %
Electricity	EUR/year	11,370	9,700	-15 %
Water	EUR/year	34,029	29,031	-15 %
Detergent costs	EUR/year	266,921	215,733	-24 %
Repair & maintenance costs	EUR	146,250	147,500	0 %
	EUR/year	10,675	6,224	-41 %
Total	**EUR/year**	**450,004**	**356,470**	**-21 %**

6.5.6. D1: LCC impact of Design Options

Table 6-35: 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
Life time expectancy	years	10	15	+50 %
Product price	EUR	1,600	1,650	+3 %
	EUR/year	160	110	-31 %
Installation/ acquisition costs	EUR	64	66	+3 %
Natural gas (for heat)	EUR/year	0	0	0 %
Electricity	EUR/year	353	273	-23 %
Repair & maintenance costs	EUR	48	50	+4 %
	EUR/year	4.8	3.33	-31 %
Total	**EUR/year**	**524**	**391**	**-25 %**

6.5.7. D2: LCC impact of Design Options

Table 6-36: 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
Life time expectancy	years	15	20	+33 %
Product price	EUR	6,000	6,500	+8 %
	EUR/year	400	325	-19 %
Installation/ acquisition costs	EUR	240	260	+8 %
Natural gas (for heat)	EUR/year	1,328	1,224	-8 %
Electricity	EUR/year	7,947	7,322	-8 %
Repair & maintenance costs	EUR	180	195	+8 %
	EUR/year	12.0	9,75	-19 %
Total	**EUR/year**	**9,703**	8,894	**-8 %**

6.5.8. D3: LCC impact of Design Options

Table 6-37: 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
Life time expectancy	years	10	15	+50 %
Product price	EUR	2,000	2,500	+25 %
	EUR/year	200	167	-17 %
Installation/ acquisition costs	EUR	80	100	+25 %
Natural gas (for heat)	EUR/year	0	0	0 %
Electricity	EUR/year	3,225	3,025	-6 %
Repair & maintenance costs	EUR	60	75	+25 %
	EUR/year	6.0	5.0	-17 %
Total	**EUR/year**	**3,489**	**3,204**	**-8 %**

6.5.9. D4: LCC impact of Design Options

Table 6-38: 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
Life time 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	44,909	-20 %
Electricity	EUR/year	18,593	14,902	-20 %
Repair & maintenance costs	EUR	9,000	9,900	+10 %
	EUR/year	360	330	-8 %
Total	**EUR/year**	**77,166**	**62,139**	**-19 %**

6.6. Overview of Design Options per Base Case

This section contains an overview of both the environmental effects and life cycle cost (LCC) outcomes to identify which design alternatives could be promoted as policy recommendations. Because these options relate to the product characteristics specified in Article 5(1), it is essential to assess the full spectrum of environmental impacts to ensure a comprehensive and balanced evaluation. Including multiple impact dimensions in the analysis allows a design solution to excel in one area while potentially falling short in others.

6.6.1. Overview of environmental impact of Design Options per Base Case

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Table 6-40 contain an overview of the effect the Design Options have on the original Base Cases in terms of environmental impact expressed in energy/water/detergent consumption and the 16 PEF impact categories. The effect is expressed in percentage difference, where a negative value indicates a reduction in the environmental impact and resources consumption.

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Table 6-39: 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	-20 %	-10 %	-20 %	-10 %	-5 %
Water (use phase)	-15 %	-10 %	-20 %	-10 %	-5 %
Detergent (use phase)	-20 %	-20 %	-20 %	-20 %	-10 %
Climate change, total	-20 %	-9 %	-21 %	-23 %	-7 %
Ozone depletion	-19 %	-19 %	-20 %	-18 %	-10 %
Human toxicity, cancer	-20 %	-15 %	-21 %	-25 %	-21 %
Human toxicity, non-cancer	-18 %	-13 %	-22 %	-19 %	-8 %
Particulate matter	-21 %	-17 %	-23 %	-29 %	-14 %
Ionising radiation, human health	-20 %	-11 %	-20 %	-18 %	-7 %
Photochemical ozone formation, human health	-20 %	-14 %	-22 %	-27 %	-10 %
Acidification	-21 %	-17 %	-24 %	-31 %	-15 %
Eutrophication, terrestrial	-20 %	-15 %	-22 %	-27 %	-11 %
Eutrophication, freshwater	-18 %	-15 %	-20 %	-15 %	-8 %
Eutrophication, marine	-20 %	-16 %	-21 %	-24 %	-10 %
Ecotoxicity, freshwater	-20 %	-15 %	-21 %	-23 %	-10 %
Land use	-27 %	-20 %	-26 %	-30 %	-20 %
Water use	-16 %	-11 %	-20 %	-12 %	-6 %
Resource use, minerals and metals	-26 %	-27 %	-31 %	-33 %	-25 %
Resource use, fossils	-20 %	-9 %	-21 %	-22 %	-7 %

Table 6-40: 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	-23 %	-5 %	-10 %	-18 %
Climate change, total	-21 %	-5 %	-11 %	-18 %
Ozone depletion	-24 %	-5 %	-10 %	-18 %
Human toxicity, cancer	-25 %	-8 %	-8 %	-17 %
Human toxicity, non-cancer	-28 %	-5 %	-14 %	-18 %
Particulate matter	-20 %	-6 %	-15 %	-18 %
Ionising radiation, human health	-26 %	-5 %	-10 %	-18 %
Photochemical ozone formation, human health	-28 %	-5 %	-13 %	-18 %
Acidification	-25 %	-6 %	-16 %	-18 %
Eutrophication, terrestrial	-23 %	-5 %	-13 %	-18 %
Eutrophication, freshwater	-25 %	-5 %	-11 %	-18 %
Eutrophication, marine	-24 %	-5 %	-13 %	-18 %
Ecotoxicity, freshwater	-10 %	-5 %	-12 %	-18 %
Land use	-22 %	-8 %	-5 %	-14 %
Water use	-32 %	-5 %	-11 %	-18 %
Resource use, minerals and metals	-22 %	-17 %	-31 %	-18 %
Resource use, fossils	-23 %	-5 %	-11 %	-18 %

6.6.2. Total yearly cost of Design Options per Base Case

Below, the annualised life-cycle costs are summarised from the data previously presented in this report. This is because discount rates and present-worth calculations are applied internally by the EcoReport tool. The total yearly costs are presented for the Design Options per Base Case, enabling a like-for-like comparison of annualised life-cycle costs. Discounting and present-worth conversion are both conducted within the tool, 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. **Table 6-41** and **Table 6-42** contain an overview of the total yearly costs per Base Case, both for the original Base Case (reference) and the Design Option (DO), for washing machines and dryers respectively.

Table 6-41: Total yearly costs of Design Options in EUR per washing machine Base Case.

BC		Total costs (EUR/year)	Difference (%)
WM1	Reference	973	0 %
	DO	738	-24 %
WM2	Reference	8,882	0 %
	DO	7,153	-19 %
WM3	Reference	12,322	0 %
	DO	9,385	-24 %
WM4	Reference	13,076	0 %
	DO	10,011	-23 %
WM5	Reference	450,004	0 %
	DO	356,470	-21 %

Table 6-42: Total yearly costs of Design Options in EUR per dryer Base Case.

BC		Total costs (EUR/year)	Difference (%)
D1	Reference	524	0 %
	DO	391	-25 %
D2	Reference	9,703	0 %
	DO	8,894	-8 %
D3	Reference	3,489	0 %
	DO	3,204	-8 %
D4	Reference	77,166	0 %
	DO	62,139	-19 %

The evaluation of the selected Design Options presented in the previous sections allows to draw the major conclusion that in all cases, the estimated Design Options have the potential to generate environmental benefits, which go hand in hand with cost savings over the lifetime.

7. Task 7: Policy Options and Scenarios

7.1. Objectives of MEErP Task 7

This task identifies and discusses in Task 7.1 policy options aimed at reducing the impacts of commercial and industrial laundry appliances on the environment as analysed in previous tasks. It provides in Task 7.2 and Task 7.3 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 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 Task 6, only one package of design options was taken into account, 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 Base Case.

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 professional laundry appliances within the scope proposed in Task 1, namely commercial and industrial appliances. The environmental impact improvement and the key parameters to do this were previously discussed in Task 6, while this Task 7 discusses how the design options can potentially be converted into policy. In relation to the proposed policy options this task also analyses and models impact scenarios. This is a reviewed version elaborated after consulting a few stakeholders in bilateral meetings and collecting feedback in writing. A summary of stakeholder positions with regards to the proposed policy is included as a support to the subsequent policy making process.

7.1.1. Introduction to the evaluation of Scenarios using the MEErP methodology

The Methodology for Ecodesign of Energy-related Products (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 least life-cycle cost (LLCC) and best available technologies (BAT). This ensures that design decisions not only meet regulatory requirements but also promote sustainability and cost-effectiveness.

The evaluation of design options within MEErP is prepared by several tasks, including the definition of product scope (Task 1), market analysis (Task 2), use-phase and technical analysis of existing products (Task 3 & 4), as well as the subsequent life-cycle assessment (LCA) and life-cycle-costing (LCC) (Task 5). The revised MEErP methodology (2024) introduces refinements to better align the framework with the EU's Green Deal objectives,

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emphasising aspects related to climate neutrality, circularity, and Substances of Concern (SoC) related to the product group under study. The work process for developing design options remains structured around seven core tasks, with 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 EcoReport tool. The latter helps to quantify the improvement potential of environmental impact against the Base Cases. 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.

Task 7 of the preparatory study encompasses the following sections:

- Policy analysis;
- Scenario analysis;
- Socio-economic impact analysis for industry, consumers and society;
- Sensitivity analysis of the main parameters;
- Summary of results and main policy recommendations per product.

7.2. Policy analysis

7.2.1. 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 Task 5 and the status of 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: meeting minutes**).

From July 2025 onward, the study team engaged intensive exchanges with manufacturer associations and selected members - most notably with laundry appliance stakeholders APPLiA[75] (30 July 2025) and ETCT[76] (4 August 2025).

The following stakeholders provided written comments in various stages.

[75] Representing leading home appliance manufacturers in Europe

[76] ETCT European Textile Care Technology, represents the interests of European manufacturers of industrial textile care technology

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7.2.1.1. Switzerland

The Swiss Federal Office of Energy (Bundesamt für Energie, BfE) mentioned a new policy instrument, under which electricity suppliers are given savings targets, which are to be met by implementing various measures among end consumers (including businesses and private households).[77] 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.

The Standardized Measure GG-03a focuses on replacing commercial laundry equipment. Its scope 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 cabinet dryers with built-in electric heating.

Table 7-1: 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 of 5 to 9 kg: 0.20 kWh	
	Tumble dryer with a load of 10 to 23 kg: 0.25 kWh	
	Tumble dryer with a load of 24 to 40 kg: 0.55 kWh	
	Cabinet dryer: With heat pump	

Source: BfE 2025 , translation: Fraunhofer ISI

7.2.1.2. 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 harmonized measurement standards and the storage of this data in a centralized 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.

[77] Directive for Energy Efficiency Improvements by Electricity Suppliers Implementation Guide according to Articles 51a–51i of the Energy Ordinance (EnV): https://www.bfe.admin.ch/bfe/de/home/effizienz/energieeffizienzsteigerungen-durch-elektrizitaetslieferanten.exturl.html/aHR0cHM6Ly9wdWJkYi5iZmUuYWRtaW4uY2gvZGUvcHVibGljYX/Rpb24vZG93bmxvYWQvMTE5NTM=.html

For spare parts, since the delivery process managed by the logistics provider is beyond the manufacturer's control, APPLiA emphasizes that the requirement proposed during the 2nd 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 motors and fans. Under Regulation (EU) 2019/1781 for Electric Motors, exemptions allow replacement motors only until 1 July 2029 for products marketed before 1 July 2022. In contrast, spare parts for 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 Substances of Concern (SoC) across product groups and was unable to respond to the recent questionnaire[78] on this matter. After discussions with ZVEI[79], 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 APPLiA**.

In an exchange with the study team held at the end of July, APPLiA:

- Mentioned that after the last preparatory study, it proposed a Voluntary Agreement to the EC, focussing on measuring and reporting products according to the EN standards. The idea was to enable the elaboration of mandatory requirements only once enough data of the EU market became available.
- 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 customized tuning according to the type of laundry and the business they run.
- APPLiA doesn't have figures from test reports. Some members might have tested products according to 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.[80]

7.2.1.3. Electrolux

Electrolux shared a presentation focused on the relevant standards for commercial laundry equipment. The EN 50640 standard is applicable for measuring the performance and

[78] See consultation on SoC, May 2025

[79] German Electro and Digital Industry Association

[80] 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

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consumption of commercial washers (WM1, WM2, WM3 and WM4), and the EN 50594 for commercial tumble dryers (D1 and D2). According to Electrolux, both standards can be used for testing batch load machines, no load size limit is needed.

7.2.1.4. 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.[81]

Table 7-2: average performance of the tested industrial products.

	Dryers	Continuous tunnel washers	Washer extractors
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 €[82]	4.320 - 8.640	64.800	2.160

FMC: final moisture content

The figures of **Table 7-2** 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[83].

ETCT confirmed that the capacity has no impact on the specific energy efficiency performance of the products.

[81] the energy data have been shared earlier.

[82] assuming that 50 % of the costs are offset by additional shifts or similar measures in the laundry company

[83] Institut - wfk - Institut für angewandte Forschung GmbH, see: https://wfk-iaf.de/

7.2.2. Barriers (and opportunities) for improvements

7.2.2.1. Opportunities

For most impact categories, 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,[84] the use phase contributes to 55 % - 99 % of the lifecycle impact, the energy consumption in the use phase contributes alone to 29 %-99 %.

Table 7-3: Contribution to the LCA impact (PEF single score) over the total lifetime of the product, on product level.[85]

Use phase	WM 1	WM2	WM3	WM4	WM5	D1	D2	D3	D4
Energy consumption	62.6 %	71.5 %	84.1 %	29.2 %	74.3 %	77.3 %	99.4 %	94.6 %	99.8 %
Water consumption	8.6%	6.4%	2.7%	8.8%	5.1%	n.a.	n.a.	n.a.	n.a.
Detergent consumption	23.3 %	17.8 %	6.8%	16.6 %	17.0 %	n.a.	n.a.	n.a.	n.a.
Total use phase	94.5 %	95.7 %	93.6 %	54.6 %	96.4 %	77.3 %	99.4 %	94.6 %	99.8 %

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 likewise confirm that the use phase is the dominant cost driver for all product categories within the scope of the study. Depending on the WM Base Case considered, costs related to detergent consumption alone can account for up to 60 % of the total LCC (see **Table 7-4**).

Table 7-4: Relevance of the use phase in the LCC, at product level.[86]

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 %

[84] PEF single scores were calculated for each Base Case, aggregating impacts across all life-cycle stages over the product's entire lifetime. Although the EcoReport tool 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 than as a comprehensive PEF assessment when comparing results.

[85] Based on the LCA results of the sensitivity analysis carried out in Task 5

[86] Based on the sensitivity analysis carried out in Task 5

The Task 6 report identified significant potential savings in energy, detergent, and water consumption. When coupled with extended product lifetimes, these efficiency improvements can translate into substantial annual reductions in life cycle costs (LCC/a) (see **Table 7-5**):

Table 7-5: Improvement potentials, on product level.[87]

	WM1	WM2	WM3	WM4	WM5	D1	D2	D3	D4
Energy consumption	-20 %	-10 %	-20 %	-10 %	-5 %	-20 %	-5 %	-10 %	-18 %
Water consumption	-15 %	-10 %	-20 %	-10 %	-5 %	n.a.	n.a.	n.a.	n.a.
Detergent consumption	-20 %	-20 %	-20 %	-20 %	-10 %	n.a.	n.a.	n.a.	n.a.
Yearly life cycle costs	-24 %	-19 %	-24 %	-23 %	-21 %	-25 %	-8 %	-8 %	-19 %

The improvement potentials were also analysed on market level, see **Table 7-6.** WM2 and D2 and D4 together deliver over 78% of the savings in the four categories reported earlier, WM5 contributes also to large savings despite its lowest market share.

Table 7-6: Contribution of each BC to the achievable savings of the whole market.

Savings	WM 1	WM 2	WM 3	WM 4	WM 5		D1	D2	D3	D4
	Whole WM market						Whole D market			
Total energy savings	5 %	81 %	2 %	1 %	11 %		2 %	41 %	4 %	54 %
Total water savings	7 %	84 %	1 %	3 %	6 %		n.a.	n.a.	n.a.	n.a.
Total detergent savings	4 %	86 %	0 %	2 %	7 %		n.a.	n.a.	n.a.	n.a.
Total costs savings (LCC/a)	5 %	70 %	1 %	3 %	21 %		3 %	64 %	4 %	28 %
		Whole WM and D market								
Total energy savings	1 %	23 %	1 %	0 %	3 %		1 %	29 %	3 %	38 %
Total water savings	7 %	84 %	1 %	3 %	6 %		n.a.	n.a.	n.a.	n.a.
Total detergent savings	4 %	86 %	0 %	2 %	7 %		n.a.	n.a.	n.a.	n.a.
Total costs savings (LCC/a)	3 %	45 %	1 %	2 %	13 %		1 %	23 %	2 %	10%

7.2.2.2. Barriers

The aforementioned potential improvements are large but can hardly be tapped. One key barrier is the lack of transparency in market information. Currently, consumers have access to limited data on product performance - specifically regarding energy, water, and detergent consumptions. However:

[87] Based on Task 6

- The consumption figures are typically derived from proprietary testing protocols developed by individual manufacturers and do not conform to standardized EN performance test methods, hindering comparability between manufacturers.
- In addition, data made publicly are scarce, further limiting its utility for comparison.

APPLiA and ETCT recognize that, under these conditions, consumers are unable to make objective comparisons between products based on environmental performance. This lack of harmonized and accessible data not only undermines informed decision-making. Furthermore, the absence of standardized performance metrics and market transparency has likely hindered competition and slowed innovation toward more sustainable product development across the sector.

In greater detail, the current obstacles hindering the market transformation toward sustainable products in the EU and the elaboration of an EU regulation include the following aspects:

- **Limited uptake of EN standards:** Although most of the relevant EN test standards[88] 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 *Base Cases* analysed in Task 5, as well as the improvements achieved through the *Design Options* in 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:
  - 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 standardized 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 optimized 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.
- **Inconsistent testing results:** To ensure comparability between competing products, all similar products should be tested under the same programme. This is still not the case. E.g.: two tumble dryers tested according to EN 50594 might have a different efficiency but show the same energy consumption if the final moisture content in both test is not the same.

[88] no standard has been developed for cabinet dryers, see **Section 7.2.4.1**

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The specification of the reference programme for the product declaration, if not available in the EN standard, should be given in the regulation.

- **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.

- **Limitations of the Task 6 analysis:** The evaluation in Task 6 could not account for all factors associated with the Design Options, such as the potential increase in product size or the possible impact on productivity when aiming for improved environmental performance.

7.2.3. ESPR Framework

ESPR[89] 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 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 sets ecodesign requirements for product categories, focusing on:

- 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.

89 https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/ecodesign-sustainable-products-regulation_en

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Figure 7-1: Type of requirements within the ESPR framework.

Source: EC

7.2.4. Potential Policy Options

7.2.4.1. 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 7-7: 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 Task 1, a **clear definition between what is a commercial and an industrial product is not yet available**. The five standards mentioned in **Table 7-7** don't 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,

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which might be an issue for regulation as the EN test standards are different and will deliver different results.

Therefore, in addition to the work already carried out in 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 7-8**, 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 commercial or industrial.

Table 7-8: 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)*
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
WM	EN 17116-4:2019	Specifications for industrial laundry machines – Definitions and testing of capacity and consumption characteristics – Part 4: Washer extractors;	Perfor-mance	Industrial	> 400 l > 40 kg
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	> 1000 l > 40 kg

Appli-ance	Full reference	Title of the standard	Focus	Declaration	Capacity
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[90]
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)[91]
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 l[92]
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)[93]
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.					

6187

[90] considering the ratio 1 kg = 10 l from the EN 17116-4:2019, this would correspond to a capacity <= 15 kg

[91] considering the ratio 1 kg = 10 l from the EN 17116-4:2019, this would correspond to a capacity > 15 kg (> 6 kg)

[92] considering the ratio 1 kg = 25 l from the EN 17116-2:2018, this would correspond to a capacity <= 14 kg

[93] considering the ratio 1 kg = 25 l from the EN 17116-2:2018, this would correspond to a capacity > 14 kg (> 6.4 kg)

As we can see from the previous table:

- The capacity thresholds for the safety and performance standards are not harmonised
- 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 60l-150 l and for dryers in the range 160l-350l

ETCT interpretates the EN- 10472 standards as follows:[94]

- Washer extractors:
  - Up to 60 liters: the application pertains to purely household machines
  - From 60 to 150 liters (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 liters, EN 10472 (Safety Requirements for Commercial Washing Machines) and EN 60204 (Safety of machinery – Electrical equipment of machines – General requirements) must be applied
- Dryers:
  - Up to 160 liters of drum volume, the application pertains to purely household machines.
  - Between 160 liters and 350 liters 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 liters, EN 10472 (Safety Requirements for Commercial 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 finalize a clear definition of the scope and the standard to be applied in the context of a possible regulation. The objective is to have ensure 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 to each product to be tested within the framework of a possible ESPR regulation.

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[94] Communication on 12.08.2025

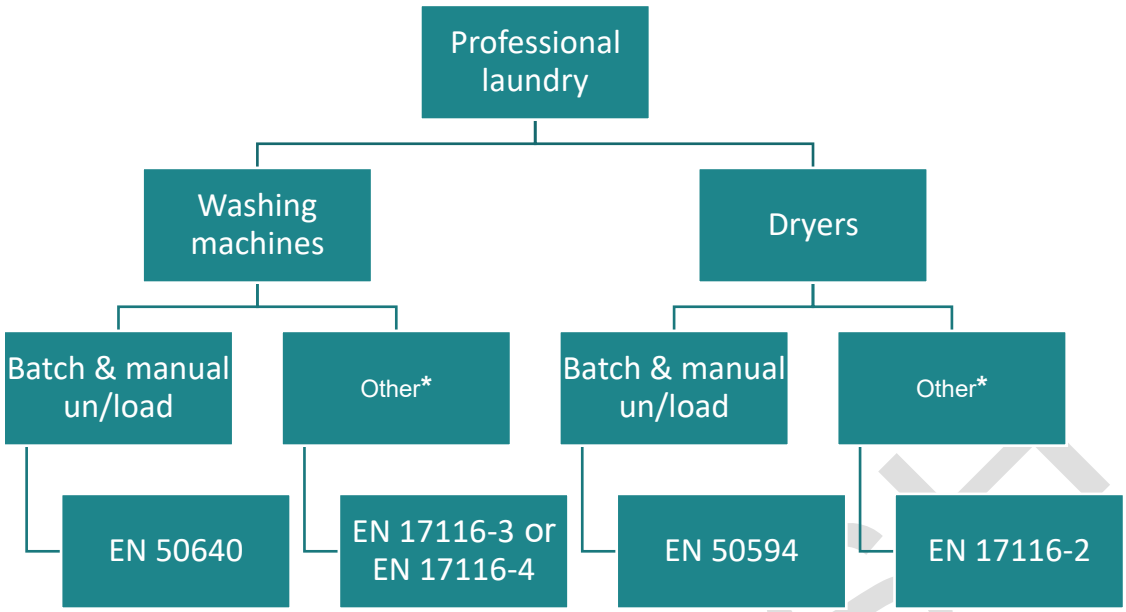

Figure 7-2:Suggested EN standards to be applied in a possible ESPR regulation according to the product to be tested

*: “Batch AND automatic un/loading" or "continuous" machines

Question to the stakeholders:

Do you support the approach presented in **Figure 7-2**?

If not, please provide a clear definition of products to be tested according to:

- EN 50640
- EN 50594
- EN 17116-4
- EN 17116-2

The situation for EN 17116-3 is clear.

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Standards:

Following the mandate M495[95] given by the Commission to CENELEC and CEN to develop new performance standards for professional laundry machines, a few new standards were developed regarding the performance and related test procedures for professional washing and drying appliances. The standards differ for industrial laundry machines (EN 17116 series) and professional 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[96], 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."

[95] Standardisation mandate to CEN, CENELEC and ETSI under Directive 2009/125/EC relating to harmonised standards in the field of Ecodesign, M/495 EN.

[96] M/495 described the Standardisation needs for Professional washing machines, dryers and dishwashers

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While the elaborated EN standards provide a measurement method, they don't provide always requirements for a "reference programme" (or "declaration programme") [97] in terms of service delivered by the tested product.[98] This could be provided within the regulation.

Test procedure for washing machines

In addition to a test standard, a "reference programme" for the test should be provided and should include requirements on:

- Wash performance
- Remaining Moisture Content (RMC) after extraction (except for continuous tunnel washer as extraction is not part of the test in EN 17116-3:2019[99])
  - 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 professional barrier washers, it could be relevant that the standard program include compliance to hygiene standards.

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 reference program 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:

- Min wash performance: 0,93 (Reference Program Wascator CLS: Cotton 60)
- Max time 70: minutes
- Max 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[100] has been in use for at least five years. Data collection is required, but no threshold will be defined in the first tier.

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[97] Reference program: 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 reference programme is not the reference programme of the reference machine (see, for example, EN 17116-3).

[98] EN 17116-2 (industrial tumble dryers) provides a final moisture content while EN 50594 (commercial tumble dryers) does not.

[99] 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.

[100] 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

- 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 program': The 'Declaration Program' should not be designated as the default program. However, it must meet specific requirements, including: washing at full load (rated capacity), compliance with ecodesign criteria for wash performance, program duration and maximum residual moisture content (RMC).

    - Reference machine: It is clearly defined in EN 50640:2018 Annex D.[101] 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 reference programme of the reference machine as reported in EN 17116-3.[102]

When testing, following parameters should be measured and reported:

- electricity consumption,
- steam consumption,
- gas consumption,
- detergent consumption,
- water consumption,
- duration information,
- wash performance.

An overview of the main difference between the EN standards for washing machines is provided in **Table 7-9.** This clarifies why the results are not comparable, emphasizing the necessity of accurately declaring products and testing them in accordance with the correct standard.

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[101] Wascator FOM71CLS

[102] 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.

6311 **Table 7-9: 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 program with detailed test temperature and time	NO	No specification of test program. 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 program, 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
Soiling strips	YES	EMPA strips	-	YES	Different soilings	-	The soiling strips are different and thereby not comparable and also different base material

6312 Source: APPLiA

Test procedure for dryers

The “reference program” (or “declaration program”) for the test should include requirements on:

- Final moisture content, and
- Max duration.

After the exchange on 30 July, 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:
  - Max time 130 min. 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).
  - Authorities also require in future to lower power peaks on the grid.
  - 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 optimize energy efficiency.
  - ‘Declaration program’ shall not be specified as default program
  - ‘Declaration program’ has to fulfil particular requirements: drying the rated capacity; reach nominal final moisture content 0 %; maximum program duration 130 min.
  - No reference dryer is needed as the goal of residual moisture % does not need to be measured against a reference, it’s weight only

For drying tumblers tested according to EN 171162-2, 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 to apply 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 7-7**), no standard has been developed for cabinet dryers. 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. Alternatively, and to save time, the rational of a testing procedure could be suggested first in the annex of a possible regulation covering this product group.

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Question to the stakeholders:

Do you have any suggestions for a simple approach for quantifying the energy consumption and the energy efficiency of a cabinet dryer?

Critical question:

Since there is some overlap between commercial and industrial laundry appliances, would it be realistic and reasonable to base a future regulation for commercial and industrial laundry appliances on:

- One testing method for **all** tumble dryers (independently of the size). If so, which one?
- One testing method for **all** washer-extractors (independently of the size). If so, which one?

For continuous tunnel washers, EN 171162-3 would be applied.

The testing method should allow in-situ testing, when testing in the lab is not possible.[103]

7.2.4.2. Performance requirements (ESPR Art. 6)

At this stage of the study, there is a lack of data , as the following table shows.

Table 7-10: Data available to assess performance requirements.

	Commercial	Industrial
Washers	EN 50640:2018: • no reference programme • data of products tested according to the standard not available	EN 17116-3 and EN 17116-4 • no reference programme • some products have been tested (average performance available)
Dryer	EN 50640:2018: • no reference programme • data of products tested according to the standard not available	EN 17116-2 (drying tumblers) • fmc defined • some products have been tested (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:

- 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:

[103] In case e.g. the size of the laundry machine is too large

- **From T_0 + 6 months to T_0 + X years**: information requirement, test reports based on the EN standards
- **At T_0 + X years**: publication of the performance requirements, based on the data collected during the previous phase. Continuation of the information requirement. The minimum performance is set at the level reached by e.g. [75 %] of the models on the market. (The exact figure on the number of worst-performing models to be removed from the market remains to be discussed)
- **As of T_0 + (X + Y) years**: entry into force of the performance requirements.

Remark: Such an approach has some similarities with the Japanese TopRunner programme.[104]

- 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*"
- 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".
- Minimum requirements to be assessed before the regulation is published, based on a sample of data reflecting the market.

Following consultation with the European Commission, it was confirmed that the first two approaches are not viable. In particular, the second approach is legally infeasible, as the ESPR regulation specific to professional laundry appliances would already constitute a delegated act and therefore cannot refer to another delegated act that has yet to be issued.

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 reference programme, the tests conducted to date may have limited relevance and comparability.

[104] 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

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6400 – The largest saving potentials are expected for the base cases WM2 (professional
6401 washer extractor designed for extra-long durability) and D2 (professional tumble
6402 dryer designed for extra-long durability).

6403 • For industrial machines: average figures based on products tested are already
6404 available and have been shared by ETCT (see **Table 7-2**). These values could serve
6405 as a useful starting point for defining reasonable minimum performance requirements,
6406 enabling the removal of the lowest performing products from the market. Additional
6407 data from ETCT or its members could help assess whether the average figures would
6408 be too stringent or not.

6409 *Remark: In relation to energy efficiency and space constraints of process laundry machines,*
6410 *as well as possible trade-offs (especially when existing industrial laundry facilities are*
6411 *upgraded or refurbished), the regulation could evtl. allow a given product to be less efficient,*
6412 *provided that the waste heat it generates is recovered and used elsewhere in the process to*
6413 *maintain a high overall system efficiency. This point should be further analysed when*
6414 *elaborating the draft regulation and the Impact Assessment.*

6415 While for dryers, performance requirements based solely on energy efficiency would be
6416 sufficient, the situation for washing machines is more complex: in addition to energy
6417 consumption, detergent use and water consumption have significant influence in both Life
6418 Cycle Assessment (LCA) and Life Cycle Cost (LCC) analyses.

6419 Consequently, two approaches could be considered:

6420 • Set specific minimum requirements for each parameter: energy, detergent, and water
6421 consumption in the use phase as measured in line with the EN standard for the
6422 reference programme, or
6423 • Set minimum requirement on a parameter combining of the three aforementioned
6424 parameters and reflecting the environmental impact of each one as follows:

6425 $$performance = \frac{w_e \times E + w_d \times D + w_w \times W}{M}$$

6426 With:

6427 E: energy consumption in the use phase (in kWh or MJ)

6428 D: detergent consumption in the use phase (in kg)

6429 W: Water consumption in the use phase (in m³)

6430 w: weighting factor

6431 M: mass of the laundry washed

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The weighting factors could be derived from the environmental impact of each parameter based on the PEF single score as suggested in Table 7-11.[105]

Table 7-11: Suggested weighting factor to convert specific consumption in PEF single score.[106]

Consumption in the use phase	Quantity	Corresponding PEF single score
Electricity	1 kWh	1.174E+01
Heat	1 MJ	1.113E+00
Water	1 m³	3.659E+01
Detergent	1 kg	1.260E+02

Further technical and methodological analysis would be needed to validate the weighting and ensure comparability of the results.

Important remark:

Article 6(2) of the ESPR mentions:

> "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 Task 6. For example, regarding energy efficiency: if no specific criteria or minimum performance level can be determined, then design options identified as contributing to reduced environmental impact and lower lifecycle costs may be set as non-quantitative requirements for new products.

7.2.4.3. Information requirements (ESPR Art. 7)

As already emphasized, the lack of a (harmonized) 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.

Products should be tested according to the standards mentioned in **Section 7.2.4.2**. At least, the following information should be reported:

[105] PEF single scores were calculated for each Base Case, aggregating impacts across all life-cycle stages over the product's entire lifetime. Although the EcoReport tool 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 than as a comprehensive PEF assessment when comparing results.

[106] Based on Task 6

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- electricity consumption,
- steam consumption,
- gas consumption,
- detergent consumption (for WM),
- water consumption,
- duration information,
- wash performance (for WM)
- drying performance (for D)
- general information such as:
- nominal capacity,
- loading: manual / automatic,
- batch / continuous,
- noise level
- SoCs: see information requirements in **Section 7.2.4.8**.

Remark: Please note that the information requirements should be harmonised with the content of the DPP.

7.2.4.4. 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 professional laundry appliances are Business-to-Business (B2B) products purchased by professionals 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 toward 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.

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 section **Section 7.2.4.2**.

7.2.4.5. Digital Product Passport (DPP) (ESPR Art. 9):

This chapter evaluates the DPP requirements for the product group of professional laundry appliances, in line with the provisions of ESPR Article 9, Annex III and referenced or related articles.

Professional 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 professional laundry appliances. This reinforces the importance of implementing a DPP for this product group.

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Professional 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 7-13,** 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 in September 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 here** 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 professional 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 integration in this product group could be facilitated through third-party service providers or industry associations. Third-party providers already offer DPP-compliant services that can handle data storage, validation, and access rights in line with ESPR requirements. 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 7-12 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 professional laundry appliances are not and will not be covered by EPREL, this option is obsolete.

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6525 **Table 7-12: 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 & 2.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)**
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)

6526

Table 7-13: 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 7-14, Table 7-15
*(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 name-plate; Label should indicate it links to a DPP; Must withstand humidity, detergents, and mechanical cleaning.
*(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 o information: e.g. energy and water performance, durability, repair instructions; • Professionals o Manufacturers/importers: full access and control rights. o Recyclers: e.g. material composition, hazardous substance & location; End-users/customers: to be clarified; o Service technicians: e.g. disassembly instructions, software versioning, spare part IDs; • Market authorities: all information including conformity and substance declarations;

(a) the data to be included in the digital product passport pursuant to Annex III;

See Table 7-14, Table 7-15

*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 third-party 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 requirements** for professional 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 7-14: 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) Global Trade Identification Number (GTIN) – ISO/IEC 15459-6 or equivalent	Yes - To be determined by standardisation
(d) Relevant commodity codes (e.g., TARIC code)	Yes - To be determined by standardisation

Digital Product Passport Data Element (Annex III ESPR)	Relevant for DPP? (Yes/No)
(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)	Yes
(i) Unique facility identifiers	Yes
(j) Importer information, including Article 29(3) info (name, registered trade name or registered trade mark, 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
(l) Reference of the DPP service provider hosting the backup copy	Yes
Standards compliance (where relevant): ISO/IEC 15459-1 to -6	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

6547

6548 **Table 7-15: Evaluation of data related requirements according to ESPR Article 7**
6549 **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

Information Requirement (from Article 7 ESPR)	Relevant? (Yes/No)
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
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 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
- on packaging	Yes
- on a label (Art. 16)	No
- in a user manual or other docs	Yes
- on a free-access website or app	Yes

Information Requirement (from Article 7 ESPR)	Relevant? (Yes/No)
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

7.2.4.6. Green Public Procurement GPP (ESPR Art. 65)

In 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,[107] highlighting its substantial impact on the economy. Professional laundry machines are operated in or by various public entities, including hospitals, nursing homes, prisons, and similar facilities. Thus, it is reasonable to assume that Green Public Procurement (GPP) could have a meaningful impact on the EU market for professional 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 emphasizes 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 Task 6 indicated that the BAT level corresponds to the lowest life cycle cost (LCC) level.

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[107] See ESPR regulation: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401781

7.2.4.7. Circular economy

Spare parts

In order to ease repairability of the professional 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 professional-grade 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 minimize operational downtime.
- APPLiA has emphasized that the actual delivery process lies outside the manufacturers' control. Therefore, the proposed 5-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:

- Parts of the dosing system.
- Parts related to the water circulation system e.g. circulation pump, piping.
- Electronics and dosing pumps.
- Pumps, heating elements, printed circuit boards (PCBs)
- Temperature sensors and boiler heating elements
- Tumble drums, motors, parts of the "traction systems"

The list should be carefully updated in the further process.

In addition, manufacturers shall provide comprehensive repair and maintenance information to facilitate servicing by professional repairers and, where applicable, end-users.

Question to the stakeholders: Please review carefully the list of spare sparts.

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 professional 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)

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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.

7.2.4.8. Substances of concern

The ESPR requires manufacturers of professional 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 end-of-life treatment.[108] 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 Harmonized 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 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.

[108] Substances of concerned are in the scope of Ecodesign requirements (Art. 5) and Information requirements (Art. 7) of the ESPR regulations.

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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.

7.3. Scenario analysis

The scenario analysis is performed using a stock model calculation, comparing a business-as-usual (BAU) scenario with the best available technology (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 7.3.1 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 7.3.2** introduces the logic behind the stock model, including its components and the granularity level. Results of the environmental assessment are presented in **Section 7.3.3**, structured according to sales and stock, use-phase electricity, gas, water and detergent consumption. After the environmental results, socio-economic impacts are presented (**Section 7.3.5**) and finally a sensitivity analysis (**Section 7.3.6**).

7.3.1. Inputs from previous Tasks and necessary assumptions

Base cases, design options and policy timing

The analysis includes the seven base cases described in Task 5 and 6. Five are washing machines, four are dryers. **Table 7-16** lists the base cases and selected input data for the BAU and BAT products variations.

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Table 7-16 Selected input data from Tasks 5 and 6 for BAU[109] 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: Semi-professional washer extractor	10	15 (+50 %)	2,080	2,184 (+5 %)	987	790 (-20 %)	1,724	1,379 (-20 %)	83.7	71.1 (-15 %)	99	79 (-20 %)
WM2: Professional washer extractor	10	15 (+50 %)	9,360	9,880 (+6 %)	13,237	11,911 (-10 %)	32,264	29,040 (-10 %)	783	705 (-10 %)	957	766 (-20 %)
WM3: Professional washer dryer	10	15 (+50 %)	13,520	14,040 (+4 %)	33,481	26,785 (-20 %)	-	-	540	432 (-20 %)	594	475 (-20 %)
WM4: Professional barrier washer	10	15 (+50 %)	36,400	37,440 (+2 %)	2,361	2,125 (-10 %)	45,621	41,062 (-10 %)	1,277	1,149 (-10 %)	1,056	845 (-20 %)
WM5: Industrial continuous tunnel washer	13.7	23.7 (+73 %)	637,650	643,100 (+1 %)	57,375	54,507 (-5 %)	4,131,000	3,924,447 (-5 %)	21,038	19,986 (-5 %)	30,600	27,540 (-10 %)
D1: Semi professional tumble dryer	10	15 (+50 %)	1,664	1,716 (+3 %)	1,623	1,299 (-20 %)	-	-	-	-	-	-
D2: Professional tumble dryer	15	20 (+33 %)	6,240	6,760 (+8 %)	37,537	35,660 (-5 %)	63,833	60,643 (-5 %)	-	-	-	-
D3: Professional cabinet dryer	10	15 (+50 %)	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	73,602 (-18 %)	2,752,067	2,256,696 (-18 %)	-	-	-	-

[109] 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)

Task 2 provides sales and stock data for the reference year 2025 (see **Table 7-17**). Due to long lifetimes of e.g. base case 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 base case.

Assumptions for market growth are based on 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 2011-2021;
- 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 (professional barrier washer) a value of 1.44 % per year is assumed, corresponding to the Healthcare Laundry (HCL) market segment. Similarly, for D2 (professional 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 Task 2, the numbers were adjusted accordingly.

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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 7-17).**

Table 7-17 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: Semi-professional washer extractor	24,300	Coin & Card laundry (CCL) and Apartment household laundry (AHL)	1 %	3.8 %	1.9 %
WM2: Professional washer extractor	50,000	Commercial Laundry (CL)	1.1 %	3.8 %	1.9 %
WM3: Professional washer dryer	405	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	1 %	3.8 %	1.9 %
WM4: Professional 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: Semi professional tumble dryer	16,000	Coin & Card laundry (CCL) and Apartment household laundry (AHL)	1 %	3.8 %	1.9 %
D2: Professional 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: Professional cabinet dryer	10,000	Coin & Card laundry (CCL) and Apartment Household Laundry (AHL)	1 %	3.8 %	1.9 %
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 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 the PRIMES model was used for a consistent scenario (see **Table 7-18**)[110]. 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 Task 5 environmental assessment. In Task 5, values are fixed to 0.234€/kWh for costs and 0.419 kg $CO_{2eq.}$/kWh for

[110] https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en

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 Task 5 is added (see below).

Table 7-18 Data on greenhouse gas intensity of electricity production and electricity prices from the EU reference scenario and derived dynamic data for Task 7.

	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
EU reference scenario										
Average Price in final demand sectors *(€'15/kWh)*	- (no value)	0.1332	0.1371	0.1487	0.1545	0.1613	0.1615	0.1628	0.1638	0.1656
Greenhouse gas intensity *(kg CO_{2eq}/kWh)*	0.45	0.40	0.37	0.27	0.22	0.18	0.13	0.09	0.07	0.07
Dynamic data for Task 7 (including										
Electricity price *(€/kWh)*	0.196	0.202	0.208	0.225	0.234	0.244	0.245	0.247	0.248	0.251
Greenhouse gas intensity *(kg CO_{2eq}/kWh)*	0.857	0.762	0.704	0.514	0.419	0.343	0.248	0.171	0.133	0.133

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 Task 5 Appendix 4 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 base cases 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 professional laundry appliance market.

7.3.2. Stock model description

The stock model is meant to establish scenarios according to the design options described in Task 6 and the policy options described in Task 7 **Section 7.2**. 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 Task 5 assessments for the 9 base cases, respectively for BAU and BAT (in total 18 ERTs), including:

- Purchase price, installation costs, repair costs, electricity, gas, water and detergent costs
- 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 End-of-Life 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 base cases. 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 **End-of-Life** require further clarification to understand their usage within the stock model.

- **Stock** denotes the total inventory of each base case 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.
- **End-of-Life** 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.

$$stock_y = \sum_{t=y-lifetime+1}^{t=y} sales_t \quad (1)$$

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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 Task 5 and 6 for all nine base cases, 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 7.3.1)**

The disaggregation level is set on monthly basis, resulting in 840 timesteps for the period 1980 – 2050. For the results calculation, the relevant reference period is from 2025 to 2050.

Figure 7-3 presents a visual representation of the modelling logic and its components.

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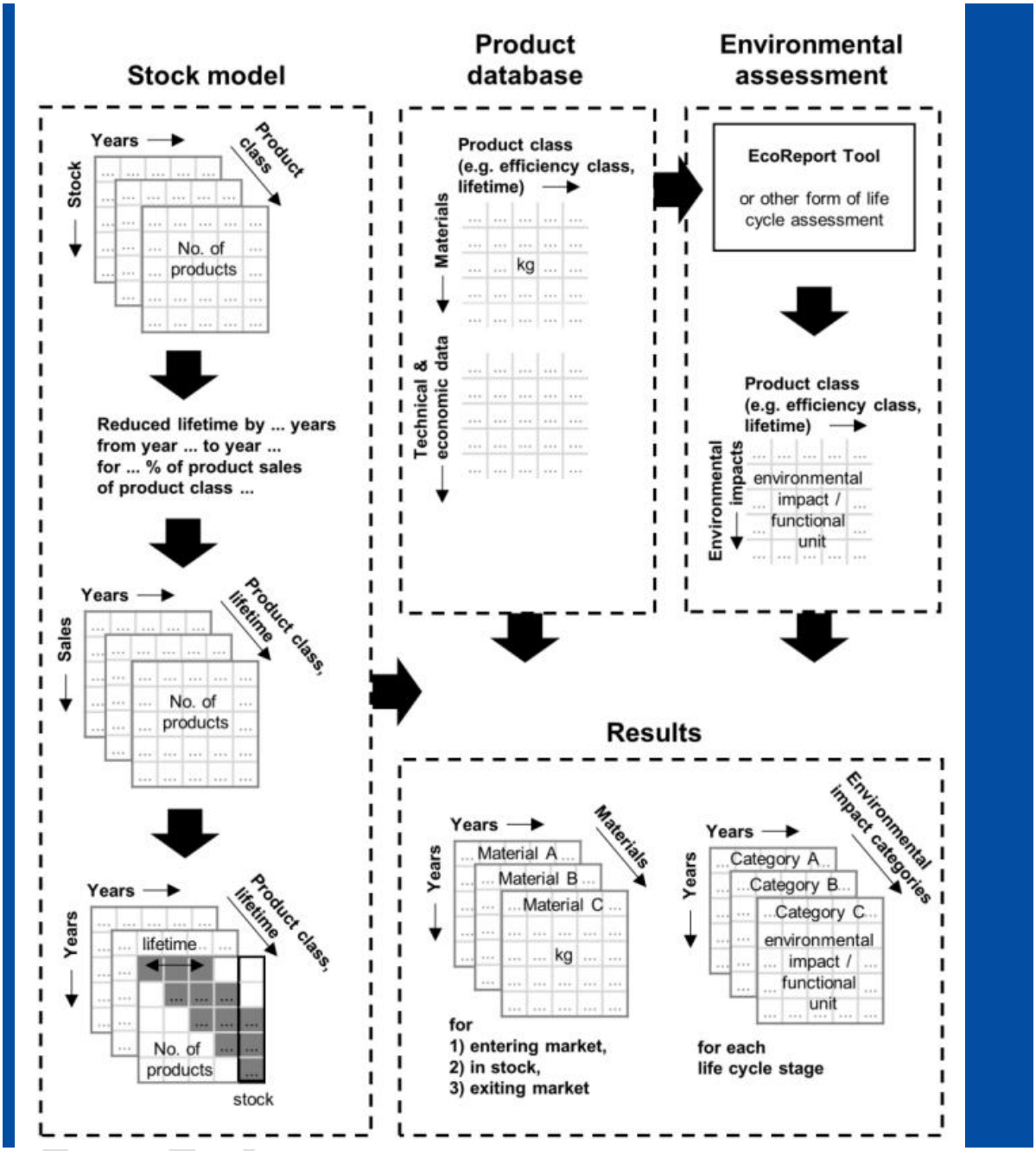

6796 **Figure 7-3 Schematic representation of the scenario analysis model.**

6797 source: Fraunhofer ISI

6798 ## 7.3.3. Results: Sales and stock

6799 Based on the described sales data the stocks for the BAU can be calculated and are shown
6800 in **Figure 7-4**. In 2025, sales for the four dryer base cases (D1-D4) accumulate to 873,845
6801 units while for the five base cases representing washing machines the number is 637,857. As
6802 can be seen from the graph, base case D2 (Professional tumble dryer) and WM2 (Professional
6803 washer extractor) are the ones with the highest number of sales. They are followed by WM1
6804 (Semi-professional washer extractor), D1 (Semi professional tumble dryer), and D3
6805 (Professional cabinet dryer). Very low sales numbers are calculated for WM4 (Professional

barrier washer), D4 (Industrial pass-through tumble dryer), WM3 (Professional washer dryer) and WM5 (Industrial continuous tunnel washer).

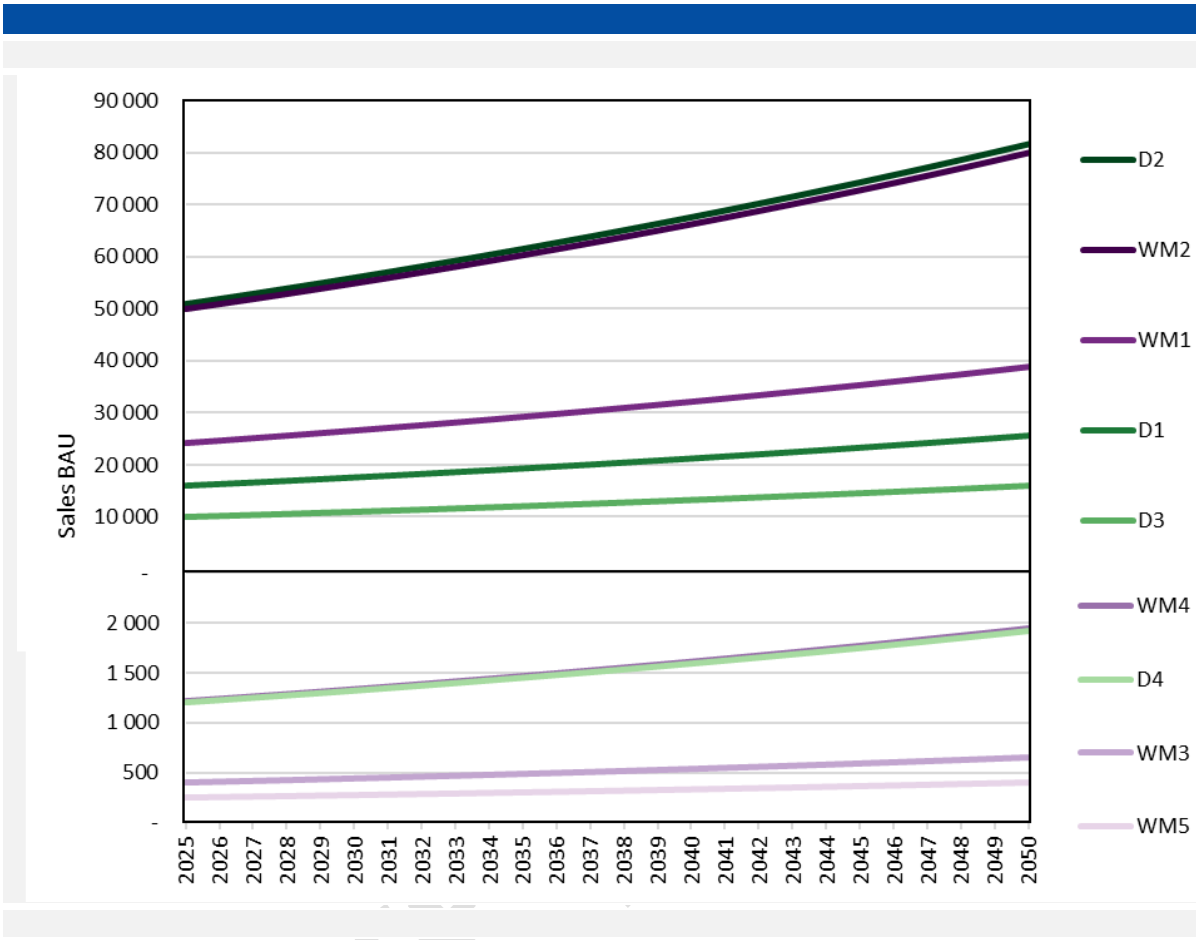

Figure 7-4 Sales in the BAU scenario for all base cases (sorted according to sales numbers).

The stock is shown in **Figure 7-5**. It raises from a total of 1,511,706 in 2025 (637,857 washing machines, 873,849 dryers) to 2,599,462 in 2050 (1,113,578 washing machines, 1,485,885 dryers).

Corresponding to the sales figures, also stock is dominated by the base cases D2 and WM2. The total stock in 2050 is made up to 69 % from base case D2 und WM2 (D2: 1,067,835, corresponding to 72 % of dryer market; WM2: 730,210, corresponding to 66 % of washing machine market).

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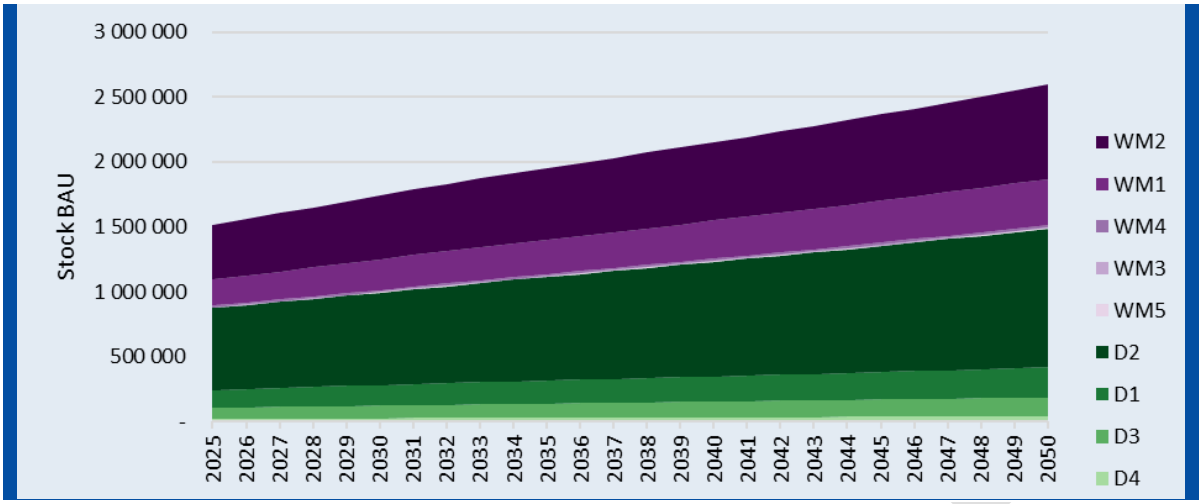

Figure 7-5 Calculated stock in the BAU scenario based on sales data assumptions and lifetimes.

The change in the stock due to the introduction of BAT products is exemplary shown in **Figure 7-6** for base case 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 five years (15 to 20 years), resulting in a five-year period (2043-2047) 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.

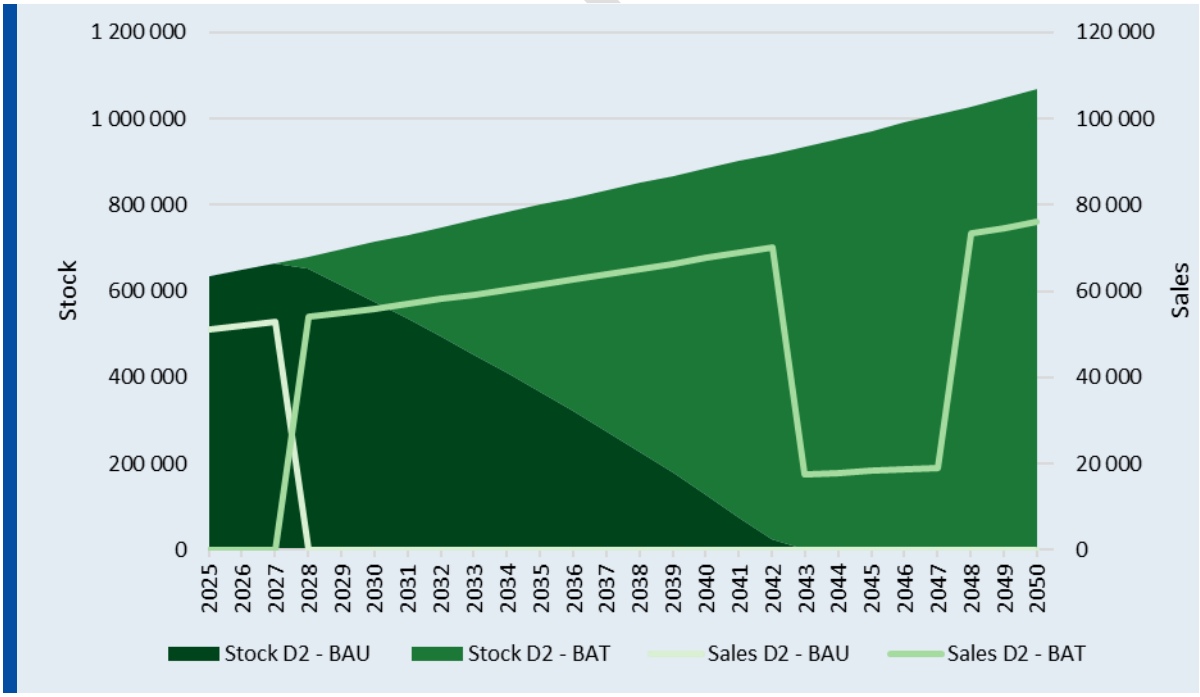

Figure 7-6 Changes in the stock of the BAT scenario for base case D2 due to BAU and BAT product sales.

7.3.4. Results: Environmental Impacts

Electricity consumption

The impacts of the BAT scenario on the use-phase electricity consumption are shown in **Figure 7-7**, accumulated for all base cases. *all in GWh* provides a deeper insight into the individual base cases and includes both use-phase electricity as well as use-phase gas consumption for selected years.

For the period from 2025 to 2050 and all base cases accumulated, the relative savings of electricity are 4.75 % and those for gas 6.62 %. These relative savings equal effective savings of 54.80 TWh for electricity, and 81.33 TWh for gas, representing significant saving opportunities.

Zooming in on the year 2050 alone, use-phase electricity savings accumulate to 3.93 TWh, representing a reduction of 6.99 % compared to the BAU scenario for the same year. Similarly, for gas, 2050 savings are at 6.79 TWh, representing a reduction of 11.19 % compared to the BAU scenario.

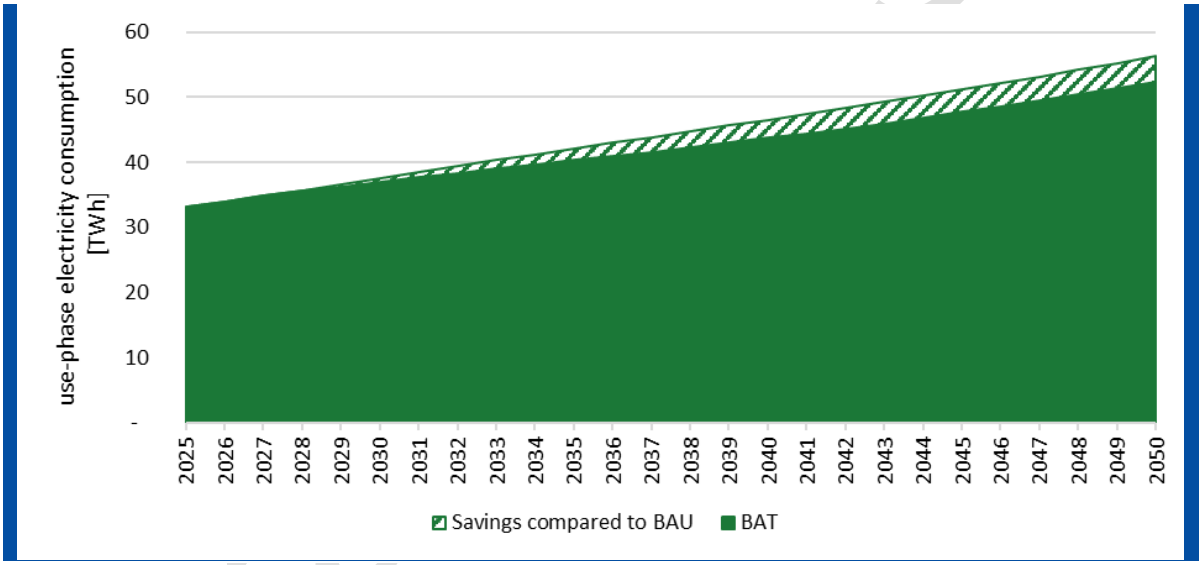

Figure 7-7 Electricity consumption of the BAT scenario and savings compared to the BAU scenario.

Table 7-19 Use-phase 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%)	222 (-6%)	108 (-6%)	222 (-6%)	108 (-6%)	223 (-15%)	108 (-15%)	232 (-20%)	113 (-20%)	280 (-20%)	136 (-20%)
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%)	6,316 (-3%)	4,276 (-3%)	6,316 (-3%)	4,276 (-3%)	6,725 (-8%)	4,554 (-8%)	7,205 (-10%)	4,880 (-10%)	8,697 (-10%)	5,890 (-10%)
WM 3	BAU	126	-	137	-	137	-	149	-	164	-	198	-
	BAT	126 (-0%)	-	129 (-5%)	-	129 (-5%)	-	126 (-15%)	-	131 (-20%)	-	158 (-20%)	-
WM 4	BAU	24	129	28	151	28	151	32	170	35	186	42	225
	BAT	24 (-0%)	129 (-0%)	27 (-3%)	147 (-3%)	27 (-3%)	147 (-3%)	29 (-8%)	156 (-8%)	31 (-10%)	168 (-10%)	38 (-10%)	202 (-10%)
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	-	255	-	255	-	286	-	314	-	379	-
	BAT	217 (-0%)	-	241 (-6%)	-	241 (-6%)	-	242 (-15%)	-	251 (-20%)	-	303 (-20%)	-
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%)	26,532 (-1%)	12,533 (-1%)	26,532 (-1%)	12,533 (-1%)	29,219 (-3%)	13,803 (-3%)	31,787 (-4%)	15,016 (-4%)	38,079 (-5%)	17,988 (-5%)
D3	BAU	1,054	-	1,237	-	1,237	-	1,388	-	1,525	-	1,840	-
	BAT	1,054 (-0%)	-	1,203 (-3%)	-	1,203 (-3%)	-	1,281 (-8%)	-	1,372 (-10%)	-	1,656 (-10%)	-
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%)	2,116 (-2%)	18,020 (-2%)	2,116 (-2%)	18,020 (-2%)	2,283 (-7%)	19,444 (-7%)	2,481 (-10%)	21,133 (-10%)	2,871 (-17%)	24,449 (-17%)

Connected to the energy savings are reductions of greenhouse gases, shown in **Figure 7-8** for all base cases from 2025 to 2050 for use-phase electricity. The carbon intensity 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 9.51 Mt $CO2_{eq.}$, representing savings of 3.72 % compared to the BAU scenario in the period 2025 to 2050. In the year 2050 alone, savings of the BAT scenario accumulate to 0.52 Mt $CO2_{eq.}$ compared to the BAU scenario.

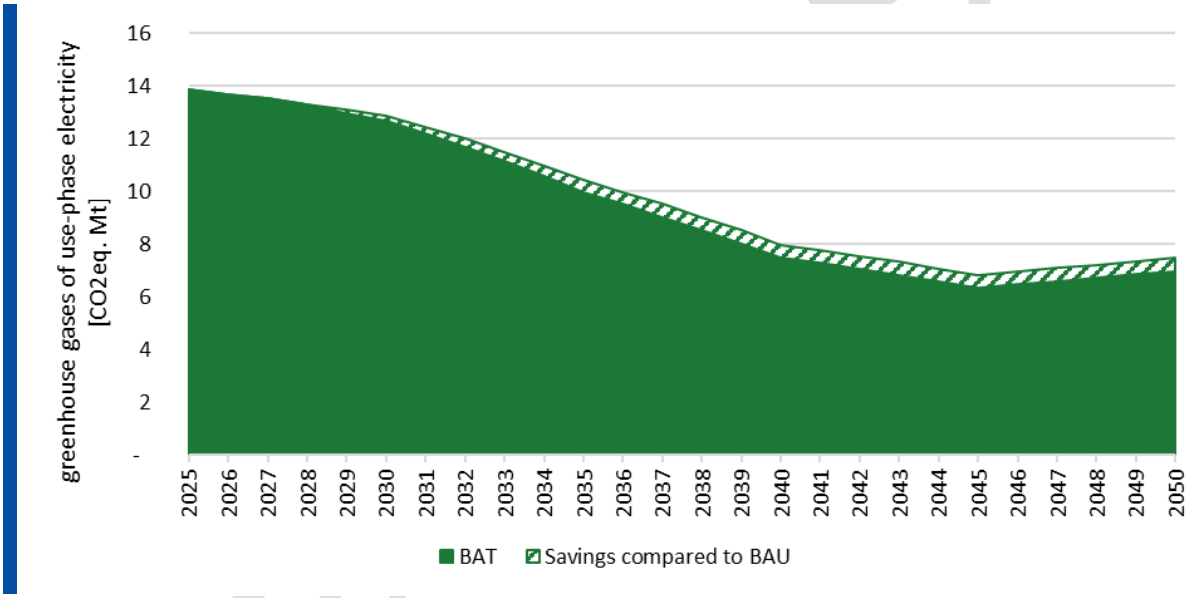

Figure 7-8 Greenhouse gases associated to use-phase electricity consumption of the BAT scenario and savings compared to the BAU scenario.

Table 7-20 lists the numerical values for selected years for the greenhouse gas emissions associated with the use-phase electricity and gas consumption. As can be seen from the data, also the savings due to the reduction in gas consumption lead to significant savings. In 2050, the reduced gas consumption in the BAT scenario saves 0.56 Mt $CO2_{eq.}$ compared to the BAU scenario. The savings are mainly attributed to the very high gas consumption and also high savings of base case D4 (Industrial pass-through tumble dryer).

Table 7-20 Greenhouse gases associated to use-phase 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 kt $CO2_{eq.}$		2025		2030		2035		2040		2045		2050	
		electricity	gas	electricity	gas	electricity	gas	electricity	gas	electricity	gas	electricity	gas
WM 1	BAU	84	8	81	9	58	9	45	9	39	12	47	14
	BAT	84 (-0 %)	8 (-0 %)	76 (-6 %)	9 (-6 %)	55 (-6 %)	9 (-6 %)	38 (-15 %)	9 (-6 %)	31 (-20 %)	9 (-20 %)	37 (-20 %)	11 (-20 %)
WM 2	BAU	2,318	310	2,227	364	1,608	364	1,249	364	1,067	449	1,288	542
	BAT	2,318 (-0 %)	310 (-0 %)	2,165 (-3 %)	354 (-3 %)	1,563 (-3 %)	354 (-3 %)	1,152 (-8 %)	354 (-3 %)	960 (-10 %)	404 (-10 %)	1,159 (-10 %)	488 (-10 %)
WM 3	BAU	53	-	47	-	34	-	26	-	22	-	26	-
	BAT	53 (-0 %)	-	44 (-5 %)	-	32 (-5 %)	-	22 (-15 %)	-	17 (-20 %)	-	21 (-20 %)	-
WM 4	BAU	10	11	10	13	7	13	5	13	5	15	6	19
	BAT	10 (-0 %)	11 (-0 %)	9 (-3 %)	12 (-3 %)	7 (-3 %)	12 (-3 %)	5 (-8 %)	12 (-3 %)	4 (-10 %)	14 (-10 %)	5 (-10 %)	17 (-10 %)
WM 5	BAU	65	257	62	301	45	301	36	301	31	380	37	459
	BAT	65 (-0 %)	257 (-0 %)	62 (-1 %)	298 (-1 %)	44 (-1 %)	298 (-1 %)	34 (-3 %)	298 (-1 %)	29 (-5 %)	362 (-5 %)	35 (-5 %)	436 (-5 %)
D1	BAU	91	-	87	-	63	-	49	-	42	-	51	-
	BAT	91 (-0 %)	-	82 (-6 %)	-	60 (-6 %)	-	41 (-15 %)	-	34 (-20 %)	-	40 (-20 %)	-
D2	BAU	9,985	932	9,183	1,048	6,632	1,048	5,147	1,048	4,426	1,299	5,342	1,568
	BAT	9,985 (-0 %)	932 (-0 %)	9,093 (-1 %)	1,038 (-1 %)	6,567 (-1 %)	1,038 (-1 %)	5,007 (-3 %)	1,038 (-1 %)	4,237 (-4 %)	1,243 (-4 %)	5,075 (-5 %)	1,489 (-5 %)
D3	BAU	441	-	424	-	306	-	238	-	203	-	245	-
	BAT	441 (-0 %)	-	412 (-3 %)	-	298 (-3 %)	-	219 (-8 %)	-	183 (-10 %)	-	221 (-10 %)	-
D4	BAU	807	1,359	743	1,529	537	1,529	419	1,529	369	1,953	459	2,427
	BAT	807 (-0 %)	1,359 (-0 %)	725 (-2 %)	1,492 (-2 %)	524 (-2 %)	1,492 (-2 %)	391 (-7 %)	1,492 (-2 %)	331 (-10 %)	1,750 (-10 %)	383 (-17 %)	2,024 (-17 %)

Water and detergent consumption

Figure 7-9 shows the water, and **Figure 7-10** 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 1,074 million m³, equaling savings of 7.18 % compared to the BAU scenario. In 2050 alone, savings reach 70 million m³ (equaling savings of 9.56 % compared with the BAU scenario).

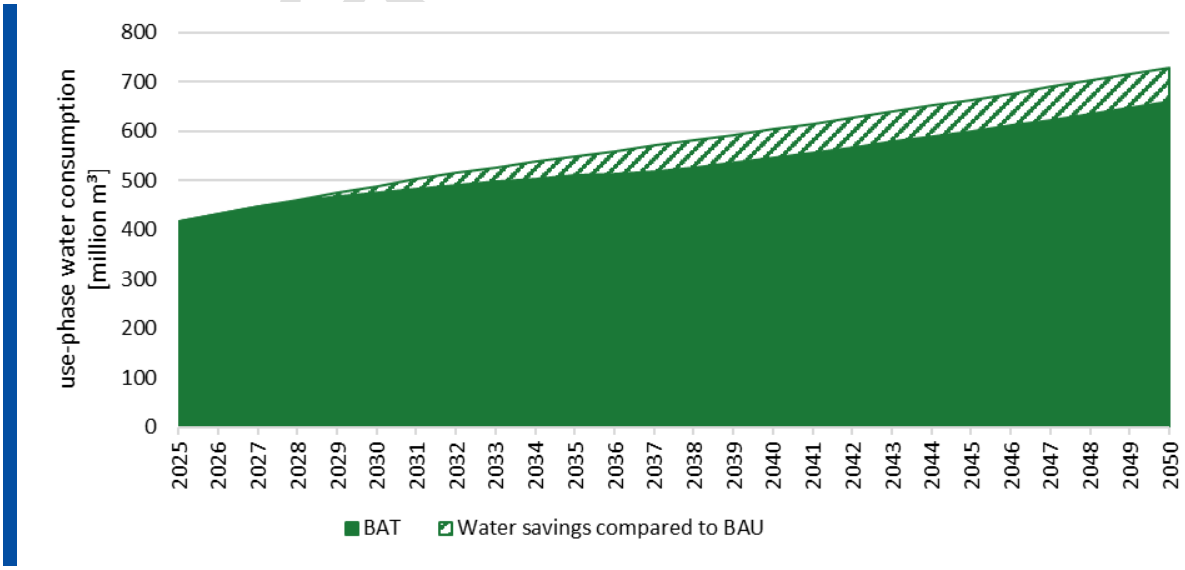

Figure 7-9 Use-phase water consumption of the BAT scenario and savings compared to the BAU scenario.

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For detergent consumption (**Figure 7-10**), savings in the period 2025 to 2050 accumulate to 16,001 kt, equaling 13.78 % compared with 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 166 kt (equaling savings of 18.38 % compared with the BAU scenario).

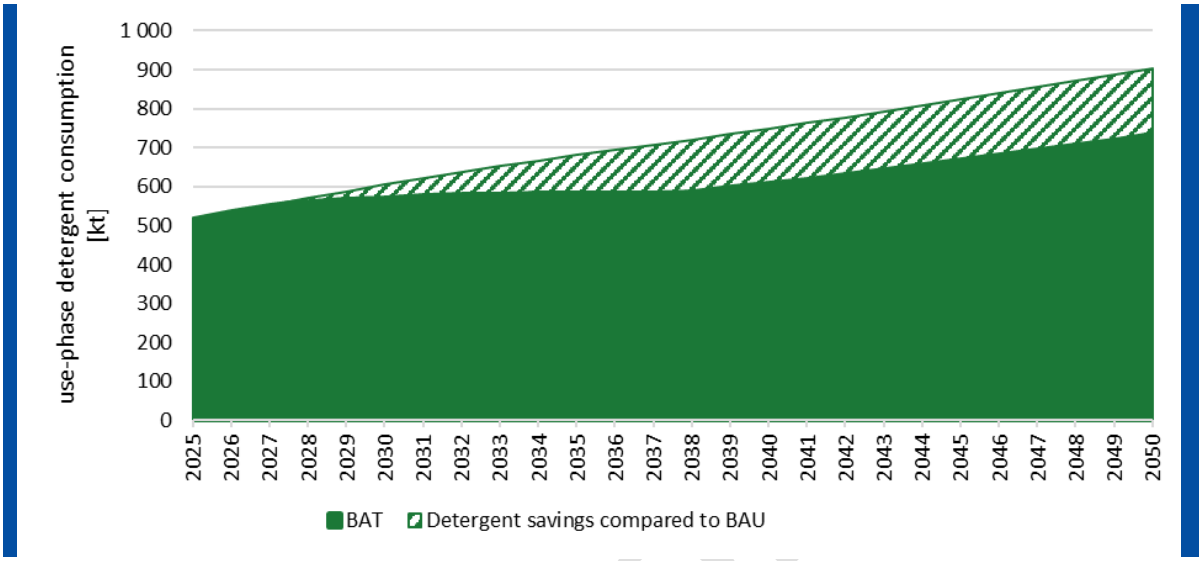

Figure 7-10 Use-phase detergent consumption of the BAT scenario and savings compared to the BAU scenario.

Table 7-21 lists the numerical values for selected years for the use-phase water and detergent consumption.

Table 7-21 Use-phase water and detergent consumption of the BAU and the BAT scenario.

water in million m³ 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 %)	19 (-4 %)	22 (-6 %)	20 (-12 %)	22 (-15 %)	21 (-15 %)	23 (-20 %)	23 (-15 %)	26 (-20 %)	25 (-15 %)	28 (-20 %)
WM 2	BAU	327	400	384	470	431	527	474	579	520	636	572	699
	BAT	327 (-0 %)	400 (-0 %)	374 (-3 %)	444 (-6 %)	398 (-8 %)	446 (-15 %)	426 (-10 %)	463 (-20 %)	468 (-10 %)	509 (-20 %)	515 (-10 %)	559 (-20 %)
WM 3	BAU	2	2	2	2	2	3	3	3	3	3	3	4
	BAT	2 (-0 %)	2 (-0 %)	2 (-5 %)	2 (-5 %)	2 (-15 %)	2 (-15 %)	2 (-20 %)	2 (-20 %)	2 (-20 %)	3 (-20 %)	3 (-20 %)	3 (-20 %)
WM 4	BAU	13	11	15	13	17	14	19	16	21	17	23	19
	BAT	13 (-0 %)	11 (-0 %)	15 (-3 %)	12 (-6 %)	16 (-8 %)	12 (-15 %)	17 (-10 %)	12 (-20 %)	19 (-10 %)	14 (-20 %)	20 (-10 %)	15 (-20 %)
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 %)

7.3.5. 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 7.3.1**).

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Figure 7-11 shows the costs of the electricity consumption. As could be expected, with the growth of the stock 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-phase electricity sum up to 17.98 billion Euro for the period 2025 to 2050, representing a reduction by 5.05 %.

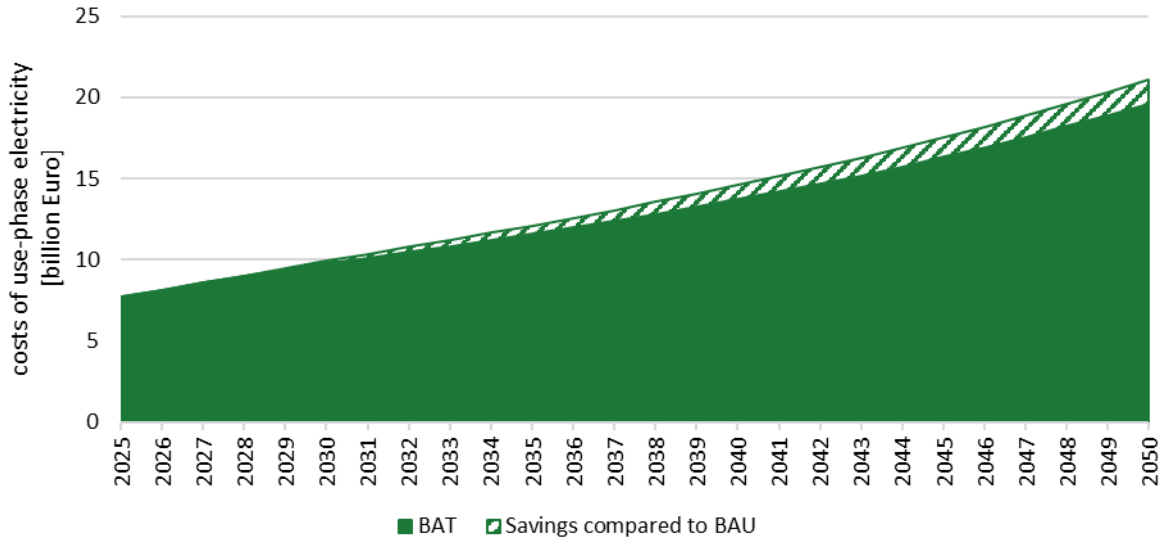

Figure 7-11 costs of use-phase electricity consumption of the BAT scenario and savings compared to the BAU scenario.

Table 7-22 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-phase 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 reduction of lifetime in combination with the modelling logic. For base case 1, for example, the lifetime is extended from 10 to 15 years. Therefore, the sales from year 2038 to 2042 are significant reduced, leading to the saving figures in 2040. While the product prices are still higher than the BAU products, the reduction 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 3.88 billion Euro. The highest contribution comes from the savings associated to reduction of electricity consumption with 1.47 billion Euro, followed by the reduction of the consumption of natural gas (0.96 billion Euro) and detergents (0.92 billion Euro).

What has already been indicated on individual product level in the previous tasks is that additional costs for the purchase of more expensive products is quickly offset to use-phase savings. Already in 2030, total cost calculations results in overall savings for the users (277 million Euro) – in the years after this savings are increasing significantly.

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6921 **Table 7-22 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%)	59 (-6%)	10 (-6%)	37 (-4%)	97 (-6%)	269 (-3%)	78 (+5%)	2 (+5%)	64 (-6%)	11 (-6%)	38 (-12%)	104 (-15%)	297 (-8%)	16 (-82%)	0 (-82%)	70 (-15%)	12 (-15%)	41 (-15%)	114 (-20%)	254 (-33%)	106 (-3%)	3 (-3%)	79 (-20%)	14 (-20%)	45 (-15%)	133 (-20%)	382 (-15%)	129 (-3%)	4 (-3%)	105 (-20%)	19 (-20%)	50 (-15%)	156 (-20%)	463 (-15%)
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%)	599 (+6%)	26 (+58%)	1,672 (-3%)	394 (-3%)	719 (-3%)	1,931 (-6%)	5,342 (-3%)	727 (+6%)	31 (+58%)	1,814 (-3%)	438 (-3%)	772 (-8%)	2,061 (-15%)	5,843 (-7%)	151 (-82%)	7 (-73%)	2,110 (-8%)	519 (-8%)	834 (-10%)	2,274 (-20%)	5,895 (-21%)	990 (-2%)	43 (+47%)	2,465 (-10%)	618 (-10%)	924 (-10%)	2,654 (-20%)	7,693 (-13%)	1,201 (-2%)	52 (+47%)	3,260 (-10%)	830 (-10%)	1,023 (-10%)	3,096 (-20%)	9,462 (-13%)
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 (+4%)	0 (+4%)	34 (-5%)	0 (+0%)	4 (-5%)	10 (-5%)	55 (-4%)	8 (+4%)	0 (+4%)	37 (-5%)	0 (+0%)	4 (-15%)	10 (-15%)	60 (-7%)	2 (-82%)	0 (-82%)	40 (-15%)	0 (+0%)	4 (-20%)	11 (-20%)	57 (-25%)	11 (-4%)	0 (-4%)	45 (-20%)	0 (+0%)	5 (-20%)	13 (-20%)	75 (-18%)	14 (-4%)	0 (-4%)	59 (-20%)	0 (+0%)	5 (-20%)	16 (-20%)	94 (-18%)
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%)	55 (+3%)	13 (+3%)	7 (-3%)	14 (-3%)	29 (-3%)	52 (-6%)	170 (-1%)	67 (+3%)	16 (+3%)	8 (-3%)	15 (-3%)	31 (-8%)	55 (-15%)	192 (-5%)	14 (-82%)	3 (-82%)	9 (-8%)	18 (-8%)	33 (-10%)	61 (-20%)	138 (-42%)	91 (-5%)	22 (-5%)	11 (-10%)	21 (-10%)	37 (-10%)	71 (-20%)	253 (-11%)	111 (-5%)	27 (-5%)	14 (-10%)	29 (-10%)	41 (-10%)	83 (-20%)	303 (-11%)
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%)	96 (-77%)	22 (-77%)	99 (-5%)	742 (-5%)	192 (-5%)	737 (-10%)	1,887 (-22%)
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%)	33 (+3%)	1 (+3%)	64 (-6%)	0 (+0%)	0 (+0%)	0 (+0%)	98 (-3%)	40 (+3%)	1 (+3%)	69 (-6%)	0 (+0%)	0 (+0%)	0 (+0%)	111 (-2%)	8 (-82%)	0 (-82%)	76 (-15%)	0 (+0%)	0 (+0%)	0 (+0%)	85 (-39%)	55 (-5%)	2 (-5%)	86 (-20%)	0 (+0%)	0 (+0%)	0 (+0%)	143 (-14%)	67 (-5%)	2 (-5%)	114 (-20%)	0 (+0%)	0 (+0%)	0 (+0%)	182 (-15%)
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%)	418 (+8%)	12 (+8%)	7,024 (-1%)	1,154 (-1%)	0 (+0%)	0 (+0%)	8,608 (-1%)	507 (+8%)	15 (+8%)	7,621 (-1%)	1,284 (-1%)	0 (+0%)	0 (+0%)	9,427 (-1%)	615 (+8%)	18 (+8%)	9,169 (-3%)	1,572 (-3%)	0 (+0%)	0 (+0%)	11,374 (-2%)	184 (-73%)	5 (-73%)	10,875 (-4%)	1,903 (-4%)	0 (+0%)	0 (+0%)	12,967 (-8%)	844 (+1%)	24 (+1%)	14,273 (-5%)	2,535 (-5%)	0 (+0%)	0 (+0%)	17,676 (-5%)
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%)	8 (-79%)	0 (-79%)	402 (-8%)	0 (+0%)	0 (+0%)	0 (+0%)	410 (-13%)	52 (+16%)	2 (+16%)	469 (-10%)	0 (+0%)	0 (+0%)	0 (+0%)	523 (-8%)	63 (+16%)	2 (+16%)	621 (-10%)	0 (+0%)	0 (+0%)	0 (+0%)	686 (-8%)
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%)	560 (-2%)	1,659 (-2%)	0 (+0%)	0 (+0%)	2,321 (-2%)	106 (+10%)	17 (+10%)	608 (-2%)	1,846 (-2%)	0 (+0%)	0 (+0%)	2,577 (-2%)	128 (+10%)	21 (+10%)	716 (-7%)	2,215 (-7%)	0 (+0%)	0 (+0%)	3,081 (-6%)	156 (+10%)	26 (+10%)	849 (-10%)	2,678 (-10%)	0 (+0%)	0 (+0%)	3,708 (-10%)	189 (+10%)	31 (+10%)	1,076 (-17%)	3,446 (-17%)	0 (+0%)	0 (+0%)	4,742 (-16%)
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%)	1,491 (+6%)	114 (+13%)	9,786 (-2%)	3,562 (-2%)	916 (-3%)	2,504 (-5%)	18,373 (-1%)	1,809 (+6%)	139 (+13%)	10,618 (-2%)	3,962 (-2%)	989 (-7%)	2,712 (-14%)	20,227 (-3%)	1,230 (-41%)	116 (-23%)	12,655 (-4%)	4,795 (-5%)	1,069 (-10%)	3,007 (-18%)	22,872 (-10%)	1,724 (-31%)	120 (-34%)	14,954 (-6%)	5,789 (-8%)	1,184 (-10%)	3,503 (-18%)	27,275 (-11%)	2,713 (-11%)	164 (-25%)	19,621 (-7%)	7,600 (-11%)	1,311 (-10%)	4,088 (-18%)	35,496 (-10%)

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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 professional laundry appliances. This limited information is insufficient to make sector-wide conclusions (see Task 2).

7.3.6. 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 7.3.1**) 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 7-23**). Values for the increase and decrease are linearly introduced from the original value in 2025 to 2030 and are then kept constant.

Table 7-23 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 7-12**, 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 15.70 billion Euro in the low-price scenario to 23.54 billion Euro in the high price scenario.

Even in the low-price scenario, electricity costs remain the most important cost factor. In 2050, 15.70 billion Euro for electricity stand against 3.04 billion Euro in purchase costs, 8.56 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 275.66 billion Euro for the low-price scenario to 401.54 billion Euro for the high-price scenario.

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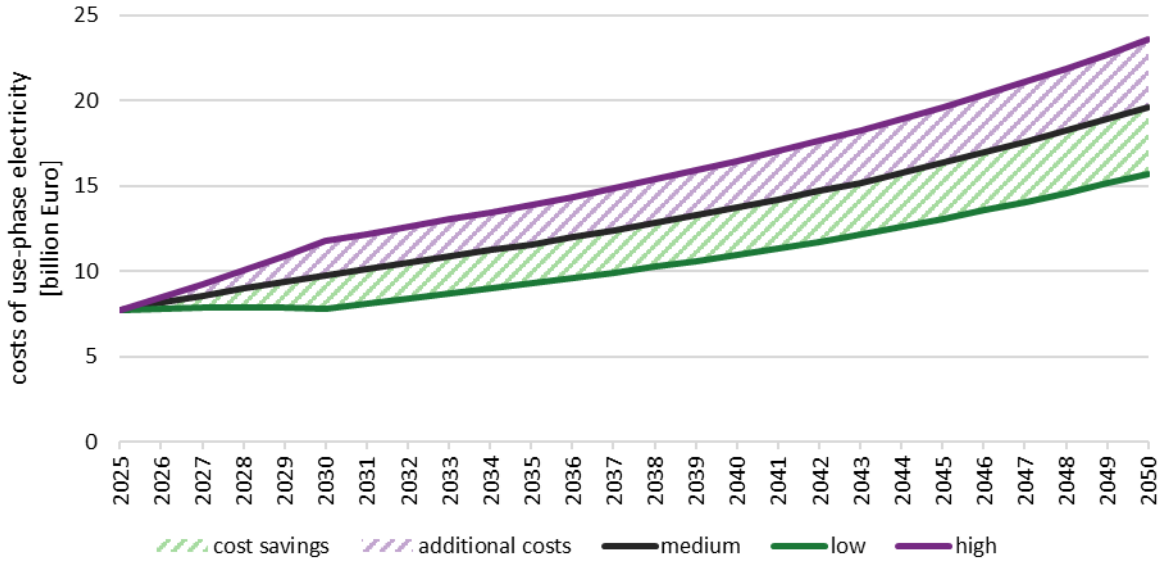

Figure 7-12 sensitivity of use-phase electricity consumption of the BAT scenario.

7.3.7. Overview of results

Table 7-24, Table 7-25 and **Table 7-26** presents an overview of the results for the years 2025, 2035 and 2050. It includes 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 of 4.75 % in electricity and 6.62 % in gas consumption from 2025 to 2050, equating to 54.80 TWh and 81.33 TWh, respectively (see **Section 7.3.4**). In 2050, savings are 3.93 TWh for electricity and 6.79 TWh for gas.

Greenhouse gas emissions are reduced by 9.51 Mt CO2eq. from 2025 to 2050, a 3.72 % decrease compared to the BAU scenario. In 2050, greenhouse gas emissions are reduced by 0.52 Mt CO2eq. for electricity and 0.56 Mt CO2eq. for gas.

Resource consumption sees water savings of 1,074 million m³ (7.18 % reduction) and detergent savings of 16,001 kt (13.78 % reduction) from 2025 to 2050. In 2050, water savings accumulate to 70 million m³ (9.56 % reduction) and detergent savings reach 166 kt (18.38% reduction).

Based on the stated assumptions, the BAT scenario leads to total savings of 17.98 billion Euro in electricity costs from 2025 to 2050, with overall savings of 3.88 billion Euro in 2050 compared to BAU. Sensitivity analysis shows that electricity price fluctuations significantly impact total costs, with expenses ranging from 15.70 billion Euro in a low-price scenario to 23.54 billion Euro in a high-price scenario in 2050. Overall, transitioning to BAT products supports both environmental sustainability and economic benefits.

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6977 **Table 7-24 Overview of results for 2025.**

		2025											
		energy consumption (TWh)		Emissions (Mt 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	8	17	20	51	1	47	8	32	82
	BAT	200 (+0 %)	97 (+0 %)	84 (+0 %)	8 (+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	310	327	400	468	14	1,295	310	625	1,640
	BAT	5,5 34 (+0%)	3,747 (+0 %)	2,318 (+0 %)	310 (+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	0	4	9
	BAT	126 (+0 %)	-	53 (+0 %)	-	2 (+0 %)	2 (+0 %)	5 (+0 %)	0 (+0 %)	30 (+0 %)	0 (+0 %)	4 (+0 %)	9 (+0 %)
WM4	BAU	24	129	10	11	13	11	44	11	6	11	25	44
	BAT	24 (-0 %)	129 (-0%)	10 (-0 %)	11 (-0 %)	13 (-0 %)	11 (-0 %)	44 (-0 %)	11 (-0 %)	6 (-0 %)	11 (-0 %)	25 (-0 %)	44 (-0 %)
WM5	BAU	155	3,109	65	257	57	83	159	37	36	257	109	341
	BAT	155 (-0 %)	3,109 (-0 %)	65 (-0 %)	257 (-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	932	-	-	318	9	5,578	932	-	-
	BAT	23,836 (+0 %)	11,259 (+0 %)	9,985 (+0 %)	932 (+0 %)	-	-	318 (+0 %)	9 (+ 0%)	5,578 (+0 %)	932 (+0 %)	-	-
D3	BAU	1,054	-	441	-	-	-	21	1	247	-	-	-
	BAT	1,0 54 (-0%)	-	441 (-0 %)	-	-	-	21 (-0 %)	1 (-0 %)	247 (-0 %)	-	-	-
D4	BAU	1,927	16,414	807	1,359	-	-	65	11	451	1,359	-	-
	BAT	1,927 (+0 %)	16,414 (+0 %)	807 (+0%)	1,359 (+0 %)	-	-	65 (+0 %)	11 (+0 %)	451 (+0 %)	1,359 (+0 %)	-	-
total	BAU	33,074	34,755	13,854	2,878	416	516	1,159	84	7,739	2,878	795	2,117
	BAT	33,074 (+0 %)	34,755 (+ 0%)	13,854 (+0 %)	2,878 (+ 0%)	416 (+ 0%)	516 (+0 %)	1,159 (+0 %)	84 (+0 %)	7,739 (+0 %)	2,878 (+0 %)	795 (+0 %)	2,117 (+0 %)

6978 **Table 7-25 Overview of results for 2035.**

		2035											
		energy consumption (TWh)		Emissions (Mt 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	58	9	22	26	74	2	68	12	43	122
	BAT	222 (-6 %)	108 (-6 %)	55 (-6 %)	9 (-6 %)	20 (-12 %)	22 (-15 %)	78 (+5 %)	2 (+5%)	64 (-6 %)	11 (-6 %)	38 (-12 %)	104 (-15 %)
WM2	BAU	6,497	4,399	1,608	364	431	527	689	20	1,866	451	837	2,436
	BAT	6,316 (-3 %)	4,276 (-3 %)	1,563 (-3 %)	354 (-3 %)	398 (-8 %)	446 (-15 %)	727 (+6 %)	31 (+58%)	1,814 (-3 %)	438 (-3 %)	772 (-8 %)	2,061 (-15 %)
WM3	BAU	137	-	34	-	2	3	8	0	39	0	5	12
	BAT	129 (-5 %)	-	32 (-5 %)	-	2 (-15 %)	2 (-15 %)	8 (+4 %)	0 (+4%)	37 (-5 %)	0 (+0 %)	4 (-15 %)	10 (-15 %)
WM4	BAU	28	151	7	13	17	14	65	16	8	15	33	65
	BAT	2 7 (-3%)	147 (-3 %)	7 (-3 %)	12 (-3 %)	16 (-8 %)	12 (-15 %)	67 (+3 %)	16 (+3%)	8 (-3 %)	15 (-3 %)	31 (-8 %)	55 (-15 %)
WM5	BAU	182	3,633	45	301	76	111	235	54	52	372	148	512
	BAT	180 (-1 %)	3,594 (-1 %)	44 (-1 %)	298 (-1 %)	74 (-3 %)	104 (-6 %)	237 (+1%)	54 (+1 %)	52 (-1 %)	368 (-1 %)	143 (-3 %)	482 (-6 %)
D1	BAU	255	-	63	-	-	-	39	1	73	-	-	-
	BAT	241 (-6 %)	-	60 (-6 %)	-	-	-	40 (+3%)	1 (+3 %)	69 (-6 %)	-	-	-
D2	BAU	26,793	12,656	6,632	1,048	-	-	468	14	7,696	1,296	-	-
	BAT	26,532 (-1 %)	12,533 (-1 %)	6,5 67 (-1%)	1,038 (-1 %)	-	-	507 (+8%)	15 (+8 %)	7,621 (-1 %)	1,284 (-1 %)	-	-
D3	BAU	1,237	-	306	-	-	-	31	1	355	-	-	-
	BAT	1,203 (-3 %)	-	298 (-3 %)	-	-	-	38 (+25%)	1 (+25 %)	345 (-3 %)	-	-	-
D4	BAU	2,169	18,471	537	1,529	-	-	96	16	623	1,892	-	-
	BAT	2,116 (-2 %)	18,020 (-2 %)	524 (-2 %)	1,492 (-2 %)	-	-	106 (+10%)	17 (+10 %)	608 (-2 %)	1,846 (-2 %)	-	-
total	BAU	37,533	39,424	9,290	3,264	549	681	1,705	123	10,781	4,038	1,066	3,149
	BAT	36,965 (- 2%)	38,678 (- 2%)	9,150 (-2 %)	3,203 (-2 %)	509 (-7 %)	586 (-14 %)	1,809 (+6%)	139 (+13 %)	10,618 (-2 %)	3,962 (-2 %)	989 (-7 %)	2,712 (-14 %)

Table 7-26 Overview of results for 2050.

		2050											
		energy consumption (TWh)		Emissions (Mt 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	47	14	30	35	133	4	131	24	59	195
	BAT	280 (-20 %)	136 (-20 %)	37 (-20 %)	11 (-20 %)	25 (-15 %)	28 (-20 %)	129 (-3 %)	4 (-3 %)	105 (-20 %)	19 (-20 %)	50 (-15 %)	156 (-20 %)
WM2	BAU	9,666	6,544	1,288	542	572	699	1,229	35	3,623	922	1,137	3,870
	BAT	8,697 (-10 %)	5,890 (-10 %)	1,159 (-10 %)	488 (-10 %)	515 (-10 %)	559 (-20 %)	1,201 (-2 %)	52 (+47 %)	3,260 (-10 %)	830 (-10 %)	1,023 (-10 %)	3,096 (-20 %)
WM3	BAU	198	-	26	-	3	4	14	0	74	0	6	19
	BAT	158 (-20 %)	-	21 (-20 %)	-	3 (-20 %)	3 (-20 %)	14 (-4 %)	0 (-4 %)	59 (-20 %)	0 (+0 %)	5 (-20 %)	16 (-20 %)
WM4	BAU	42	225	6	19	23	19	116	28	16	32	45	104
	BAT	38 (-10 %)	202 (-10 %)	5 (-10 %)	17 (-10 %)	20 (-10 %)	15 (-20 %)	111 (-5 %)	27 (-5 %)	14 (-10 %)	29 (-10 %)	41 (-10 %)	83 (-20 %)
WM5	BAU	277	5,539	37	459	102	148	419	96	104	781	202	820
	BAT	263 (-5 %)	5,262 (-5 %)	35 (-5 %)	436 (-5 %)	97 (-5 %)	133 (-10 %)	96 (-77 %)	22 (-77 %)	99 (-5 %)	742 (-5 %)	192 (-5 %)	737 (-10 %)
D1	BAU	379	-	51	-	-	-	70	2	142	-	-	-
	BAT	303 (-20 %)	-	40 (-20 %)	-	-	-	67 (-5 %)	2 (-5 %)	114 (-20 %)	-	-	-
D2	BAU	40,084	18,934	5,342	1,568	-	-	836	24	15,024	2,668	-	-
	BAT	38,079 (-5 %)	17,988 (-5 %)	5,075 (-5 %)	1,489 (-5 %)	-	-	844 (+1 %)	24 (+1 %)	14,273 (-5 %)	2,535 (-5 %)	-	-
D3	BAU	1,840	-	245	-	-	-	55	2	690	-	-	-
	BAT	1,656 (-10 %)	-	221 (-10 %)	-	-	-	63 (+16 %)	2 (+16 %)	621 (-10 %)	-	-	-
D4	BAU	3,441	29,309	459	2,427	-	-	172	28	1,290	4,130	-	-
	BAT	2,871 (-17 %)	24,449 (-17 %)	383 (-17 %)	2,024 (-17 %)	-	-	189 (+10 %)	31 (+10 %)	1,076 (-17 %)	3,446 (-17 %)	-	-
total	BAU	56,277	60,721	7,501	5,028	729	904	3,043	220	21,094	8,557	1,449	5,008
	BAT	52,346 (-7 %)	53,928 (-11 %)	6,977 (-7 %)	4,465 (-11 %)	659 (-10 %)	738 (-18 %)	2,713 (-11 %)	164 (-25 %)	19,621 (-7 %)	7,600 (-11 %)	1,311 (-10 %)	4,088 (-18 %)

7.4. Conclusions

In the BAU scenario for 2025, the total sales of dryers (D1-D4) reach 873,845 units, while washing machines (WM1-WM5) total 637,857 units. The Professional tumble dryer (D2) and Professional washer extractor (WM2) lead in sales, with significantly lower figures for other base cases. 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 base cases. 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 of 4.75 % in electricity and 6.62 % in gas consumption from 2025 to 2050, equating to 54.80 TWh and 81.33 TWh, respectively. In 2050, yearly savings are 3.93 TWh for electricity and 6.79 TWh for gas.

Greenhouse gas emissions are reduced by 9.51 Mt CO2eq. from 2025 to 2050, a 3.72 % decrease compared to the BAU scenario. Resource consumption sees water savings of 1,074 million m³ (7.18 % reduction) and detergent savings of 16,001 kt (13.78 % reduction) over the same period.

The BAT scenario leads to total savings of 17.98 billion Euro in electricity costs from 2025 to 2050, with overall savings of 3.88 billion Euro in 2050 compared to BAU. Sensitivity analysis shows that electricity price fluctuations significantly impact total costs, with expenses ranging from 15.70 billion Euro in a low-price scenario to 23.54 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 Task 1, Member States have not implemented any mandatory instruments to regulate the market; only a few incentive programs 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 55 %-99 % of the environmental impact and for 65 %-97 % of the life cycle cost,[111] the focus of the ESPR requirements should be on:

- **Information requirements** regarding energy consumption

[111] See **Section 7.2.2**

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- **Minimum requirements** for energy efficiency (for electricity and fuel)
- For washing machines, information and minimum requirements should also cover detergent and water.

Further aspects include provisions for spare parts availability and delivery, as well as information requirements related to SoCs. As commercial and industrial laundry appliances are a typical B2B product group, the energy label is considered as relevant, while Green Public Procurement (GPP) is. Finally, to align with the ESPR regulation, a DPP would be necessary.

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 reference 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 reference program. Based on the analysis of such data, the ESPR minimum requirements will be developed.

Furthermore, for cabinet dryers, a standardized test method is necessary to regulate the energy efficiency.

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9. Annexes

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 BV 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 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

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industrial purposes as stated by the manufacturer in the Declaration of Conformity (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.

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☐ 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:

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- 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.

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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

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- 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) *kWh/kg laundry*	Water consumption (range) *l/kg laundry*	Detergent / laundry aid consumption (range) *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:

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- 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.

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Annex II: Questionnaire of 2nd stakeholder consultation

To be added separately.

Annex III: Categorisation of 2011 study (Graulich et al., 2011)

The categorisations proposed in the 2011 study (Graulich et al., 2011) is specified in **Table 9-1**.

Table 9-1: 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

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[112] 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[113] 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)

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

[112] VDMA: network organization for the machinery and equipment manufacturing industry in Germany and Europe, see www.vdma.eu

[113] EFCEM Italia have also recently raised support for this proposal. Efcem Italia represents Italian companies that produce professional equipment for catering and hospitality

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 are 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 so far is 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 4.1.3.1**) 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, 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.

The consultants would thus propose to maintain an umbrella term in the categorisation of appliances falling in the scope of this study. Though 'professional', 'non-household' and 'non-domestic' are to some degree interchangeable, only 'professional' allows to maintain the term 'semi-professional', which is understood to be necessary for differentiating between commercial machines intended and operated by professionals and those operated also by laymen (i.e., semi-professional).

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”[114], EN ISO 17116 Part 2, 3 and 4[115] - based on Directive 2009/125/EC[116] and Mandate M539 as well as by practice.

ETCT (2025a) provide **Table 9-2** to show the differences between commercial and industrial machines.

Table 9-2: 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; EN50694
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

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

[114] See details under: https://energy.ec.europa.eu/publications/ecodesign-and-energy-labelling-working-plan-2022-2024_en

[115] Specifications for industrial laundry machines - Definitions and testing of capacity and consumption characteristics – see **Section 4.1.4.1** for details.

[116] 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

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][117] 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 9-3** below, left column.

Table 9-3: 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: Professional 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: Professional 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

*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.

Source: ETCT (2025a)*.

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 made statements seem to support this threshold, manufacturers of commercial machines have repeatedly objected to this limit.

[117] 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.

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%”[118]. (ETCT, 2025a). This was further elaborated as follows:

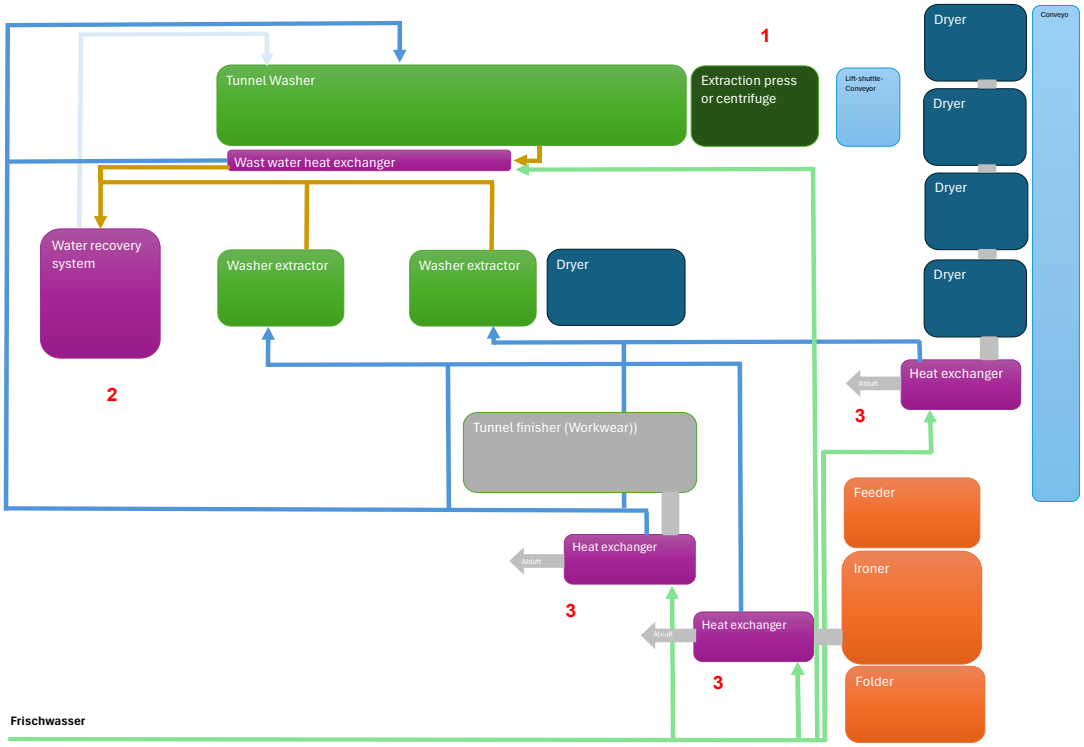
Industrial laundry facilities can clean different textiles such as hotel linen, mats, mops, workwear, hospital linen, resident laundry, or a mix of the above. The degree of contamination varies greatly as do hygienic requirements. The consumption of energy, water, and detergent are a result of the requirements 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 mats[119] in the first stages of the washing process to reduce water consumption.

ETCT (2025a) provide the following process diagram (**Figure 9-1**) to illustrate these examples more clearly in terms of their context within an industrial laundry set-up.

[118] 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%.

[119] 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 9-1: 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 9-4: 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., consumptions 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-consumer 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 9-4 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.

Annex V: Inputs for LCA / LCC per Base Case

WM1: Semi-professional washer extractor

Raw materials

Below, the Bill of Materials (BoM) followed by the packaging used is provided for Base Case WM1 including recycled content, dataset used, data source and quality scoring. BoM data was sourced from Tasks 1-4 of this Preparatory study.

Table 9-5: 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 galvanized	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
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 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
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
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

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
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
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

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
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 (control) - Based on ERT, 1 m2 = 3,08 kg	0.05	m2	0.2 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**73.86**	**kg**	**100 %**					

8307

8308 **Table 9-6: 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

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset used	Dataset recycling
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 %

8309

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Manufacturing

Table 9-7: 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 9-8: 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 galvanized	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
Acrylonitrile Butadiene Styrene (ABS)	1.145	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
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
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

Material	Value	Unit	Input value ERT	Comments	Dataset used
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

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Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 9-9: 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 9-11**), the parameters indicated in **Table 9-10** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 9-10: Use phase parameters for calculation for WM1.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	1,260	kWh	Expert judgement	Medium quality	Task 1-4, Table 4-53: Energy, water and detergent consumption of a semi-professional washer extractor.
Energy consumption for heating: Electricity	60 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household washing machines.
Energy consumption for heating: Heat	40 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household 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 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Electricity consumption rest (motor etc)	21 %	%	Expert judgement	Medium quality	Task 1-4, ESPR preparatory study, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Annual water consumption	76,600.0	litres/year	Expert judgement	Medium quality	Task 1-4, Table 4-53: Energy, water and detergent consumption of a semi-professional washer extractor.
Cycles per day	6	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 4-37: Typical intensity of use of the regarded washing machine categories.
Daily cleaned laundry	23	kg/day	Expert judgement	Medium quality	Task 1-4, Table 4-37: Typical intensity of use of the regarded washing machine categories.

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 4-37: Typical intensity of use of the regarded washing machine categories.
Annually cleaned laundry	7.0	tons/year	Expert judgement	Medium quality	Task 1-4, Table 4-37: Typical intensity of use of the regarded washing machine categories.
Annual detergent consumption	142	kg/year	Expert judgement	Medium quality	Task 1-4, Table 4-53: Energy, water and detergent consumption of a semi-professional washer extractor.
Specific detergent consumption operation	0.02	kg/kg laundry	Stakeholder input	High quality	Task 1-4, Table 4-55: Energy, water and detergent consumption of a professional washer dryer (category WM3).
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	0.75	hours	Previous study	Medium quality	Task 1-4, Table 4-43: Programme selection of non-household washing machine categories.

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8326 **Table 9-11: Use phase input data for WM1.**

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	0.479	kWh		Calculations based on Table 6-11
On-mode: No. of cycles / year	1800	#	Cycles per day* Number of working days per year	Calculations based on Table 6-11
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household washing machines.

Use phase inputs	Value	Unit	Comment	Reference
Standby-mode: No. of hours / year	600	#	120 min per day = 2 hours	Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household 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	0.221	kWh	External + internal heating: 40 %	Calculations based on Table 6-11
No. of cycles / year	1,800	#	Cycles per day* Number of working days per year	Calculations based on Table 6-11
Avg. Heat Power Output	0.295	kW	Total energy per year/total operating time per year	Calculations based on Table 6-11.
No. of hours / year	1,350	hrs.	Hours per cycle * cycles per year	Calculations based on Table 6-11
Water use				
Annual water use	76.6	m^3		Calculations based on Table 6-11
Auxilliary materials				
Detergent per cycle	0.079	kg		Calculations based on Table 6-11

Economic input data

All economic input parameters are provided below.

8329 **Table 9-12: Economic inputs for WM1.**

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	5.6	years	Stakeholder input	High quality	Broad range of cycles per lifetime (5000-15000) - average taken	Task 1-4, Table 4-35: Key market segments of non-household washing machines 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						
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 4-16: Number of batch-loaded washing machines manufactured in the EU27.
Assumed purchase price	2,136	Euro/unit	Expert judgement	Medium quality	Average price, extrapolation of 2011 data	Task 1-4, Table 4-25: Estimate of the unit prices of professional 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 (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)	85.44	Euro/ unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, 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, 4.2.4.3 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, 4.2.4.3 Electricity rate

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Water rate	1.91	Euro/m^3	Literature	Medium quality	Statistics, average prices of water from EU members	Task 1-4, 4.2.4.3 Water costs
Repair & maintenance costs	64.08	Euro/ unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, 4.2.4.4 Maintenance and service costs
Discount rate (interest minus inflation)	3	%	Literature	Medium quality	Meerp Review	European Commission/JRC, 2024
Escalation rate (project annual growth of running costs)	1.17 %	%				See **Table 9-13**
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 non-household products: 0,082 euros/kg of laundry. Specific detergent consumption 0,023 kg detergent/kg laundry.	Calculations based on Table 5-38

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Table 9-13: 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 %	419.1	35.4	3.67 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	861.8	201.4	20.86 %	
Water	0.16 %	76,600.0	146.3	15.16 %	
Detergent	1.21 %	142.0	582.2	60.31 %	
Weighted average Escalation rate	1.17 %				

WM2: Professional washer extractor

Raw materials

Below, the Bill of Materials (BoM) followed by the packaging used is provided for Base Case WM2 including recycled content, dataset used, data source and quality scoring.

Table 9-14: 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 galvanized	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 (control)	1.40	m2	2.0 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**210.45**	**kg**	**100 %**					

Table 9-15: 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

Material	Value	Unit	Weight in %	Material category	Recycled content percentage	Data quality assessment	Dataset material	Dataset recycling
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 %**					

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8342 ## Manufacturing

8343 The electricity consumption for the manufacturing of the product is described in **Table 9-16**. **Table 9-17** provides the data points related to the
8344 manufacturing of the components of the product.

8345 **Table 9-16: 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

8346 **Table 9-17: 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 galvanized	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
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

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Distribution

Below, the transport scenario input data is provided (**Table 9-18**). Scenarios are based on PEF defaults as no stakeholder data was available.

Table 9-18: Distribution input for WM2.

Transport means	Value	Unit	Dataset used	Data Source	Data quality assessment	Comment
Transported weight (all modes of transport)	0.229	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 9-20)**, the parameters indicated in **Table 9-19** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 9-19: Use phase parameters for calculation for WM2.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	15,180	kWh	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Energy consumption for heating: Electricity	55 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household washing machines.
Energy consumption for heating: Heat	45 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household washing machines.
Energy consumption for heating: Total	87 %	%	Expert judgement	Medium quality	Task 1-4,Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Electricity consumption rest (motor etc)	13 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Annual water consumption	1,076,000	litres/year	Expert judgement	Medium quality	Task 1-4, Table 4-56: Energy, water and detergent consumption of a professional barrier washer (category WM4).
Cycles per day	12	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 4-37: Typical intensity of use of the regarded washing machine categories.
Daily cleaned laundry	230	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 cleaned laundry	69.0	tons/year	Expert judgement	Medium quality	
Annual detergent consumption	1,518	kg/year	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Specific detergent consumption operation	0.022	kg/kg laundry	Previous study	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
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 4-43: Programme selection of non-household washing machine categories.

8358 **Table 9-20: Use phase input data for WM2.**

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	2.566	kWh		Calculations based on **Table 9-19**
On-mode: No. of cycles / year	3,600	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-19**
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household washing machines.

Use phase inputs	Value	Unit	Comment	Reference
Standby-mode: No. of hours / year	300	#	60 min per day = 1 hour	Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household 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	1.651	kWh		Calculations based on **Table 9-19**
No. of cycles / year	3,600	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-19**
Avg. Heat Power Output	2.201	kW	Total energy per year/total operating time per year	Calculations based on **Table 9-19**
No. of hours / year	2,700	hrs.	Hours per cycle * cycles per year	Calculations based on **Table 9-19**
Water use				
Water use per cycle	0.30	m^3	Annual water consumption / number of cycles per year	Calculations based on **Table 9-19**
No. of cycles / year	3,600	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-19**
Annual water use	1,076	m^3		Calculations based on **Table 9-19**
Auxilliary materials				
Detergent per cycle	0.422	kg		Calculations based on **Table 9-19**

Economic input data

All economic input parameters are provided below.

8361 **Table 9-21: Economic inputs for WM2.**

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	15.3	years	Stakeholder input	High quality	Broad range of cycles per lifetime (30000-80000) - average taken	Table 4-35: Key market segments of non-household washing machines according to spatial requirements and operator skills.
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024, (European Commission/JRC, 2024)
Economic life cycle data						
Latest Annual sales	0.016935	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.	Table 4-16: Number of batch-loaded washing machines manufactured in the EU27.
Assumed purchase price	34,775	Euro/unit	Expert judgement	Medium quality	WM2 (2011): 40050-48600 units	Table 4-25: Estimate of the unit prices of professional 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 (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)	1,391	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
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

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 "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	1,043.25	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
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, (European Commission/JRC, 2024)
Escalation rate (project annual growth of running costs)	1.14 %	%				See **Table** 9-22
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 5-47**

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Table 9-22: 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 %	6,255.8	528.7	5.08 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	9,237.0	2,158.1	20.75 %	
Water	0.16 %	1,076,000.0	2,055.2	19.76 %	
Detergent	1.21 %	1,518.0	5,658.0	54.40 %	
Weighted average Escalation rate	1.14 %				

WM3: Professional washer dryer

Raw materials

Below, the Bill of Materials (BoM) followed by the packaging used is provided for Base Case WM3 including recycled content, dataset used, data source and quality scoring.

Table 9-23: 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 galvanized	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
Electronics (control)	3.47	m2	2.8 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**382.00**	**kg**	**100 %**					

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Table 9-24: 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
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 9-25**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 9-26** provides the data points related to the manufacturing of the components of the product.

Table 9-25: 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 9-26: 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 galvanized	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			
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

Material	Value	Unit	Input value ERT	Comments	Dataset used
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 9-27: 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
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 9-29**), the parameters indicated in **Table 9-28** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 9-28: Use phase parameters for calculation for WM3.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	6,475	kWh	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Energy consumption for heating: Electricity	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household washing machines.
Energy consumption for heating: Heat	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Energy consumption for heating: Total	80 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Electricity consumption rest (motor etc)	20 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual water consumption	81,400	litres/year	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Cycles per day	8	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 4-37: Typical intensity of use of the regarded washing machine categories.
Daily cleaned laundry	34	kg/day	Expert judgement	Medium quality	
Number of working days per year	220	days/year	Expert judgement	Medium quality	
Annually cleaned laundry	7.0	tons/year	Expert judgement	Medium quality	
Annual detergent consumption	120	kg/year	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Specific detergent consumption operation	0.016	kg/kg laundry	Previous study	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Detergent price per kg of laundry	0.082	EUR/kg laundry	Literature	Medium quality	Task 1-4, Chapter "Detergent costs"

Description	Value	Unit	Source	Data quality assessment	Reference
Duration of the typically used washing program	1.25	hours	Previous study	Medium quality	Task 1-4, Table 4-43: Programme selection of non-household washing machine categories.

8388 **Table 9-29: Use phase input data for WM3.**

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	3.679	kWh		Calculations based on **Table 9-28**
On-mode: No. of cycles / year	1,760	#	Cycles per day* Number of working days per year	Calculations based on**Table 9-28**
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household washing machines.
Standby-mode: No. of hours / year	220	#	60 min per day = 1 hour	Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household 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 9-28**
No. of cycles / year	1,760	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-28**
Avg. Heat Power Output	0	kW	Total energy per year/total operating time per year	Calculations based on **Table 9-28**

Use phase inputs	Value	Unit	Comment	Reference
No. of hours / year	1760	hrs.	Hours per cycle * cycles per year	Calculations based on **Table 9-28**
Water use				
Water use per cycle	0.05	m^3	Annual water consumption / number of cycles per year	Calculations based on **Table 9-28**
No. of cycles / year	1,760	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-28**
Annual water use	81.4	m^3		Calculations based on **Table 9-28**
Auxilliary materials				
Detergent per cycle	0.068	kg		Calculations based on **Table 9-28**

Economic input data

All economic input parameters are provided below.

Table 9-30: Economic inputs for WM3.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	31.3	years	Stakeholder input	High quality	Broad range of cycles per lifetime (30000-80000) - average taken	Task 1-4, Table 4-35: Key market segments of non-household washing machines 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	0.000405	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 4-16: Number of batch-loaded washing machines manufactured in the EU27.
Assumed purchase price	12,200	Euro/unit	Expert judgement	Medium quality	Based on stakeholder data (APPLiA)	Task 1-4, Table 4-25: Estimate of the unit prices of professional 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, (European commission/JRC, 2018)
Installation/acquisition costs (if any)	488	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
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	366	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
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, page 62, (European Commission/JRC, 2024)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Escalation rate (project annual growth of running costs)	1.41 %	%				See **Table 9-31**
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

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8393 **Table 9-31: 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 %	6,475.0	1,512.8	66.26 %	
Water	0.16 %	81,400.0	155.5	6.81 %	
Detergent	1.21 %	120.0	615.0	26.94 %	

Use phase input	Escalation rate	Annual amount used	Annual costs	Share of total annual costs	Comments
Weighted average Escalation rate	1.41 %				

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8395 WM4: Professional barrier washer

8396 **Raw materials**

8397 Below, the Bill of Materials (BoM) followed by the packaging used is provided for Base Case WM4 including recycled content, dataset used, data
8398 source and quality scoring.

8399 **Table 9-32: 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 galvanized	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

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
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
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 (control)	19.55	m2	6.0 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**1003.50**	**kg**	**100 %**					

Table 9-33: 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 %
Total packaging weight	**2.73**	**kg**	**100 %**					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 9-34**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 9-35** provides the data points related to the manufacturing of the components of the product.

Table 9-34: 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 9-35: 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 galvanized	50.10	kg			
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				
Polyvinylchloride (PVC)	2.00	kg			
EDPM-rubber	20.10	kg			

Material	Value	Unit	Input value ERT	Comments	Dataset used
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

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Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 9-36: 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 9-38), the parameters indicated in **Table 9-37** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 9-37: Use phase parameters for calculation for WM4.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	16,890	kWh	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Energy consumption for heating: Electricity	5 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household washing machines.
Energy consumption for heating: Heat	95 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household washing machines.
Energy consumption for heating: Total	88 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Electricity consumption rest (motor etc)	12 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Annual water consumption	816,350	litres/year	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Cycles per day	10	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 4-37: Typical intensity of use of the regarded washing machine categories.
Daily cleaned laundry	256	kg/day	Expert judgement	Medium quality	

Description	Value	Unit	Source	Data quality assessment	Reference
Number of working days per year	220	days/year	Expert judgement	Medium quality	
Annually cleaned laundry	56.0	tons/year	Expert judgement	Medium quality	
Annual detergent consumption	901	kg/year	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Specific detergent consumption operation	0.016	kg/kg laundry	Stakeholder input	High quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
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	hours	Previous study	Medium quality	Task 1-4, Table 4-43: Programme selection of non-household washing machine categories.

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8423 **Table 9-38: Use phase input data for WM4**

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	1.259	kWh		Calculations based on **Table 9-37**
On-mode: No. of cycles / year	2,200	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-37**
Standby-mode: Consumption per hour	-	kWh		Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household washing machines.
Standby-mode: No. of hours / year	-	#		Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household 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	6.418	kWh		Calculations based on **Table 9-37**
No. of cycles / year	2,200	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-37**
Avg. Heat Power Output	6.418	kW	Total energy per year/total operating time per year	Calculations based on **Table 9-37**
No. of hours / year	2,200	hrs.	Hours per cycle * cycles per year	Calculations based on **Table 9-37**
Water use				
Water use per cycle	0.37	m^3	Annual water consumption / number of cycles per year	Calculations based on **Table 9-37**
No. of cycles / year	2,200	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-37**
Annual water use	816.35	m^3		Calculations based on **Table 9-37**
Auxilliary materials				
Detergent per cycle	0.410	kg		Calculations based on **Table 9-37**

Economic input data

All economic input parameters are provided below.

Table 9-39: Economic inputs for WM4.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	20.5	years	Stakeholder input	High quality	Lifetime 45000 cycles	Task 1-4, Table 4-35: Key market segments of non-household washing machines 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						
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)"	Task 1-4, Table 4-16: Number of batch-loaded washing machines manufactured in the EU27.
Assumed purchase price	57,375	Euro/unit	Expert judgement	Medium quality	"Estimated unit prices for WM6 Base Case of the 2011 study Average price, extrapollation of 2011 data"	Task 1-4, Table 4-25: Estimate of the unit prices of professional 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)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Installation/acquisition costs (if any)	2,295	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
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	14,343.75	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
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024 (European Commission/JRC, 2024), page 62
Escalation rate (project annual growth of running costs)	1.19 %	%				See **Table 9-40**

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 9-37**

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8428 **Table 9-40: 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 %	14,863.2	1,256.2	15.55 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	2,770.0	647.2	8.01 %	
Water	0.16 %	816,350.0	1,559.2	19.30 %	
Detergent	1.21 %	901.0	4,617.6	57.15 %	
Weighted average Escalation rate	1.19 %				

8429 WM5: Industrial continuous tunnel washers

8430 **Raw materials**

Below, the Bill of Materials (BoM) is provided for Base Case WM5 including recycled content, dataset used, data source and quality scoring. There is no data available for packaging for this Base Case.

Table 9-41: 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
Steel Sheet galvanized	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

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
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
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 (control)	38.96	m2	1.0 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**12,120.0**	**kg**	**100 %**					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 9-42**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 9-43** provides the data points related to the manufacturing of the components of the product.

8438 **Table 9-42: 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

8439 **Table 9-43: 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 galvanized	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

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Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 9-44: 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 9-46), the parameters indicated in **Table 9-45** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 9-45: 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 4-54: Energy, water and detergent consumption of a professional washer extractor.
Energy consumption for heating: Electricity	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household washing machines.
Energy consumption for heating: Heat	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-47: Energy Sources for water heating in non-household washing machines.
Energy consumption for heating: Total	95 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Electricity consumption rest (motor etc)	5 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Annual water consumption	21,037,500	litres/year	Expert judgement	Medium quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
Cycles per day	10	cycles/day	Expert judgement	Medium quality	
Daily cleaned laundry	12,750	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	Task 1-4, Table 4-37: Typical intensity of use of the regarded washing machine categories.
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 4-54: Energy, water and detergent consumption of a professional washer extractor.
Specific detergent consumption operation	0.008	kg/kg laundry	Stakeholder input	High quality	Task 1-4, Table 4-54: Energy, water and detergent consumption of a professional washer extractor.
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 4-43: Programme selection of non-household washing machine categories.

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8454 **Table 9-46: 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 9-23
Standby-mode: Consumption per hour	-	kWh		Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household washing machines.
Standby-mode: No. of hours / year	-	#		Task 1-4, Table 4-45: Typical time in low-power mode(s) consumption of non-household 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 cycle * cycles 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 cycle * cycles per year	Calculations based on Table 6-46
Water use				
Water use per cycle	7.01	m^3	Annual water consumption / number of cycles per year	Calculations based on Table 6-46
No. of hours / year	3,000	#	Hours per cycle * cycles per year	Calculations based on Table 9-45
Annual water use	21,037.5	m^3		Calculations based on Table 6-46
Auxilliary materials				

Use phase inputs	Value	Unit	Comment	Reference
Detergent per cycle	10.200	kg		Calculations based on Table 6-45

Economic input data

All economic input parameters are provided below.

Table 9-47: Economic inputs for WM5.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	13.7	years	Stakeholder input	High quality	Lifetime 41,000 hours	Task 1-4, Table 4-35: Key market segments of non-household washing machines 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						
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 4-16: Number of batch-loaded washing machines manufactured in the EU27.
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 4-25: Estimate of the unit prices of professional laundry appliances in 2023 (based on extrapolation of 2011 data using the evolution of PRODCOM data on unit prices).

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
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
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)	1.33 %	%				See Table 9-48

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	10.3	Euro/kg detergent	Stakeholder input	High quality		Calculations based on Table 9-46

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8459 **Table 9-48: 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 %**				

8460 D1: Semi-professional tumble dryer

Raw materials

Below, the Bill of Materials (BoM) followed by the packaging used is provided for Base Case D1 including recycled content, dataset used, data source and quality scoring.

Table 9-49: 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 galvanized	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 (control)	0.62	m2	3.2 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**60.20**	**kg**	**100 %**					

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Table 9-50: 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 %
Total packaging weight	**6.80**	**kg**	**100 %**					

Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 9-51**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 9-52** provides the data points related to the manufacturing of the components of the product.

8471 **Table 9-51: 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

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8473 **Table 9-52: Material inputs Manufacturing for D1.**

Material	Value	Unit	Input value ERT	Comments	Dataset used
Stainless Steel	34.6	kg	38.1	Best dataset choice from tool options	91-Steel sheet stamping and bending stamping and bending single route, at plant 5 % loss
Steel Sheet galvanized	3.5	kg			
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

Material	Value	Unit	Input value ERT	Comments	Dataset used
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
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 9-53: 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

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

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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 9-55), the parameters indicated in **Table 9-54** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 9-54: Use phase parameters for calculation for D1.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	4,147	kWh	Stakeholder input	High quality	Task 1-4, Table 4-65: Energy consumption of semi-professional tumble dryers
Energy consumption: Electricity	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-48: "Energy Sources for heating in new professional dryers"
Energy consumption: Heat	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-48: "Energy Sources for heating in new professional dryers"
Energy consumption for heating: Total	95 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines
Electricity consumption rest (motor etc)	5 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines
Cycles per day	6	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 4-38: Typical intensity of use of the regarded dryer categories
Daily dried laundry	22	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	6.5	tons/year	Stakeholder input	High quality	
Duration of the typically used drying program	0.67	hours	Previous study	Medium quality	Task 1-4, Table 4-44: "Programme selection of non-household dryer categories"

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8486 **Table 9-55: Use phase input data for D1.**

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	2.304	kWh		Calculations based on **Table 9-54**
On-mode: No. of cycles / year	1,800	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-54**
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 4-46: Typical time in low-power mode(s) consumption of non-household dryers
Standby-mode: No. of hours / year	900	#	180 min per day = 3 hours	Task 1-4, Table 4-46: Typical time in low-power mode(s) consumption of non-household 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	
Heat				
Consumption of heat per cycle	0	kWh		Calculations based on **Table 9-54**

Use phase inputs	Value	Unit	Comment	Reference
No. of cycles / year	1,800	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-54**
Avg. Heat Power Output	0	kW	Total energy per year/total operating time per year	Calculations based on **Table 9-54**
No. of hours / year	1,200	hrs.	Hours per cycle * cycles per year	Calculations based on **Table 9-54**

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8488 ## Economic input data

8489 All economic input parameters are provided below.

8490 **Table 9-56: Economic inputs for D1.**

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	5.6	years	Stakeholder input	High quality	Broad range of cycles per lifetime (5000-15000) - average taken	Task 1-4, Table 4-36: Key market segments of non-household 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						
Latest Annual sales	0.008	mln. Units/ year	Stakeholder input	High quality	Range of estimated numbers of batch-loaded units: 7000-9000. Average number taken	Task 1-4, Table 4-17 Number of batch-loaded dryers manufactured in the EU27

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Assumed purchase price	1,460	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	Task 1-4, Table 4-25 "Estimate of the unit prices of professional 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, (European commission/JRC, 2018)
Installation/ acquisition costs (if any)	58.4	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
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	43.8	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"
Discount rate (interest minus inflation)	3	%	Literature	Medium quality		MEErP review 2024, page 62 (European Commission/JRC, 2024)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Escalation rate (project annual growth of running costs)	1.62 %	%				See Table 9-57
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.	

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8492 **Table 9-57: 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 %	4,147.0	968.9	100 %	
Water	0.16 %	-	-	0 %	
Detergent	1.21 %	-	-	0 %	
Weighted average Escalation rate	**1.62 %**				

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D2: Professional tumble dryer

Raw materials

Below, the Bill of Materials (BoM) followed by the packaging used is provided for Base Case D2 including recycled content, dataset used, data source and quality scoring.

Table 9-58: 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 galvanized	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 %

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
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 %
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 (control)	0.58	m2	3.1 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**57.20**	**kg**	**100 %**					

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Table 9-59: 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 %
Total packaging weight	**6.80**	**kg**	**100 %**					

Manufacturing

The electricity consumption for the manufacturing of the product is described in Table **9-60**. The value is taken from literature and has been adjusted to represent the weight of the product. **Table 9-61** provides the data points related to the manufacturing of the components of the product.

8505 **Table 9-60: 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

8506 **Table 9-61: 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 galvanized	3.5	kg			
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

Material	Value	Unit	Input value ERT	Comments	Dataset used
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

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Distribution

Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

Table 9-62: 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 9-63** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

Table 9-63: Use phase parameters for calculation for D2.

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	71,160	kWh	Stakeholder input	High quality	Task 1-4, Table 4-65: Energy consumption of semi-professional tumble dryers
Energy consumption: Electricity	65 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-48: "Energy Sources for heating in new professional dryers"
Energy consumption: Heat	35 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-48: "Energy Sources for heating in new professional dryers"
Energy consumption for heating: Total	89 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines
Electricity consumption rest (motor etc)	12 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household 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	
Number of working days per year	273.3	days/year	Expert judgement	Medium quality	

Description	Value	Unit	Source	Data quality assessment	Reference
Annually dried laundry	74.3	tons/year	Stakeholder input	High quality	Task 1-4, Table 4- 66: "Energy consumption of professional tumble dryers (category D4-5-6)"
Duration of the typically used drying program	0.67	hours	Previous study	Medium quality	Task 1-4, Table 4-44: "Programme selection of non-household dryer categories"

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8519 **Table 9-64: Use phase input data for D2.**

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	19.254	kWh		
On-mode: No. of cycles / year	2,551	#	Cycles per day* Number of working days per year	
Standby-mode: Consumption per hour	-	kWh	No data	Task 1-4, Table 4-46: Typical time in low-power mode(s) consumption of non-household dryers
Standby-mode: No. of hours / year	-	#	No data	Task 1-4, Table 4-46: Typical time in low-power mode(s) consumption of non-household 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	
Heat				
Consumption of heat per cycle	8.640	kWh		
No. of cycles / year	2,551.1	#	Cycles per day* Number of working days per year	

Use phase inputs	Value	Unit	Comment	Reference
Avg. Heat Power Output	12.960	kW	Total energy per year/total operating time per year	
No. of hours / year	1,700.7	hrs.	Hours per cycle * cycles per year	

Economic input data

All economic input parameters are provided below.

Table 9-65: Economic inputs for D2.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	21.6	years	Stakeholder input	High quality	Broad range of cycles per lifetime (30000-80000) - average taken	Task 1-4, Table 4-36: Key market segments of non-household dryers according to spatial requirements and operator skills
Weibull shape parameter (b)	2.2	-	Literature	Medium quality		MEErP review 2024, page 48 (European Commission/JRC, 2024)
Economic life cycle data						

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Latest Annual sales	0.0077	mln. Units/ year	Stakeholder input	High quality	Range of estimated numbers of batch-loaded dryers for D4, D5 and D6 Base Cases of the 2011 study - Average number taken. D4 (2011): 16000-19000 units D5 (2011): 3200-6400 units D6 (2011): 0-1600 units	Task 1-4, Table 4-17 Number of batch-loaded dryers manufactured in the EU27
Assumed purchase price	8,700	Euro/ unit	Previous study	Medium quality	Estimated unit prices for D4, D5 and D6 Base Cases of the 2011 study Average prices, extrapollation of 2011 data	Task 1-4, Table 4-25 "Estimate of the unit prices of professional 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)	348	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
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

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 4.2.4.3.1.1 Electricity rate
Repair & maintenance costs	261	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
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 9-66
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.	

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Table 9-66: 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 %	23,201.9	1,961.0	14.59 %	Heat (kWh) divided by 0.95 to account for efficiency of natural gas boiler (95 %)
Electricity	1.62 %	49,118.2	11,475.6	85.41 %	
Water	0.16 %	-	-	0 %	
Detergent	1.21 %	-	-	0 %	
Weighted average Escalation rate	**1.7 %**				

D3: Professional cabinet dryer

Raw materials

Below, the Bill of Materials (BoM) followed by the packaging used is provided for Base Case D3 including recycled content, dataset used, data source and quality scoring.

Table 9-67: 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 galvanized	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 %
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

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
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 %
Electronics (control)	0.99	m2	2.1 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**145.15**	**kg**	**100 %**					

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8533 **Table 9-68: 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
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 %**					

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Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 9-69**. The value is taken from literature and has been adjusted to represent the weight of the product.

Table 9-70 provides the data points related to the manufacturing of the components of the product.

Table 9-69: 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 9-70: 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 galvanized	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

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8544 ## Distribution

8545 Below, the transport scenario input data is provided. Scenarios are based on PEF defaults as no stakeholder data was available.

8546 **Table 9-71: 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

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8548 ## Use phase

8549 For the use phase, energy inputs (electricity and heat), water and detergent use were included. To calculate the exact inputs for the ERT (**Table**
8550 **9-73**), the parameters indicated in **Table 9-72** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

8551 **Table 9-72: Use phase parameters for calculation for D3.**

Description	Value	Unit	Source	Data quality assessment	Reference
Annual energy consumption (total)	5,418	kWh	Stakeholder input	High quality	Task 1-4, Table 4-65: Energy consumption of semi-professional tumble dryers.:
Energy consumption: Electricity	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-48: Energy Sources for heating in new professional dryers.
Energy consumption: Heat	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-48: Energy Sources for heating in new professional dryers.

Description	Value	Unit	Source	Data quality assessment	Reference
Energy consumption for heating: Total	95 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Electricity consumption rest (motor etc)	5 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Cycles per day	6	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 4-38: Typical intensity of use of the regarded dryer categories.
Daily dried laundry	29	kg/day	Expert judgement	Medium quality	
Number of working days per year	220	days/year	Expert judgement	Medium quality	
Annually dried laundry	6.3	tons/year	Stakeholder input	High quality	Task 1-4, Table 4-67: Energy consumption of professional cabinet dryers.
Duration of the typically used drying program	2.16	hours	Previous study	Medium quality	Task 1-4, Table 4-44: Programme selection of non-household dryer categories.

Table 9-73: Use phase input data for D3.

Use phase inputs	Value	Unit	Comment	Reference
Electricity				
On-mode: Consumption per cycle	4.105	kWh		Calculations based on Table 9-72

Use phase inputs	Value	Unit	Comment	Reference
On-mode: No. of cycles / year	1320	#	Cycles per day* Number of working days per year	Calculations based on Table 6-73
Standby-mode: Consumption per hour	0.003	kWh	Low power mode consumption = standby mode	Task 1-4, Table 4-46: Typical time in low-power mode(s) consumption of non-household dryers.
Standby-mode: No. of hours / year	660	#	180 min per day = 3 hours	Task 1-4, Table 4-46: Table 4-46: Typical time in low-power mode(s) consumption of non-household 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 cycle	0	kWh		Calculations based on Table 6-73
No. of cycles / year	1320	#	Cycles per day* Number of working days per year	Calculations based on Table 6-73
Avg. Heat Power Output	0	kW		Calculations based on Table 6 -3
No. of hours / year	3,801	hrs.	Hours per cycle * cycles per year	Calculations based on Table 6-73

Economic input data

All economic input parameters are provided below.

Table 9-74: Economic inputs for D3.

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	41.7	years	Stakeholder input	High quality	Broad range of cycles per lifetime (30000-80000) - average taken cycles per lifetime	Task 1-4, Table 4-36: Key market segments of non-household 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						
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 4-17: Number of batch-loaded dryers manufactured in the EU27.
Assumed purchase price	2,800	Euro/ unit	Previous study	Medium quality	Estimated unit prices for D3 Base Case of the 2011 study Average prices, extrapolation of 2011 data	Task 1-4, Table 4-25: Estimate of the unit prices of professional 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)	112	Euro/ unit	Stakeholder input	High quality	Assumed 4 % of the purchase price for smallest appliances	Task 1-4, 4.2.4.2 Installation costs

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, 4.2.4.3 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, 4.2.4.3 Electricity Rate
Repair & maintenance costs	84	Euro/ unit	Stakeholder input	High quality	3 % of the purchase price over its lifetime based on stakeholder's estimation	Task 1-4, Chapter "4.2.4.4Maintenance 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)	1.62 %	%				See **Table 9-75**
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 9-75: 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 %	5,418.0	1,265.8	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 Bill of Materials (BoM) is provided for Base Case D4 including recycled content, dataset used, data source and quality scoring. There is no data available for packaging for this Base Case.

Table 9-76: 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 galvanized	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
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

Material	Value	Unit	Weight in %	Material category	Recycled content	Data quality assessment	Dataset material	Dataset recycling
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
Electronics (control)	1.08	m2	0.1 %	6-Electronics	Default	Medium quality	141-Controller board	206-Recycling of controller board
Total product weight	**2,870.88**	**kg**	**100 %**					

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Manufacturing

The electricity consumption for the manufacturing of the product is described in **Table 9-77** . The value is taken from literature and has been adjusted to represent the weight of the product. **Table 9-78** provides the data points related to the manufacturing of the components of the product.

Table 9-77: 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 9-78: 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 galvanized	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 9-79: 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 9-81**), the parameters indicated in **Table 9-80** were used. For heat modelling, default efficiency values were used (95 %), incorporated in the ERT.

8579 **Table 9-80: 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 4-67: Energy consumption of professional cabinet dryers.
Energy consumption: Electricity	0 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-48: Energy Sources for heating in new professional dryers.
Energy consumption: Heat	100 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-48: "Energy Sources for heating in new professional dryers"
Energy consumption for heating: Total	89 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines.
Electricity consumption rest (motor etc)	11 %	%	Expert judgement	Medium quality	Task 1-4, Table 4-52: Estimated share of the average energy consumption in the different categories of non-household washing machines
Cycles per day	10	cycles/day	Expert judgement	Medium quality	Task 1-4, Table 4-38: 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 4-68: Energy consumption of industrial pass-through dryers.
Duration of the typically used drying program	0.33	hours	Previous study	Medium quality	Task 1-4, Table 4-44: Programme selection of non-household dryer categories.

Table 9-81: 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 9-80**
On-mode: No. of hours / year	3,000	#	Cycles per day* Number of working days per year	Calculations based on **Table 9-58**
Standby-mode: Consumption per hour	-	kWh	Negligible	Task 1-4, Table 4-46: Typical time in low-power mode(s) consumption of non-household dryers.
Standby-mode: No. of hours / year	-	#	Negligible	Task 1-4, Table 4-46: Typical time in low-power mode(s) consumption of non-household 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 cycle	242.080	kWh		Calculations based on Table 6-81
No. of hours / year	3,000	#	Cycles 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 cycle * cycles per year	Calculations based on Table 6-81

Economic input data

All economic input parameters are provided below.

8583 **Table 9-82: Economic inputs for D4.**

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
Lifetime						
Average expected initial life time	25	years	Stakeholder input	High quality	Lifetime 50000 to 100000 hours - average taken	Task 1-4, Table 4-36: Key market segments of non-household 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						
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 4-17: 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 4-25: Estimate of the unit prices of professional 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)

LCC parameter	Value	Unit	Source	Data quality assessment	Comments	Reference
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 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, 4.2.4.3 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, Chapter "4.2.4.3Electricity 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 "4.2.4.4Maintenance 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 9-83**

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.	

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8585 **Table 9-83: 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 %**				

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Calculation of escalation rate

The escalation rate was calculated based on the data in **Table 9-84.** Below is the explanation of how the escalation rate was calculated.

Table 9-84: 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 detergent, 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.**

$$Increase\ (\%)\ = (\frac{2024\ price^{\frac{1}{10}}}{2014\ price} - 1) \times 100\ \%$$

Formula 1: Calculation of % increase

Subsequently, the escalation rate was calculated by **Formula 2.**

$$Escalation\ rate\ (\%)\ = (\frac{1 + \%\ increase\ product}{1 + \%\ increase\ HICP} - 1) \times 100\ \%$$

Formula 2: Calculation of % increase

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 9-85** and per Base Case in **Annex V: Inputs for LCA / LCC per Base Case.**

Table 9-85: Escalation rate per product .

Parameter	Escalation rate
Water	0.16 %
Electricity	1.62 %
Natural gas (for heat)	2.15 %
Detergent	1.21

As per Base Case, 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 Base Case a weighted average of the escalation rate was calculated based on the share of yearly costs per product.

Annex VI – Results of LCA / LCC per Base Case

WM1: Semi-professional washer extractor

Below, the life cycle impact is provided per product (**Table 9-86)**, per year of use of the product **(Table 9-87**), total impact for the EU27 for the new product (**Table 9-88**) and the impact of the stock of products in the EU27 (**Table 9-89**). The life cycle costs per product and as EU27 total are provided in **Table 9-90**.

Table 9-86: Life cycle impact per product: WM1.

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	13,470	13,210		51	0	n.a.			**26,731**
Metals	g	39,533	39,533		0	0	n.a.			**79,066**
Electronics	g	154	50		0	0	n.a.			**204**
Others	g	20,695	0		2,452	429,755,200	n.a.			**429,778,347**
Total weight	g	**73,852**	**52,793**		**2,503**	**429,755,200**	**739**			**429,885,087**
Energy consumption										
Electricity	kWh		9		0	4,838	0			**4,847**
Thermal energy	MJ		0		0	8,451	0			**8,451**
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	4.1E+02	1.4E+01	8.5E+00	2.0E+00	4.5E+03	4.3E+00	2.7E+01	-1.2E+02	**4.9E+03**
Ozone depletion	kg CFC-11 eq	3.4E-07	4.7E-09	9.8E-11	9.5E-11	8.1E-05	3.5E-09	6.1E-09	-3.4E-09	**8.1E-05**
Human toxicity, cancer	CTUh	1.4E-05	8.0E-10	2.3E-09	1.6E-09	5.3E-06	1.4E-07	3.4E-08	-9.9E-06	**1.0E-05**
Human toxicity, non-cancer	CTUh	4.9E-06	1.1E-07	5.5E-08	3.2E-08	6.1E-05	5.0E-08	1.4E-07	-1.3E-06	**6.5E-05**
Particulate matter	disease incidence	6.8E-05	7.2E-07	2.7E-07	1.2E-07	2.6E-04	6.8E-07	1.6E-06	-1.9E-05	**3.1E-04**
Ionising radiation, human health	kBq U235 eq	2.0E+01	5.4E+00	1.5E-01	1.2E-01	1.1E+03	2.6E-01	7.4E+00	-4.7E+00	**1.1E+03**
Photochemical ozone formation, human health	kg NMVOC eq	1.4E+00	3.1E-02	3.0E-02	9.9E-03	9.3E+00	1.4E-02	4.0E-02	-3.4E-01	**1.0E+01**
Acidification	mol H+ eq	5.2E+00	4.9E-02	3.3E-02	8.0E-03	1.7E+01	5.3E-02	6.2E-02	-1.4E+00	**2.1E+01**
Eutrophication, terrestrial	mol N eq	4.4E+00	1.2E-01	1.6E-01	2.4E-02	3.9E+01	4.6E-02	1.5E-01	-1.1E+00	**4.3E+01**
Eutrophication, freshwater	kg P eq	3.3E-03	3.0E-05	5.1E-05	2.1E-05	2.4E-01	3.3E-05	3.8E-05	-8.4E-05	**2.4E-01**
Eutrophication, marine	kg N eq	4.1E-01	1.1E-02	1.4E-02	2.4E-03	6.7E+00	4.2E-03	1.4E-02	-9.4E-02	**7.0E+00**
Ecotoxicity, freshwater	CTUe	3.6E+03	1.0E+02	7.9E+01	9.4E+00	4.0E+04	3.7E+01	8.8E+01	-1.2E+03	**4.3E+04**
Land use	pt	7.4E+04	8.6E+01	6.6E+01	5.0E+02	5.5E+04	7.4E+02	8.3E+01	-3.6E+02	**1.3E+05**

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	1.0E+02	5.0E+00	7.9E-01	2.3E-01	9.9E+03	1.1E+00	5.9E+00	-3.0E+01	**1.0E+04**
Resource use, minerals and metals	kg Sb eq	4.4E-02	5.5E-06	5.6E-06	4.2E-07	2.5E-02	4.4E-04	5.3E-06	-1.2E-02	**5.8E-02**
Resource use, fossils	MJ	5.5E+03	2.5E+02	1.2E+02	2.0E+01	7.2E+04	5.8E+01	4.3E+02	-1.4E+03	**7.7E+04**
Additional technical information										
Primary energy consumption	MJ	5.5E+03	2.6E+02	1.2E+02	2.0E+01	7.3E+04	5.8E+01	4.3E+02	-1.4E+03	**7.8E+04**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-87: 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	2,405	2,359		9	0	n.a.			**4,773**
Metals	g	7,059	7,059		0	0	n.a.			**14,119**
Electronics	g	28	9		0	0	n.a.			**36**
Others	g	3,696	0		478	76,742,000	n.a.			**76,746,173**
Total weight	g	13,188	9,427		487	76,742,000	132			**76,765,234**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Energy consumption										
Electricity	kWh		2		0	864	0			**866**
Thermal energy	MJ		0		0	1,509	0			**1,509**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	7.3E+01	2.5E+00	1.5E+00	4.0E-01	8.1E+02	7.6E-01	4.8E+00	-2.2E+01	**8.7E+02**
Ozone depletion	kg CFC-11 eq	6.1E-08	8.5E-10	1.7E-11	1.9E-11	1.4E-05	6.2E-10	1.1E-09	-6.1E-10	**1.5E-05**
Human toxicity, cancer	CTUh	2.6E-06	1.4E-10	4.0E-10	3.0E-10	9.4E-07	2.6E-08	6.0E-09	-1.8E-06	**1.8E-06**
Human toxicity, non-cancer	CTUh	8.7E-07	2.0E-08	9.8E-09	6.0E-09	1.1E-05	8.9E-09	2.4E-08	-2.4E-07	**1.2E-05**
Particulate matter	disease incidence	1.2E-05	1.3E-07	4.9E-08	2.3E-08	4.7E-05	1.2E-07	2.8E-07	-3.4E-06	**5.6E-05**
Ionising radiation, human health	kBq U235 eq	3.6E+00	9.7E-01	2.7E-02	2.4E-02	1.9E+02	4.6E-02	1.3E+00	-8.4E-01	**1.9E+02**
Photochemical ozone formation, human health	kg NMVOC eq	2.5E-01	5.5E-03	5.4E-03	2.0E-03	1.7E+00	2.5E-03	7.2E-03	-6.1E-02	**1.9E+00**
Acidification	mol H+ eq	9.3E-01	8.7E-03	5.9E-03	1.7E-03	3.0E+00	9.4E-03	1.1E-02	-2.6E-01	**3.7E+00**
Eutrophication, terrestrial	mol N eq	7.9E-01	2.2E-02	2.8E-02	5.0E-03	7.1E+00	8.1E-03	2.6E-02	-1.9E-01	**7.7E+00**
Eutrophication, freshwater	kg P eq	5.9E-04	5.4E-06	9.1E-06	5.2E-06	4.3E-02	5.9E-06	6.8E-06	-1.5E-05	**4.3E-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	7.2E-02	2.0E-03	2.5E-03	5.1E-04	1.2E+00	7.4E-04	2.5E-03	-1.7E-02	**1.3E+00**
Ecotoxicity, freshwater	CTUe	6.5E+02	1.8E+01	1.4E+01	1.9E+00	7.1E+03	6.6E+00	1.6E+01	-2.2E+02	**7.6E+03**
Land use	pt	1.3E+04	1.5E+01	1.2E+01	1.1E+02	9.8E+03	1.3E+02	1.5E+01	-6.4E+01	**2.3E+04**
Water use	m^3 water eq. of deprived water	1.8E+01	8.9E-01	1.4E-01	5.0E-02	1.8E+03	1.9E-01	1.1E+00	-5.3E+00	**1.8E+03**
Resource use, minerals and metals	kg Sb eq	7.9E-03	9.8E-07	1.0E-06	9.7E-08	4.5E-03	7.9E-05	9.5E-07	-2.1E-03	**1.0E-02**
Resource use, fossils	MJ	9.9E+02	4.5E+01	2.2E+01	4.2E+00	1.3E+04	1.0E+01	7.7E+01	-2.5E+02	**1.4E+04**
Additional technical information										
Primary energy consumption	MJ	9.9E+02	4.6E+01	2.2E+01	4.2E+00	1.3E+04	1.0E+01	7.7E+01	-2.5E+02	**1.4E+04**

*** Manufacturing materials are currently double counting the raw materials column.**

Table 9-88: EU total impact of new products sold in the year of study: WM1 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**0**	**0**		**0**	**0**	**0**			**0**
Energy consumption										
Electricity	kWh		0		0	118	0			118
Thermal energy	MJ		0		0	205	0			205
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	1.0E+01	3.4E-01	2.1E-01	4.8E-02	1.1E+02	1.0E-01	6.5E-01	-3.0E+00	1.2E+02
Ozone depletion	kg CFC-11 eq	8.4E-09	1.2E-10	2.4E-12	2.3E-12	2.0E-06	8.5E-11	1.5E-10	-8.4E-11	2.0E-06
Human toxicity, cancer	CTUh	3.5E-07	2.0E-11	5.5E-11	4.0E-11	1.3E-07	3.5E-09	8.2E-10	-2.4E-07	2.4E-07
Human toxicity, non-cancer	CTUh	1.2E-07	2.7E-09	1.3E-09	7.8E-10	1.5E-06	1.2E-09	3.3E-09	-3.2E-08	1.6E-06
Particulate matter	disease incidence	1.6E-06	1.8E-08	6.6E-09	2.8E-09	6.3E-06	1.7E-08	3.8E-08	-4.6E-07	7.6E-06

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	4.9E-01	1.3E-01	3.7E-03	2.9E-03	2.6E+01	6.2E-03	1.8E-01	-1.1E-01	2.6E+01
Photochemical ozone formation, human health	kg NMVOC eq	3.3E-02	7.4E-04	7.3E-04	2.4E-04	2.3E-01	3.4E-04	9.8E-04	-8.3E-03	2.5E-01
Acidification	mol H+ eq	1.3E-01	1.2E-03	8.1E-04	2.0E-04	4.1E-01	1.3E-03	1.5E-03	-3.5E-02	5.1E-01
Eutrophication, terrestrial	mol N eq	1.1E-01	2.9E-03	3.9E-03	5.8E-04	9.6E-01	1.1E-03	3.6E-03	-2.6E-02	1.1E+00
Eutrophication, freshwater	kg P eq	8.0E-05	7.4E-07	1.2E-06	5.0E-07	5.8E-03	8.1E-07	9.3E-07	-2.0E-06	5.9E-03
Eutrophication, marine	kg N eq	9.9E-03	2.7E-04	3.5E-04	5.8E-05	1.6E-01	1.0E-04	3.3E-04	-2.3E-03	1.7E-01
Ecotoxicity, freshwater	CTUe	8.8E+01	2.5E+00	1.9E+00	2.3E-01	9.7E+02	9.0E-01	2.1E+00	-3.0E+01	1.0E+03
Land use	pt	1.8E+03	2.1E+00	1.6E+00	1.2E+01	1.3E+03	1.8E+01	2.0E+00	-8.7E+00	3.2E+03
Water use	m^3 water eq. of deprived water	2.5E+00	1.2E-01	1.9E-02	5.5E-03	2.4E+02	2.6E-02	1.4E-01	-7.3E-01	2.4E+02
Resource use, minerals and metals	kg Sb eq	1.1E-03	1.3E-07	1.4E-07	1.0E-08	6.1E-04	1.1E-05	1.3E-07	-2.9E-04	1.4E-03
Resource use, fossils	MJ	1.3E+02	6.2E+00	3.0E+00	5.0E-01	1.7E+03	1.4E+00	1.1E+01	-3.3E+01	1.9E+03
Additional technical information										
Primary energy consumption	MJ	1.3E+02	6.2E+00	3.0E+00	5.0E-01	1.8E+03	1.4E+00	1.1E+01	-3.3E+01	1.9E+03

8624

Table 9-89: EU total impact of Stock of products in the year of study: WM1 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Others	g	0.000	0.000		0.000	0.058	n.a.			**0.058**
Total weight	g	**0.000**	**0.000**		**0.000**	**0.058**	**0.000**			**0.058**
Energy consumption										
Electricity	kWh		1		0	658	0			**660**
Thermal energy	MJ		0		0	1,150	0			**1,150**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	5.6E+01	1.9E+00	1.2E+00	2.7E-01	6.1E+02	5.8E-01	3.7E+00	-1.7E+01	**6.6E+02**
Ozone depletion	kg CFC-11 eq	4.7E-08	6.4E-10	1.3E-11	1.3E-11	1.1E-05	4.7E-10	8.3E-10	-4.7E-10	**1.1E-05**
Human toxicity, cancer	CTUh	2.0E-06	1.1E-10	3.1E-10	2.2E-10	7.2E-07	2.0E-08	4.6E-09	-1.3E-06	**1.4E-06**
Human toxicity, non-cancer	CTUh	6.7E-07	1.5E-08	7.5E-09	4.4E-09	8.3E-06	6.8E-09	1.8E-08	-1.8E-07	**8.8E-06**
Particulate matter	disease incidence	9.2E-06	9.8E-08	3.7E-08	1.6E-08	3.6E-05	9.3E-08	2.1E-07	-2.6E-06	**4.3E-05**

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+00	7.4E-01	2.1E-02	1.6E-02	1.4E+02	3.5E-02	1.0E+00	-6.4E-01	**1.5E+02**
Photochemical ozone formation, human health	kg NMVOC eq	1.9E-01	4.2E-03	4.1E-03	1.3E-03	1.3E+00	1.9E-03	5.5E-03	-4.6E-02	**1.4E+00**
Acidification	mol H+ eq	7.1E-01	6.6E-03	4.5E-03	1.1E-03	2.3E+00	7.1E-03	8.5E-03	-2.0E-01	**2.8E+00**
Eutrophication, terrestrial	mol N eq	6.0E-01	1.6E-02	2.2E-02	3.2E-03	5.4E+00	6.2E-03	2.0E-02	-1.5E-01	**5.9E+00**
Eutrophication, freshwater	kg P eq	4.5E-04	4.1E-06	6.9E-06	2.8E-06	3.3E-02	4.5E-06	5.2E-06	-1.1E-05	**3.3E-02**
Eutrophication, marine	kg N eq	5.5E-02	1.5E-03	1.9E-03	3.2E-04	9.1E-01	5.7E-04	1.9E-03	-1.3E-02	**9.6E-01**
Ecotoxicity, freshwater	CTUe	4.9E+02	1.4E+01	1.1E+01	1.3E+00	5.4E+03	5.1E+00	1.2E+01	-1.7E+02	**5.8E+03**
Land use	pt	1.0E+04	1.2E+01	8.9E+00	6.8E+01	7.5E+03	1.0E+02	1.1E+01	-4.9E+01	**1.8E+04**
Water use	m^3 water eq. of deprived water	1.4E+01	6.8E-01	1.1E-01	3.1E-02	1.3E+03	1.5E-01	8.0E-01	-4.1E+00	**1.4E+03**
Resource use, minerals and metals	kg Sb eq	6.0E-03	7.4E-07	7.7E-07	5.7E-08	3.4E-03	6.0E-05	7.3E-07	-1.6E-03	**7.9E-03**
Resource use, fossils	MJ	7.5E+02	3.4E+01	1.7E+01	2.8E+00	9.7E+03	7.9E+00	5.9E+01	-1.9E+02	**1.0E+04**
Additional technical information										
Primary energy consumption	MJ	7.5E+02	3.5E+01	1.7E+01	2.8E+00	9.9E+03	7.9E+00	5.9E+01	-1.9E+02	**1.1E+04**

8627

Table 9-90: Life cycle costs per product and total EU expenditure: WM1.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	2,136	EUR	52	mln. EUR/year
Installation/ acquisition costs (if any)	85	EUR	2	mln. EUR/year
Fuel (gas, oil, wood)	33	EUR/year	5	mln. EUR/year
Electricity	191	EUR/year	28	mln. EUR/year
Water	138	EUR/year	20	mln. EUR/year
Auxiliary material 1: Detergent	549	EUR/year	79	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	64	EUR	2	mln. EUR/year
Total	**1,318**	**EUR/year**	**187**	**mln. EUR/year**

WM2: Professional washer extractor

Below, the life cycle impact is provided per product (**Table 9-91**), per year of use of the product (**Table 9-92**), total impact for the EU27 for the new product (**Table 9-93**) and the impact of the stock of products in the EU27 (**Table 9-94**).

8633 **Table 9-91: 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 Impacts	EoL Credits	Total
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	4,312	1,400		0	0	n.a.			**5,712**
Others	g	0	0		18,000	16,486,025,400	n.a.			**16,486,043,400**
Total weight	g	**210,472**	**207,608**		**18,050**	**16,486,025,400**	**2,105**			**16,486,463,635**
Energy consumption										
Electricity	kWh		27		0	141,349	0			**141,376**
Thermal energy	MJ		0		0	344,551	0			**344,551**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	5.2E+03	3.2E+01	2.5E+01	1.6E+01	1.4E+05	5.3E+01	2.0E+02	-5.7E+02	**1.5E+05**
Ozone depletion	kg CFC-11 eq	2.2E-07	1.1E-08	2.9E-10	7.5E-10	2.4E-03	2.3E-09	4.6E-08	-2.0E-08	**2.4E-03**
Human toxicity, cancer	CTUh	3.8E-05	3.2E-09	6.8E-09	1.0E-08	1.8E-04	3.8E-07	2.5E-07	-2.5E-05	**1.9E-04**
Human toxicity, non-cancer	CTUh	5.9E-05	1.7E-06	1.6E-07	2.1E-07	2.1E-03	6.1E-07	1.1E-06	-1.2E-05	**2.1E-03**

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	7.9E-04	3.7E-06	8.1E-07	8.7E-07	7.9E-03	8.0E-06	1.2E-05	-6.6E-05	**8.6E-03**
Ionising radiation, human health	kBq U235 eq	2.5E+02	1.2E+01	4.6E-01	9.3E-01	3.1E+04	2.6E+00	5.5E+01	-2.6E+01	**3.2E+04**
Photochemical ozone formation, human health	kg NMVOC eq	2.0E+01	9.0E-02	9.0E-02	8.3E-02	2.9E+02	2.0E-01	3.0E-01	-1.4E+00	**3.1E+02**
Acidification	mol H+ eq	8.4E+01	1.3E-01	9.9E-02	6.6E-02	5.1E+02	8.4E-01	4.6E-01	-4.6E+00	**5.9E+02**
Eutrophication, terrestrial	mol N eq	6.3E+01	3.5E-01	4.8E-01	2.0E-01	1.2E+03	6.3E-01	1.1E+00	-4.3E+00	**1.2E+03**
Eutrophication, freshwater	kg P eq	8.5E-03	7.3E-05	1.5E-04	2.6E-04	7.7E+00	8.5E-05	2.9E-04	-4.4E-04	**7.7E+00**
Eutrophication, marine	kg N eq	5.8E+00	3.2E-02	4.3E-02	2.1E-02	2.0E+02	5.8E-02	1.0E-01	-3.8E-01	**2.1E+02**
Ecotoxicity, freshwater	CTUe	3.5E+04	2.4E+02	2.3E+02	6.8E+01	1.2E+06	3.5E+02	6.6E+02	-6.8E+03	**1.2E+06**
Land use	pt	2.0E+05	2.9E+02	2.0E+02	4.6E+03	1.6E+06	2.0E+03	6.2E+02	-6.4E+03	**1.8E+06**
Water use	m^3 water eq. of deprived water	9.2E+02	1.2E+01	2.4E+00	2.3E+00	3.6E+05	9.4E+00	4.4E+01	-1.1E+02	**3.6E+05**
Resource use, minerals and metals	kg Sb eq	6.2E-01	1.5E-05	1.7E-05	4.5E-06	7.6E-01	6.2E-03	4.0E-05	-5.7E-02	**1.3E+00**
Resource use, fossils	MJ	6.8E+04	6.1E+02	3.7E+02	1.5E+02	2.2E+06	6.9E+02	3.2E+03	-6.1E+03	**2.3E+06**

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	6.8E+04	6.2E+02	3.7E+02	1.5E+02	2.3E+06	6.9E+02	3.2E+03	-6.1E+03	**2.3E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-92: 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 Impacts	EoL Credits	Total
Materials	unit									
Plastics	g	601	646		3	0	n.a.			**1,250**
Metals	g	12,873	12,832		0	0	n.a.			**25,705**
Electronics	g	282	92		0	0	n.a.			**373**
Others	g	0	0		1,176	1,077,518,000	n.a.			**1,077,519,176**
Total weight	g	**13,756**	**13,569**		**1,180**	**1,077,518,000**	**138**			**1,077,546,643**
Energy consumption										
Electricity	kWh		2		0	9,239	0			**9,240**
Thermal energy	MJ		0		0	22,520	0			**22,520**

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	3.4E+02	2.1E+00	1.7E+00	1.0E+00	9.3E+03	3.4E+00	1.3E+01	-3.7E+01	**9.6E+03**
Ozone depletion	kg CFC-11 eq	1.4E-08	7.1E-10	1.9E-11	4.9E-11	1.6E-04	1.5E-10	3.0E-09	-1.3E-09	**1.6E-04**
Human toxicity, cancer	CTUh	2.5E-06	2.1E-10	4.4E-10	6.5E-10	1.2E-05	2.5E-08	1.6E-08	-1.7E-06	**1.2E-05**
Human toxicity, non-cancer	CTUh	3.9E-06	1.1E-07	1.1E-08	1.4E-08	1.3E-04	4.0E-08	7.0E-08	-7.6E-07	**1.4E-04**
Particulate matter	disease incidence	5.2E-05	2.4E-07	5.3E-08	5.7E-08	5.1E-04	5.2E-07	7.6E-07	-4.3E-06	**5.6E-04**
Ionising radiation, human health	kBq U235 eq	1.6E+01	8.2E-01	3.0E-02	6.1E-02	2.0E+03	1.7E-01	3.6E+00	-1.7E+00	**2.1E+03**
Photochemical ozone formation, human health	kg NMVOC eq	1.3E+00	5.9E-03	5.9E-03	5.4E-03	1.9E+01	1.3E-02	2.0E-02	-8.9E-02	**2.0E+01**
Acidification	mol H+ eq	5.5E+00	8.6E-03	6.5E-03	4.3E-03	3.3E+01	5.5E-02	3.0E-02	-3.0E-01	**3.8E+01**
Eutrophication, terrestrial	mol N eq	4.1E+00	2.3E-02	3.1E-02	1.3E-02	7.8E+01	4.1E-02	7.2E-02	-2.8E-01	**8.2E+01**
Eutrophication, freshwater	kg P eq	5.5E-04	4.8E-06	1.0E-05	1.7E-05	5.0E-01	5.6E-06	1.9E-05	-2.9E-05	**5.0E-01**
Eutrophication, marine	kg N eq	3.8E-01	2.1E-03	2.8E-03	1.4E-03	1.3E+01	3.8E-03	6.7E-03	-2.5E-02	**1.4E+01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Ecotoxicity, freshwater	CTUe	2.3E+03	1.6E+01	1.5E+01	4.4E+00	7.9E+04	2.3E+01	4.3E+01	-4.5E+02	**8.1E+04**
Land use	pt	1.3E+04	1.9E+01	1.3E+01	3.0E+02	1.0E+05	1.3E+02	4.1E+01	-4.2E+02	**1.2E+05**
Water use	m^3 water eq. of deprived water	6.0E+01	8.1E-01	1.5E-01	1.5E-01	2.3E+04	6.1E-01	2.9E+00	-6.9E+00	**2.3E+04**
Resource use, minerals and metals	kg Sb eq	4.1E-02	9.6E-07	1.1E-06	2.9E-07	4.9E-02	4.1E-04	2.6E-06	-3.7E-03	**8.7E-02**
Resource use, fossils	MJ	4.5E+03	4.0E+01	2.4E+01	1.0E+01	1.5E+05	4.5E+01	2.1E+02	-4.0E+02	**1.5E+05**
Additional technical information										
Primary energy consumption	MJ	4.5E+03	4.1E+01	2.4E+01	1.0E+01	1.5E+05	4.5E+01	2.1E+02	-4.0E+02	**1.5E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-93: EU total impact of new products sold in the year of study: WM2 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**0**	**0**		**0**	**0**	**0**			**0**
Energy consumption										
Electricity	kWh		0		0	2,394	0			**2,394**
Thermal energy	MJ		0		0	5,835	0			**5,835**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	8.9E+01	5.4E-01	4.3E-01	2.6E-01	2.4E+03	8.9E-01	3.4E+00	-9.7E+00	**2.5E+03**
Ozone depletion	kg CFC-11 eq	3.7E-09	1.8E-10	4.9E-12	1.3E-11	4.1E-05	3.9E-11	7.7E-10	-3.4E-10	**4.1E-05**
Human toxicity, cancer	CTUh	6.5E-07	5.4E-11	1.1E-10	1.7E-10	3.0E-06	6.5E-09	4.3E-09	-4.3E-07	**3.2E-06**
Human toxicity, non-cancer	CTUh	1.0E-06	2.8E-08	2.8E-09	3.5E-09	3.5E-05	1.0E-08	1.8E-08	-2.0E-07	**3.6E-05**
Particulate matter	disease incidence	1.3E-05	6.3E-08	1.4E-08	1.5E-08	1.3E-04	1.3E-07	2.0E-07	-1.1E-06	**1.5E-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	4.2E+00	2.1E-01	7.8E-03	1.6E-02	5.3E+02	4.4E-02	9.3E-01	-4.5E-01	**5.4E+02**
Photochemical ozone formation, human health	kg NMVOC eq	3.4E-01	1.5E-03	1.5E-03	1.4E-03	4.8E+00	3.4E-03	5.1E-03	-2.3E-02	**5.2E+00**
Acidification	mol H+ eq	1.4E+00	2.2E-03	1.7E-03	1.1E-03	8.6E+00	1.4E-02	7.9E-03	-7.8E-02	**9.9E+00**
Eutrophication, terrestrial	mol N eq	1.1E+00	5.9E-03	8.1E-03	3.5E-03	2.0E+01	1.1E-02	1.9E-02	-7.3E-02	**2.1E+01**
Eutrophication, freshwater	kg P eq	1.4E-04	1.2E-06	2.6E-06	4.4E-06	1.3E-01	1.4E-06	4.9E-06	-7.4E-06	**1.3E-01**
Eutrophication, marine	kg N eq	9.8E-02	5.5E-04	7.2E-04	3.6E-04	3.4E+00	9.9E-04	1.7E-03	-6.5E-03	**3.5E+00**
Ecotoxicity, freshwater	CTUe	5.9E+02	4.1E+00	4.0E+00	1.1E+00	2.1E+04	6.0E+00	1.1E+01	-1.2E+02	**2.1E+04**
Land use	pt	3.4E+03	4.9E+00	3.3E+00	7.7E+01	2.7E+04	3.4E+01	1.1E+01	-1.1E+02	**3.1E+04**
Water use	m^3 water eq. of deprived water	1.6E+01	2.1E-01	4.0E-02	4.0E-02	6.0E+03	1.6E-01	7.5E-01	-1.8E+00	**6.0E+03**
Resource use, minerals and metals	kg Sb eq	1.1E-02	2.5E-07	2.8E-07	7.6E-08	1.3E-02	1.1E-04	6.8E-07	-9.6E-04	**2.3E-02**
Resource use, fossils	MJ	1.2E+03	1.0E+01	6.2E+00	2.6E+00	3.8E+04	1.2E+01	5.5E+01	-1.0E+02	**3.9E+04**
Additional technical information										
Primary energy consumption	MJ	1.2E+03	1.1E+01	6.2E+00	2.6E+00	3.8E+04	1.2E+01	5.5E+01	-1.0E+02	**4.0E+04**

Table 9-94: EU total impact of Stock of products in the year of study: WM2 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Others	g	0.000	0.000		0.000	4.242	n.a.			**4.242**
Total weight	g	**0.000**	**0.000**		**0.000**	**4.242**	**0.000**			**4.242**
Energy consumption										
Electricity	kWh		7		0	36,369	0			**36,376**
Thermal energy	MJ		0		0	88,652	0			**88,652**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	1.3E+03	8.1E+00	6.5E+00	4.0E+00	3.6E+04	1.4E+01	5.2E+01	-1.5E+02	**3.8E+04**
Ozone depletion	kg CFC-11 eq	5.6E-08	2.8E-09	7.5E-11	1.9E-10	6.2E-04	5.9E-10	1.2E-08	-5.2E-09	**6.2E-04**
Human toxicity, cancer	CTUh	9.8E-06	8.2E-10	1.7E-09	2.6E-09	4.5E-05	9.8E-08	6.5E-08	-6.5E-06	**4.9E-05**
Human toxicity, non-cancer	CTUh	1.5E-05	4.3E-07	4.2E-08	5.3E-08	5.3E-04	1.6E-07	2.8E-07	-3.0E-06	**5.4E-04**
Particulate matter	disease incidence	2.0E-04	9.6E-07	2.1E-07	2.2E-07	2.0E-03	2.0E-06	3.0E-06	-1.7E-05	**2.2E-03**

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	6.4E+01	3.2E+00	1.2E-01	2.4E-01	8.1E+03	6.7E-01	1.4E+01	-6.8E+00	**8.1E+03**
Photochemical ozone formation, human health	kg NMVOC eq	5.1E+00	2.3E-02	2.3E-02	2.1E-02	7.4E+01	5.2E-02	7.7E-02	-3.5E-01	**7.9E+01**
Acidification	mol H+ eq	2.2E+01	3.4E-02	2.6E-02	1.7E-02	1.3E+02	2.2E-01	1.2E-01	-1.2E+00	**1.5E+02**
Eutrophication, terrestrial	mol N eq	1.6E+01	9.0E-02	1.2E-01	5.3E-02	3.1E+02	1.6E-01	2.8E-01	-1.1E+00	**3.2E+02**
Eutrophication, freshwater	kg P eq	2.2E-03	1.9E-05	3.9E-05	6.6E-05	2.0E+00	2.2E-05	7.4E-05	-1.1E-04	**2.0E+00**
Eutrophication, marine	kg N eq	1.5E+00	8.4E-03	1.1E-02	5.5E-03	5.2E+01	1.5E-02	2.7E-02	-9.8E-02	**5.3E+01**
Ecotoxicity, freshwater	CTUe	9.0E+03	6.3E+01	6.0E+01	1.7E+01	3.1E+05	9.0E+01	1.7E+02	-1.8E+03	**3.2E+05**
Land use	pt	5.2E+04	7.5E+01	5.0E+01	1.2E+03	4.1E+05	5.2E+02	1.6E+02	-1.6E+03	**4.6E+05**
Water use	m^3 water eq. of deprived water	2.4E+02	3.2E+00	6.1E-01	6.0E-01	9.1E+04	2.4E+00	1.1E+01	-2.7E+01	**9.2E+04**
Resource use, minerals and metals	kg Sb eq	1.6E-01	3.8E-06	4.3E-06	1.2E-06	1.9E-01	1.6E-03	1.0E-05	-1.5E-02	**3.4E-01**
Resource use, fossils	MJ	1.8E+04	1.6E+02	9.4E+01	4.0E+01	5.7E+05	1.8E+02	8.3E+02	-1.6E+03	**5.9E+05**
Additional technical information										
Primary energy consumption	MJ	1.8E+04	1.6E+02	9.4E+01	4.0E+01	5.8E+05	1.8E+02	8.3E+02	-1.6E+03	**6.0E+05**

Table 9-95: Life cycle costs per product and total EU expenditure: WM2.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	34,775	EUR	589	mln. EUR/year
Installation/ acquisition costs (if any)	1,391	EUR	24	mln. EUR/year
Fuel (gas, oil, wood)	448	EUR/year	133	mln. EUR/year
Electricity	1,869	EUR/year	556	mln. EUR/year
Water	1,777	EUR/year	529	mln. EUR/year
Auxiliary material 1: Detergent	4,857	EUR/year	1,445	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	1,043	EUR	20	mln. EUR/year
Total	**11,384**	EUR/year	**3,296**	**mln. EUR/year**

WM3: Professional washer dryer

Below, the life cycle impact is provided per product (**Table 9-96**), per year of use of the product (**Table 9-97**), total impact for the EU27 for the new product (**Table 9-98)** and the impact of the stock of products in the EU27 (**Table 9-99**).

Table 9-96: 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 Impacts	EoL Credits	Total
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	10,688	3,470		0	0	n.a.			**14,158**
Others	g	0	0		23,500	2,551,576,000	n.a.			**2,551,599,500**
Total weight	g	**381,988**	**374,770**		**25,000**	**2,551,576,000**	**3,820**			**2,552,361,577**
Energy consumption										
Electricity	kWh		53		0	202,689	0			**202,743**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	1.2E+04	6.6E+01	4.5E+01	2.4E+01	9.5E+04	1.2E+02	4.0E+02	-8.6E+02	**1.1E+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	3.6E-07	2.1E-08	5.2E-10	1.0E-09	4.2E-04	3.8E-09	9.2E-08	-1.2E-08	**4.2E-04**
Human toxicity, cancer	CTUh	3.8E-05	1.6E-08	1.2E-08	1.4E-08	4.0E-05	3.8E-07	5.1E-07	-2.4E-05	**5.5E-05**
Human toxicity, non-cancer	CTUh	1.5E-04	4.3E-06	2.9E-07	3.2E-07	5.7E-04	1.5E-06	2.2E-06	-2.4E-05	**7.1E-04**
Particulate matter	disease incidence	1.9E-03	9.4E-06	1.4E-06	1.2E-06	3.6E-03	1.9E-05	2.3E-05	-8.9E-05	**5.5E-03**
Ionising radiation, human health	kBq U235 eq	5.4E+02	2.3E+01	8.1E-01	1.3E+00	3.7E+04	5.7E+00	1.1E+02	-2.1E+01	**3.8E+04**
Photochemical ozone formation, human health	kg NMVOC eq	4.7E+01	1.9E-01	1.6E-01	1.2E-01	1.7E+02	4.8E-01	5.9E-01	-1.9E+00	**2.1E+02**
Acidification	mol H+ eq	2.0E+02	3.0E-01	1.8E-01	9.4E-02	3.1E+02	2.0E+00	9.2E-01	-5.5E+00	**5.1E+02**
Eutrophication, terrestrial	mol N eq	1.5E+02	7.2E-01	8.5E-01	2.9E-01	6.5E+02	1.5E+00	2.2E+00	-6.0E+00	**8.0E+02**
Eutrophication, freshwater	kg P eq	2.0E-02	1.5E-04	2.7E-04	3.7E-04	1.4E+00	2.0E-04	5.7E-04	-7.3E-04	**1.4E+00**
Eutrophication, marine	kg N eq	1.4E+01	6.7E-02	7.6E-02	3.0E-02	7.5E+01	1.4E-01	2.0E-01	-5.4E-01	**8.9E+01**
Ecotoxicity, freshwater	CTUe	7.2E+04	4.6E+02	4.2E+02	1.5E+02	5.4E+05	7.3E+02	1.3E+03	-6.6E+03	**6.0E+05**
Land use	pt	8.7E+05	1.1E+04	3.5E+02	6.1E+03	5.8E+05	8.8E+03	1.2E+03	-1.5E+04	**1.5E+06**

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	2.1E+03	2.6E+01	4.2E+00	3.8E+00	8.1E+04	2.1E+01	8.9E+01	-9.9E+01	**8.3E+04**
Resource use, minerals and metals	kg Sb eq	1.5E+00	1.8E-03	3.0E-05	7.1E-06	1.3E-01	1.5E-02	8.0E-05	-9.7E-02	**1.6E+00**
Resource use, fossils	MJ	1.6E+05	1.2E+03	6.5E+02	3.1E+02	1.6E+06	1.6E+03	6.4E+03	-8.6E+03	**1.8E+06**
Additional technical information										
Primary energy consumption	MJ	1.6E+05	1.2E+03	6.5E+02	3.1E+02	1.7E+06	1.6E+03	6.4E+03	-8.6E+03	**1.8E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-97: 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 Impacts	EoL Credits	Total
Materials	unit									
Plastics	g	268	268		48	0	n.a.			**585**
Metals	g	11,594	11,594		0	0	n.a.			**23,188**
Electronics	g	341	111		0	0	n.a.			**452**
Others	g	0	0		751	81,520,000	n.a.			**81,520,751**

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	**12,204**	**11,973**		**799**	**81,520,000**	**122**			**81,545,098**
Energy consumption										
Electricity	kWh		2		0	6,476	0			**6,477**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	3.9E+02	2.1E+00	1.4E+00	7.6E-01	3.0E+03	3.9E+00	1.3E+01	-2.8E+01	**3.4E+03**
Ozone depletion	kg CFC-11 eq	1.2E-08	6.6E-10	1.7E-11	3.3E-11	1.3E-05	1.2E-10	2.9E-09	-3.8E-10	**1.3E-05**
Human toxicity, cancer	CTUh	1.2E-06	5.2E-10	3.8E-10	4.5E-10	1.3E-06	1.2E-08	1.6E-08	-7.7E-07	**1.8E-06**
Human toxicity, non-cancer	CTUh	4.7E-06	1.4E-07	9.3E-09	1.0E-08	1.8E-05	4.8E-08	7.0E-08	-7.6E-07	**2.3E-05**
Particulate matter	disease incidence	5.9E-05	3.0E-07	4.6E-08	3.8E-08	1.2E-04	6.0E-07	7.4E-07	-2.8E-06	**1.7E-04**
Ionising radiation, human health	kBq U235 eq	1.7E+01	7.5E-01	2.6E-02	4.3E-02	1.2E+03	1.8E-01	3.5E+00	-6.7E-01	**1.2E+03**
Photochemical ozone formation, human health	kg NMVOC eq	1.5E+00	6.0E-03	5.1E-03	3.7E-03	5.3E+00	1.5E-02	1.9E-02	-6.1E-02	**6.8E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Acidification	mol H+ eq	6.4E+00	9.5E-03	5.6E-03	3.0E-03	9.9E+00	6.4E-02	2.9E-02	-1.8E-01	**1.6E+01**
Eutrophication, terrestrial	mol N eq	4.8E+00	2.3E-02	2.7E-02	9.3E-03	2.1E+01	4.8E-02	7.0E-02	-1.9E-01	**2.5E+01**
Eutrophication, freshwater	kg P eq	6.3E-04	4.7E-06	8.7E-06	1.2E-05	4.3E-02	6.4E-06	1.8E-05	-2.3E-05	**4.4E-02**
Eutrophication, marine	kg N eq	4.4E-01	2.1E-03	2.4E-03	9.6E-04	2.4E+00	4.4E-03	6.5E-03	-1.7E-02	**2.8E+00**
Ecotoxicity, freshwater	CTUe	2.3E+03	1.5E+01	1.3E+01	4.7E+00	1.7E+04	2.3E+01	4.2E+01	-2.1E+02	**1.9E+04**
Land use	pt	2.8E+04	3.4E+02	1.1E+01	2.0E+02	1.9E+04	2.8E+02	4.0E+01	-4.8E+02	**4.7E+04**
Water use	m^3 water eq. of deprived water	6.8E+01	8.4E-01	1.3E-01	1.2E-01	2.6E+03	6.8E-01	2.9E+00	-3.2E+00	**2.7E+03**
Resource use, minerals and metals	kg Sb eq	4.9E-02	5.8E-05	9.6E-07	2.3E-07	4.3E-03	4.9E-04	2.5E-06	-3.1E-03	**5.1E-02**
Resource use, fossils	MJ	5.1E+03	3.8E+01	2.1E+01	1.0E+01	5.2E+04	5.1E+01	2.1E+02	-2.7E+02	**5.7E+04**
Additional technical information										
Primary energy consumption	MJ	5.1E+03	3.8E+01	2.1E+01	1.0E+01	5.3E+04	5.1E+01	2.1E+02	-2.7E+02	**5.8E+04**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-98: EU total impact of new products sold in the year of study: WM3 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

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	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**0**	**0**		**0**	**0**	**0**			**0**
Energy consumption										
Electricity	kWh		0		0	82	0			**82**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	4.9E+00	2.7E-02	1.8E-02	9.6E-03	3.8E+01	4.9E-02	1.6E-01	-3.5E-01	**4.3E+01**
Ozone depletion	kg CFC-11 eq	1.5E-10	8.4E-12	2.1E-13	4.2E-13	1.7E-07	1.6E-12	3.7E-11	-4.8E-12	**1.7E-07**
Human toxicity, cancer	CTUh	1.6E-08	6.7E-12	4.9E-12	5.8E-12	1.6E-08	1.6E-10	2.0E-10	-9.7E-09	**2.2E-08**
Human toxicity, non-cancer	CTUh	6.0E-08	1.7E-09	1.2E-10	1.3E-10	2.3E-07	6.1E-10	8.9E-10	-9.6E-09	**2.9E-07**
Particulate matter	disease incidence	7.5E-07	3.8E-09	5.9E-10	4.8E-10	1.5E-06	7.5E-09	9.4E-09	-3.6E-08	**2.2E-06**

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	2.2E-01	9.5E-03	3.3E-04	5.4E-04	1.5E+01	2.3E-03	4.5E-02	-8.5E-03	**1.5E+01**
Photochemical ozone formation, human health	kg NMVOC eq	1.9E-02	7.6E-05	6.5E-05	4.7E-05	6.8E-02	1.9E-04	2.4E-04	-7.8E-04	**8.7E-02**
Acidification	mol H+ eq	8.1E-02	1.2E-04	7.2E-05	3.8E-05	1.3E-01	8.1E-04	3.7E-04	-2.2E-03	**2.0E-01**
Eutrophication, terrestrial	mol N eq	6.0E-02	2.9E-04	3.4E-04	1.2E-04	2.6E-01	6.1E-04	8.9E-04	-2.4E-03	**3.2E-01**
Eutrophication, freshwater	kg P eq	8.0E-06	6.0E-08	1.1E-07	1.5E-07	5.5E-04	8.1E-08	2.3E-07	-2.9E-07	**5.6E-04**
Eutrophication, marine	kg N eq	5.6E-03	2.7E-05	3.1E-05	1.2E-05	3.0E-02	5.6E-05	8.3E-05	-2.2E-04	**3.6E-02**
Ecotoxicity, freshwater	CTUe	2.9E+01	1.8E-01	1.7E-01	6.0E-02	2.2E+02	2.9E-01	5.3E-01	-2.7E+00	**2.4E+02**
Land use	pt	3.5E+02	4.3E+00	1.4E-01	2.5E+00	2.4E+02	3.6E+00	5.0E-01	-6.1E+00	**5.9E+02**
Water use	m^3 water eq. of deprived water	8.6E-01	1.1E-02	1.7E-03	1.5E-03	3.3E+01	8.7E-03	3.6E-02	-4.0E-02	**3.4E+01**
Resource use, minerals and metals	kg Sb eq	6.2E-04	7.3E-07	1.2E-08	2.9E-09	5.4E-05	6.2E-06	3.2E-08	-3.9E-05	**6.4E-04**
Resource use, fossils	MJ	6.4E+01	4.8E-01	2.6E-01	1.3E-01	6.5E+02	6.5E-01	2.6E+00	-3.5E+00	**7.2E+02**
Additional technical information										
Primary energy consumption	MJ	6.4E+01	4.8E-01	2.6E-01	1.3E-01	6.8E+02	6.5E-01	2.6E+00	-3.5E+00	**7.4E+02**

8655

Table 9-99: EU total impact of Stock of products in the year of study: WM3 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Others	g	0.000	0.000		0.000	0.026	n.a.			**0.026**
Total weight	g	**0.000**	**0.000**		**0.000**	**0.026**	**0.000**			**0.026**
Energy consumption										
Electricity	kWh		1		0	2,041	0			**2,042**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	1.2E+02	6.6E-01	4.5E-01	2.4E-01	9.5E+02	1.2E+00	4.0E+00	-8.7E+00	**1.1E+03**
Ozone depletion	kg CFC-11 eq	3.7E-09	2.1E-10	5.2E-12	1.0E-11	4.2E-06	3.9E-11	9.2E-10	-1.2E-10	**4.2E-06**
Human toxicity, cancer	CTUh	3.9E-07	1.7E-10	1.2E-10	1.4E-10	4.0E-07	3.9E-09	5.1E-09	-2.4E-07	**5.6E-07**
Human toxicity, non-cancer	CTUh	1.5E-06	4.3E-08	2.9E-09	3.2E-09	5.8E-06	1.5E-08	2.2E-08	-2.4E-07	**7.1E-06**
Particulate matter	disease incidence	1.9E-05	9.5E-08	1.5E-08	1.2E-08	3.7E-05	1.9E-07	2.3E-07	-9.0E-07	**5.5E-05**

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	5.5E+00	2.4E-01	8.2E-03	1.3E-02	3.7E+02	5.7E-02	1.1E+00	-2.1E-01	**3.8E+02**
Photochemical ozone formation, human health	kg NMVOC eq	4.8E-01	1.9E-03	1.6E-03	1.2E-03	1.7E+00	4.8E-03	6.0E-03	-1.9E-02	**2.2E+00**
Acidification	mol H+ eq	2.0E+00	3.0E-03	1.8E-03	9.4E-04	3.1E+00	2.0E-02	9.3E-03	-5.6E-02	**5.1E+00**
Eutrophication, terrestrial	mol N eq	1.5E+00	7.3E-03	8.5E-03	2.9E-03	6.5E+00	1.5E-02	2.2E-02	-6.0E-02	**8.0E+00**
Eutrophication, freshwater	kg P eq	2.0E-04	1.5E-06	2.7E-06	3.7E-06	1.4E-02	2.0E-06	5.8E-06	-7.3E-06	**1.4E-02**
Eutrophication, marine	kg N eq	1.4E-01	6.7E-04	7.6E-04	3.0E-04	7.6E-01	1.4E-03	2.1E-03	-5.4E-03	**9.0E-01**
Ecotoxicity, freshwater	CTUe	7.3E+02	4.6E+00	4.2E+00	1.5E+00	5.4E+03	7.3E+00	1.3E+01	-6.6E+01	**6.1E+03**
Land use	pt	8.7E+03	1.1E+02	3.5E+00	6.2E+01	5.9E+03	8.9E+01	1.3E+01	-1.5E+02	**1.5E+04**
Water use	m^3 water eq. of deprived water	2.1E+01	2.6E-01	4.2E-02	3.8E-02	8.2E+02	2.2E-01	9.0E-01	-1.0E+00	**8.4E+02**
Resource use, minerals and metals	kg Sb eq	1.5E-02	1.8E-05	3.0E-07	7.1E-08	1.4E-03	1.5E-04	8.0E-07	-9.7E-04	**1.6E-02**
Resource use, fossils	MJ	1.6E+03	1.2E+01	6.5E+00	3.2E+00	1.6E+04	1.6E+01	6.5E+01	-8.7E+01	**1.8E+04**
Additional technical information										
Primary energy consumption	MJ	1.6E+03	1.2E+01	6.5E+00	3.2E+00	1.7E+04	1.6E+01	6.5E+01	-8.7E+01	**1.8E+04**

Table 9-100: Life cycle costs per product and total EU expenditure: WM3.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	12,200	EUR	5	mln. EUR/year
Installation/ acquisition costs (if any)	488	EUR	0	mln. EUR/year
Fuel (gas, oil, wood)	0	EUR/year	0	mln. EUR/year
Electricity	1,190	EUR/year	15	mln. EUR/year
Water	122	EUR/year	2	mln. EUR/year
Auxiliary material 1: Detergent	481	EUR/year	6	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	366	EUR	0	mln. EUR/year
Total	**2,210**	EUR/year	**28**	**mln. EUR/year**

WM4: Professional barrier washer

Below, the life cycle impact is provided per product (**Table 9-101**), per year of use of the product **(Table 9-102**), total impact for the EU27 for the new product (**Table 9-103**) and the impact of the stock of products in the EU27 (**Table 9-104**).

Table 9-101: 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 Impacts	EoL Credits	Total
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	60,214	19,550		0	0	n.a.			**79,764**
Others	g	0	0		2,675	16,753,645,500	n.a.			**16,753,648,175**
Total weight	g	**1,003,514**	**962,850**		**2,726**	**16,753,645,500**	**10,035**			**16,755,624,625**
Energy consumption										
Electricity	kWh		124		0	56,781	0			**56,905**
Thermal energy	MJ		0		0	1,096,870	0			**1,096,870**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	6.7E+04	3.2E+02	1.1E+02	2.3E+00	1.5E+05	6.7E+02	8.6E+02	-3.8E+03	**2.1E+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	2.1E-06	8.4E-08	1.3E-09	1.0E-10	2.0E-03	2.2E-08	1.9E-07	-5.7E-08	**2.0E-03**
Human toxicity, cancer	CTUh	4.5E-04	1.9E-07	3.0E-08	1.7E-09	1.6E-04	4.5E-06	1.1E-06	-2.9E-04	**3.2E-04**
Human toxicity, non-cancer	CTUh	6.5E-04	2.3E-05	7.2E-07	3.5E-08	1.9E-03	6.8E-06	5.4E-06	-4.7E-05	**2.5E-03**
Particulate matter	disease incidence	1.1E-02	3.8E-05	3.6E-06	1.3E-07	5.9E-03	1.1E-04	4.9E-05	-6.0E-04	**1.6E-02**
Ionising radiation, human health	kBq U235 eq	3.0E+03	9.5E+01	2.0E+00	1.3E-01	1.6E+04	3.1E+01	2.3E+02	-9.3E+01	**2.0E+04**
Photochemical ozone formation, human health	kg NMVOC eq	2.7E+02	8.2E-01	4.0E-01	1.1E-02	2.3E+02	2.7E+00	1.3E+00	-1.1E+01	**5.0E+02**
Acidification	mol H+ eq	1.1E+03	1.3E+00	4.4E-01	9.2E-03	3.7E+02	1.1E+01	2.0E+00	-4.6E+01	**1.5E+03**
Eutrophication, terrestrial	mol N eq	8.4E+02	2.9E+00	2.1E+00	2.8E-02	8.9E+02	8.4E+00	4.7E+00	-3.5E+01	**1.7E+03**
Eutrophication, freshwater	kg P eq	1.1E-01	6.1E-04	6.7E-04	2.8E-05	7.0E+00	1.1E-03	1.2E-03	-2.8E-03	**7.1E+00**
Eutrophication, marine	kg N eq	7.7E+01	2.7E-01	1.9E-01	2.8E-03	1.6E+02	7.8E-01	4.4E-01	-3.1E+00	**2.4E+02**
Ecotoxicity, freshwater	CTUe	4.0E+05	1.9E+03	1.0E+03	1.1E+01	9.2E+05	4.0E+03	2.8E+03	-3.6E+04	**1.3E+06**
Land use	pt	1.8E+06	5.5E+04	8.6E+02	6.0E+02	1.2E+06	1.8E+04	2.6E+03	-8.5E+04	**2.9E+06**

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	1.2E+04	1.1E+02	1.0E+01	3.1E-01	3.4E+05	1.2E+02	1.9E+02	-8.3E+02	**3.5E+05**
Resource use, minerals and metals	kg Sb eq	8.3E+00	9.4E-03	7.4E-05	5.5E-07	7.1E-01	8.3E-02	1.7E-04	-5.5E-01	**8.6E+00**
Resource use, fossils	MJ	8.8E+05	5.1E+03	1.6E+03	2.4E+01	2.2E+06	8.9E+03	1.4E+04	-4.2E+04	**3.1E+06**
Additional technical information										
Primary energy consumption	MJ	8.8E+05	5.1E+03	1.6E+03	2.4E+01	2.2E+06	8.9E+03	1.4E+04	-4.2E+04	**3.1E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-102: 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 Impacts	EoL Credits	Total
Materials	unit									
Plastics	g	4,410	4,410		2	0	n.a.			**8,822**
Metals	g	41,605	41,605		0	0	n.a.			**83,210**
Electronics	g	2,937	954		0	0	n.a.			**3,891**

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		130	817,251,000	n.a.			**817,251,130**
Total weight	g	**48,952**	**46,968**		**133**	**817,251,000**	**490**			**817,347,543**
Energy consumption										
Electricity	kWh		6		0	2,770	0			**2,776**
Thermal energy	MJ		0		0	53,506	0			**53,506**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	3.2E+03	1.5E+01	5.4E+00	1.1E-01	7.1E+03	3.3E+01	4.2E+01	-1.8E+02	**1.0E+04**
Ozone depletion	kg CFC-11 eq	1.0E-07	4.1E-09	6.2E-11	5.1E-12	9.6E-05	1.1E-09	9.3E-09	-2.8E-09	**9.6E-05**
Human toxicity, cancer	CTUh	2.2E-05	9.2E-09	1.4E-09	8.1E-11	7.9E-06	2.2E-07	5.2E-08	-1.4E-05	**1.6E-05**
Human toxicity, non-cancer	CTUh	3.2E-05	1.1E-06	3.5E-08	1.7E-09	9.1E-05	3.3E-07	2.6E-07	-2.3E-06	**1.2E-04**
Particulate matter	disease incidence	5.1E-04	1.9E-06	1.7E-07	6.3E-09	2.9E-04	5.2E-06	2.4E-06	-2.9E-05	**7.8E-04**
Ionising radiation, human health	kBq U235 eq	1.5E+02	4.7E+00	9.8E-02	6.5E-03	8.0E+02	1.5E+00	1.1E+01	-4.5E+00	**9.6E+02**
Photochemical ozone formation, human health	kg NMVOC eq	1.3E+01	4.0E-02	1.9E-02	5.5E-04	1.1E+01	1.3E-01	6.2E-02	-5.4E-01	**2.4E+01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL	Impacts Credits	Total
Acidification	mol H+ eq	5.6E+01	6.4E-02	2.1E-02	4.5E-04	1.8E+01	5.6E-01	9.6E-02	-2.3E+00	**7.2E+01**
Eutrophication, terrestrial	mol N eq	4.1E+01	1.4E-01	1.0E-01	1.4E-03	4.3E+01	4.1E-01	2.3E-01	-1.7E+00	**8.4E+01**
Eutrophication, freshwater	kg P eq	5.3E-03	3.0E-05	3.3E-05	1.4E-06	3.4E-01	5.3E-05	6.0E-05	-1.3E-04	**3.5E-01**
Eutrophication, marine	kg N eq	3.8E+00	1.3E-02	9.1E-03	1.4E-04	7.8E+00	3.8E-02	2.1E-02	-1.5E-01	**1.2E+01**
Ecotoxicity, freshwater	CTUe	2.0E+04	9.1E+01	5.0E+01	5.2E-01	4.5E+04	2.0E+02	1.4E+02	-1.8E+03	**6.3E+04**
Land use	pt	8.7E+04	2.7E+03	4.2E+01	2.9E+01	5.8E+04	8.9E+02	1.3E+02	-4.1E+03	**1.4E+05**
Water use	m^3 water eq. of deprived water	5.8E+02	5.2E+00	5.0E-01	1.5E-02	1.6E+04	5.8E+00	9.4E+00	-4.1E+01	**1.7E+04**
Resource use, minerals and metals	kg Sb eq	4.1E-01	4.6E-04	3.6E-06	2.7E-08	3.5E-02	4.1E-03	8.3E-06	-2.7E-02	**4.2E-01**
Resource use, fossils	MJ	4.3E+04	2.5E+02	7.8E+01	1.1E+00	1.1E+05	4.3E+02	6.8E+02	-2.0E+03	**1.5E+05**
Additional technical information										
Primary energy consumption	MJ	4.3E+04	2.5E+02	7.8E+01	1.1E+00	1.1E+05	4.3E+02	6.8E+02	-2.0E+03	**1.5E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-103: EU total impact of new products sold in the year of study: WM4 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**0**	**0**		**0**	**0**	**0**			**0**
Energy consumption										
Electricity	kWh		0		0	69	0			69
Thermal energy	MJ		0		0	1,333	0			1,333
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	8.1E+01	3.8E-01	1.4E-01	2.7E-03	1.8E+02	8.1E-01	1.1E+00	-4.6E+00	**2.6E+02**
Ozone depletion	kg CFC-11 eq	2.6E-09	1.0E-10	1.6E-12	1.3E-13	2.4E-06	2.7E-11	2.3E-10	-6.9E-11	**2.4E-06**
Human toxicity, cancer	CTUh	5.4E-07	2.3E-10	3.6E-11	2.0E-12	2.0E-07	5.4E-09	1.3E-09	-3.6E-07	**3.9E-07**
Human toxicity, non-cancer	CTUh	7.9E-07	2.8E-08	8.8E-10	4.2E-11	2.3E-06	8.2E-09	6.6E-09	-5.8E-08	**3.0E-06**
Particulate matter	disease incidence	1.3E-05	4.6E-08	4.3E-09	1.6E-10	7.2E-06	1.3E-07	5.9E-08	-7.2E-07	**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	
Ionising radiation, human health	kBq U235 eq	3.7E+00	1.2E-01	2.4E-03	1.6E-04	2.0E+01	3.8E-02	2.8E-01	-1.1E-01	**2.4E+01**
Photochemical ozone formation, human health	kg NMVOC eq	3.2E-01	1.0E-03	4.8E-04	1.4E-05	2.9E-01	3.3E-03	1.6E-03	-1.3E-02	**6.0E-01**
Acidification	mol H+ eq	1.4E+00	1.6E-03	5.3E-04	1.1E-05	4.5E-01	1.4E-02	2.4E-03	-5.6E-02	**1.8E+00**
Eutrophication, terrestrial	mol N eq	1.0E+00	3.6E-03	2.5E-03	3.4E-05	1.1E+00	1.0E-02	5.7E-03	-4.3E-02	**2.1E+00**
Eutrophication, freshwater	kg P eq	1.3E-04	7.4E-07	8.1E-07	3.4E-08	8.5E-03	1.3E-06	1.5E-06	-3.4E-06	**8.6E-03**
Eutrophication, marine	kg N eq	9.4E-02	3.3E-04	2.3E-04	3.4E-06	1.9E-01	9.4E-04	5.4E-04	-3.8E-03	**2.9E-01**
Ecotoxicity, freshwater	CTUe	4.9E+02	2.3E+00	1.3E+00	1.3E-02	1.1E+03	4.9E+00	3.4E+00	-4.4E+01	**1.6E+03**
Land use	pt	2.2E+03	6.6E+01	1.0E+00	7.3E-01	1.4E+03	2.2E+01	3.2E+00	-1.0E+02	**3.6E+03**
Water use	m^3 water eq. of deprived water	1.4E+01	1.3E-01	1.3E-02	3.8E-04	4.1E+02	1.5E-01	2.3E-01	-1.0E+00	**4.2E+02**
Resource use, minerals and metals	kg Sb eq	1.0E-02	1.1E-05	9.0E-08	6.7E-10	8.6E-04	1.0E-04	2.1E-07	-6.7E-04	**1.0E-02**
Resource use, fossils	MJ	1.1E+03	6.1E+00	1.9E+00	2.9E-02	2.7E+03	1.1E+01	1.7E+01	-5.1E+01	**3.8E+03**
Additional technical information										
Primary energy consumption	MJ	1.1E+03	6.2E+00	1.9E+00	2.9E-02	2.7E+03	1.1E+01	1.7E+01	-5.1E+01	**3.8E+03**

8671

Table 9-104: EU total impact of Stock of products in the year of study: WM4 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Others	g	0.000	0.000		0.000	0.026	n.a.			**0.026**
Total weight	g	**0.000**	**0.000**		**0.000**	**0.026**	**0.000**			**0.026**
Energy consumption										
Electricity	kWh		3		0	1,346	0			**1,349**
Thermal energy	MJ		0		0	26,002	0			**26,002**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	1.6E+03	7.5E+00	2.6E+00	5.3E-02	3.5E+03	1.6E+01	2.0E+01	-8.9E+01	**5.0E+03**
Ozone depletion	kg CFC-11 eq	5.1E-08	2.0E-09	3.0E-11	2.5E-12	4.7E-05	5.3E-10	4.5E-09	-1.3E-09	**4.7E-05**
Human toxicity, cancer	CTUh	1.1E-05	4.5E-09	7.0E-10	3.9E-11	3.8E-06	1.1E-07	2.5E-08	-7.0E-06	**7.6E-06**
Human toxicity, non-cancer	CTUh	1.6E-05	5.5E-07	1.7E-08	8.3E-10	4.4E-05	1.6E-07	1.3E-07	-1.1E-06	**5.9E-05**
Particulate matter	disease incidence	2.5E-04	9.0E-07	8.5E-08	3.0E-09	1.4E-04	2.5E-06	1.2E-06	-1.4E-05	**3.8E-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	7.2E+01	2.3E+00	4.8E-02	3.2E-03	3.9E+02	7.4E-01	5.5E+00	-2.2E+00	**4.7E+02**
Photochemical ozone formation, human health	kg NMVOC eq	6.3E+00	1.9E-02	9.4E-03	2.7E-04	5.6E+00	6.4E-02	3.0E-02	-2.6E-01	**1.2E+01**
Acidification	mol H+ eq	2.7E+01	3.1E-02	1.0E-02	2.2E-04	8.9E+00	2.7E-01	4.6E-02	-1.1E+00	**3.5E+01**
Eutrophication, terrestrial	mol N eq	2.0E+01	7.0E-02	5.0E-02	6.6E-04	2.1E+01	2.0E-01	1.1E-01	-8.4E-01	**4.1E+01**
Eutrophication, freshwater	kg P eq	2.6E-03	1.4E-05	1.6E-05	6.6E-07	1.7E-01	2.6E-05	2.9E-05	-6.5E-05	**1.7E-01**
Eutrophication, marine	kg N eq	1.8E+00	6.5E-03	4.4E-03	6.7E-05	3.8E+00	1.8E-02	1.0E-02	-7.4E-02	**5.6E+00**
Ecotoxicity, freshwater	CTUe	9.5E+03	4.4E+01	2.4E+01	2.5E-01	2.2E+04	9.6E+01	6.7E+01	-8.5E+02	**3.1E+04**
Land use	pt	4.2E+04	1.3E+03	2.0E+01	1.4E+01	2.8E+04	4.3E+02	6.3E+01	-2.0E+03	**7.0E+04**
Water use	m^3 water eq. of deprived water	2.8E+02	2.5E+00	2.5E-01	7.5E-03	8.0E+03	2.8E+00	4.6E+00	-2.0E+01	**8.2E+03**
Resource use, minerals and metals	kg Sb eq	2.0E-01	2.2E-04	1.8E-06	1.3E-08	1.7E-02	2.0E-03	4.0E-06	-1.3E-02	**2.0E-01**
Resource use, fossils	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	**7.3E+04**
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 9-105: Life cycle costs per product and total EU expenditure: WM4.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	57,375	EUR	70	mln. EUR/year
Installation/ acquisition costs (if any)	2,295	EUR	3	mln. EUR/year
Fuel (gas, oil, wood)	1,023	EUR/year	29	mln. EUR/year
Electricity	539	EUR/year	15	mln. EUR/year
Water	1,296	EUR/year	37	mln. EUR/year
Auxiliary material 1: Detergent	3,819	EUR/year	109	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	14,343	EUR	20	mln. EUR/year
Total	**10,286**	EUR/year	**283**	**mln. EUR/year**

WM5: Industrial continuous tunnel washer

Below, the life cycle impact is provided per product (**Table 9-106**), per year of use of the product (**Table 9-107**), total impact for the EU27 for the new product (**Table 9-108**) and the impact of the stock of products in the EU27 (**Table 9-109**).

Table 9-106: 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	119,997	38,960		0	0	n.a.			**158,957**
Others	g	0	0		0	288,632,970,000	n.a.			**288,632,970,000**
Total weight	g	**12,119,997**	**12,038,960**		**0**	**288,632,970,000**	**121,200**			**288,657,250,157**
Energy consumption										
Electricity	kWh		1,536		0	786,038	0			**787,573**
Thermal energy	MJ		0		0	56,594,700	0			**56,594,700**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	2.0E+05	1.0E+03	1.3E+03	0.0E+00	5.1E+06	2.0E+03	1.3E+04	-5.3E+04	**5.2E+06**
Ozone depletion	kg CFC-11 eq	2.8E-06	4.7E-07	1.5E-08	0.0E+00	4.3E-02	3.2E-08	3.1E-06	-1.9E-07	**4.3E-02**
Human toxicity, cancer	CTUh	6.7E-03	-4.8E-07	3.6E-07	0.0E+00	3.3E-03	6.7E-05	1.7E-05	-4.6E-03	**5.6E-03**
Human toxicity, non-cancer	CTUh	2.2E-03	5.0E-05	8.7E-06	0.0E+00	3.7E-02	2.3E-05	6.9E-05	-6.5E-04	**3.9E-02**
Particulate matter	disease incidence	3.2E-02	1.8E-04	4.3E-05	0.0E+00	1.3E-01	3.2E-04	7.9E-04	-8.8E-03	**1.6E-01**
Ionising radiation, human health	kBq U235 eq	7.0E+03	5.3E+02	2.4E+01	0.0E+00	3.1E+05	7.6E+01	3.8E+03	-7.1E+02	**3.2E+05**

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	7.3E+02	3.4E+00	4.8E+00	0.0E+00	6.1E+03	7.3E+00	2.0E+01	-1.5E+02	**6.7E+03**
Acidification	mol H+ eq	3.1E+03	5.3E+00	5.3E+00	0.0E+00	8.8E+03	3.1E+01	3.1E+01	-6.6E+02	**1.1E+04**
Eutrophication, terrestrial	mol N eq	2.3E+03	1.5E+01	2.5E+01	0.0E+00	2.1E+04	2.3E+01	7.3E+01	-4.8E+02	**2.3E+04**
Eutrophication, freshwater	kg P eq	2.6E-01	3.1E-03	8.1E-03	0.0E+00	1.5E+02	2.6E-03	1.9E-02	-3.8E-02	**1.5E+02**
Eutrophication, marine	kg N eq	2.1E+02	1.4E+00	2.3E+00	0.0E+00	3.7E+03	2.1E+00	6.8E+00	-4.2E+01	**3.9E+03**
Ecotoxicity, freshwater	CTUe	1.1E+06	1.0E+04	1.2E+04	0.0E+00	2.0E+07	1.1E+04	4.4E+04	-2.5E+05	**2.1E+07**
Land use	pt	1.4E+07	1.3E+04	1.0E+04	0.0E+00	2.7E+07	1.4E+05	4.2E+04	-2.3E+05	**4.0E+07**
Water use	m^3 water eq. of deprived water	3.9E+04	5.6E+02	1.2E+02	0.0E+00	6.1E+06	3.9E+02	3.0E+03	-1.1E+04	**6.1E+06**
Resource use, minerals and metals	kg Sb eq	2.4E+01	7.5E-04	8.9E-04	0.0E+00	2.0E+01	2.4E-01	2.7E-03	-5.8E+00	**3.8E+01**
Resource use, fossils	MJ	2.5E+06	2.4E+04	1.9E+04	0.0E+00	7.8E+07	2.5E+04	2.1E+05	-5.8E+05	**8.0E+07**
Additional technical information										
Primary energy consumption	MJ	2.5E+06	2.4E+04	1.9E+04	0.0E+00	7.8E+07	2.5E+04	2.1E+05	-5.8E+05	**8.0E+07**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-107: 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		Total
								Impacts	Credits	
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	8,759	2,844		0	0	n.a.			**11,603**
Others	g	0	0		0	21,068,100,000	n.a.			**21,068,100,000**
Total weight	g	**884,671**	**878,756**		**0**	**21,068,100,000**	**8,847**			**21,069,872,274**
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	1.5E+04	7.6E+01	9.8E+01	0.0E+00	3.7E+05	1.5E+02	9.7E+02	-3.9E+03	**3.8E+05**
Ozone depletion	kg CFC-11 eq	2.0E-07	3.4E-08	1.1E-09	0.0E+00	3.2E-03	2.4E-09	2.3E-07	-1.4E-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	**4.1E-04**

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	1.6E-04	3.7E-06	6.3E-07	0.0E+00	2.7E-03	1.7E-06	5.0E-06	-4.7E-05	**2.8E-03**
Particulate matter	disease incidence	2.3E-03	1.3E-05	3.1E-06	0.0E+00	9.8E-03	2.4E-05	5.7E-05	-6.4E-04	**1.2E-02**
Ionising radiation, human health	kBq U235 eq	5.1E+02	3.9E+01	1.8E+00	0.0E+00	2.3E+04	5.5E+00	2.7E+02	-5.2E+01	**2.3E+04**
Photochemical ozone formation, human health	kg NMVOC eq	5.3E+01	2.5E-01	3.5E-01	0.0E+00	4.5E+02	5.3E-01	1.5E+00	-1.1E+01	**4.9E+02**
Acidification	mol H+ eq	2.3E+02	3.9E-01	3.8E-01	0.0E+00	6.4E+02	2.3E+00	2.3E+00	-4.8E+01	**8.2E+02**
Eutrophication, terrestrial	mol N eq	1.7E+02	1.1E+00	1.8E+00	0.0E+00	1.5E+03	1.7E+00	5.4E+00	-3.5E+01	**1.7E+03**
Eutrophication, freshwater	kg P eq	1.9E-02	2.3E-04	5.9E-04	0.0E+00	1.1E+01	1.9E-04	1.4E-03	-2.8E-03	**1.1E+01**
Eutrophication, marine	kg N eq	1.5E+01	1.0E-01	1.6E-01	0.0E+00	2.7E+02	1.5E-01	5.0E-01	-3.1E+00	**2.9E+02**
Ecotoxicity, freshwater	CTUe	8.0E+04	7.6E+02	9.1E+02	0.0E+00	1.5E+06	8.0E+02	3.2E+03	-1.8E+04	**1.5E+06**
Land use	pt	1.0E+06	9.6E+02	7.6E+02	0.0E+00	1.9E+06	1.0E+04	3.1E+03	-1.7E+04	**2.9E+06**
Water use	m^3 water eq. of deprived water	2.8E+03	4.1E+01	9.1E+00	0.0E+00	4.4E+05	2.9E+01	2.2E+02	-8.2E+02	**4.4E+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	1.8E+00	5.5E-05	6.5E-05	0.0E+00	1.4E+00	1.8E-02	2.0E-04	-4.3E-01	**2.8E+00**
Resource use, fossils	MJ	1.8E+05	1.7E+03	1.4E+03	0.0E+00	5.7E+06	1.9E+03	1.6E+04	-4.2E+04	**5.8E+06**
Additional technical information										
Primary energy consumption	MJ	1.8E+05	1.8E+03	1.4E+03	0.0E+00	5.7E+06	1.9E+03	1.6E+04	-4.2E+04	5.8E+06

* Manufacturing materials are currently double counting the raw materials column.

Table 9-108: EU total impact of new products sold in the year of study: WM5 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

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	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	1	n.a.			**1**
Total weight	g	**0**	**0**		**0**	**1**	**0**			**1**
Energy consumption										
Electricity	kWh		0		0	197	0			197
Thermal energy	MJ		0		0	14,149	0			14,149
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	5.0E+01	2.6E-01	3.4E-01	0.0E+00	1.3E+03	5.1E-01	3.3E+00	-1.3E+01	1.3E+03
Ozone depletion	kg CFC-11 eq	6.9E-10	1.2E-10	3.9E-12	0.0E+00	1.1E-05	8.1E-12	7.8E-10	-4.8E-11	1.1E-05
Human toxicity, cancer	CTUh	1.7E-06	-1.2E-10	8.9E-11	0.0E+00	8.3E-07	1.7E-08	4.3E-09	-1.2E-06	1.4E-06
Human toxicity, non-cancer	CTUh	5.6E-07	1.3E-08	2.2E-09	0.0E+00	9.2E-06	5.7E-09	1.7E-08	-1.6E-07	9.7E-06
Particulate matter	disease incidence	8.0E-06	4.6E-08	1.1E-08	0.0E+00	3.4E-05	8.1E-08	2.0E-07	-2.2E-06	4.0E-05

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	1.8E+00	1.3E-01	6.1E-03	0.0E+00	7.7E+01	1.9E-02	9.4E-01	-1.8E-01	8.0E+01
Photochemical ozone formation, human health	kg NMVOC eq	1.8E-01	8.6E-04	1.2E-03	0.0E+00	1.5E+00	1.8E-03	5.0E-03	-3.8E-02	1.7E+00
Acidification	mol H+ eq	7.8E-01	1.3E-03	1.3E-03	0.0E+00	2.2E+00	7.8E-03	7.7E-03	-1.6E-01	2.8E+00
Eutrophication, terrestrial	mol N eq	5.7E-01	3.7E-03	6.3E-03	0.0E+00	5.3E+00	5.7E-03	1.8E-02	-1.2E-01	5.7E+00
Eutrophication, freshwater	kg P eq	6.5E-05	7.8E-07	2.0E-06	0.0E+00	3.9E-02	6.5E-07	4.8E-06	-9.6E-06	3.9E-02
Eutrophication, marine	kg N eq	5.2E-02	3.4E-04	5.6E-04	0.0E+00	9.3E-01	5.2E-04	1.7E-03	-1.1E-02	9.8E-01
Ecotoxicity, freshwater	CTUe	2.7E+02	2.6E+00	3.1E+00	0.0E+00	5.0E+03	2.8E+00	1.1E+01	-6.3E+01	5.2E+03
Land use	pt	3.4E+03	3.3E+00	2.6E+00	0.0E+00	6.6E+03	3.4E+01	1.1E+01	-5.7E+01	1.0E+04
Water use	m^3 water eq. of deprived water	9.7E+00	1.4E-01	3.1E-02	0.0E+00	1.5E+03	9.8E-02	7.5E-01	-2.8E+00	1.5E+03
Resource use, minerals and metals	kg Sb eq	6.1E-03	1.9E-07	2.2E-07	0.0E+00	4.9E-03	6.1E-05	6.7E-07	-1.5E-03	9.6E-03
Resource use, fossils	MJ	6.3E+02	5.9E+00	4.8E+00	0.0E+00	1.9E+04	6.3E+00	5.4E+01	-1.5E+02	2.0E+04
Additional technical information										
Primary energy consumption	MJ	6.3E+02	6.0E+00	4.8E+00	0.0E+00	1.9E+04	6.3E+00	5.4E+01	-1.5E+02	2.0E+04

Table 9-109: EU total impact of Stock of products in the year of study: WM5 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Others	g	0.000	0.000		0.000	0.986	n.a.			0.986
Total weight	g	**0.000**	**0.000**		**0.000**	0.986	0.000			0.986
Energy consumption										
Electricity	kWh		5		0	2,686	0			2,691
Thermal energy	MJ		0		0	193,374	0			193,374
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	6.9E+02	3.6E+00	4.6E+00	0.0E+00	1.7E+04	6.9E+00	4.6E+01	-1.8E+02	1.8E+04
Ozone depletion	kg CFC-11 eq	9.4E-09	1.6E-09	5.3E-11	0.0E+00	1.5E-04	1.1E-10	1.1E-08	-6.5E-10	1.5E-04
Human toxicity, cancer	CTUh	2.3E-05	-1.7E-09	1.2E-09	0.0E+00	1.1E-05	2.3E-07	5.9E-08	-1.6E-05	1.9E-05
Human toxicity, non-cancer	CTUh	7.6E-06	1.7E-07	3.0E-08	0.0E+00	1.3E-04	7.8E-08	2.4E-07	-2.2E-06	1.3E-04
Particulate matter	disease incidence	1.1E-04	6.3E-07	1.5E-07	0.0E+00	4.6E-04	1.1E-06	2.7E-06	-3.0E-05	5.4E-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	2.4E+01	1.8E+00	8.3E-02	0.0E+00	1.1E+03	2.6E-01	1.3E+01	-2.4E+00	1.1E+03
Photochemical ozone formation, human health	kg NMVOC eq	2.5E+00	1.2E-02	1.6E-02	0.0E+00	2.1E+01	2.5E-02	6.8E-02	-5.2E-01	2.3E+01
Acidification	mol H+ eq	1.1E+01	1.8E-02	1.8E-02	0.0E+00	3.0E+01	1.1E-01	1.1E-01	-2.3E+00	3.9E+01
Eutrophication, terrestrial	mol N eq	7.8E+00	5.1E-02	8.6E-02	0.0E+00	7.2E+01	7.8E-02	2.5E-01	-1.6E+00	7.8E+01
Eutrophication, freshwater	kg P eq	8.8E-04	1.1E-05	2.8E-05	0.0E+00	5.3E-01	8.9E-06	6.6E-05	-1.3E-04	5.3E-01
Eutrophication, marine	kg N eq	7.1E-01	4.7E-03	7.7E-03	0.0E+00	1.3E+01	7.1E-03	2.3E-02	-1.4E-01	1.3E+01
Ecotoxicity, freshwater	CTUe	3.7E+03	3.6E+01	4.2E+01	0.0E+00	6.8E+04	3.8E+01	1.5E+02	-8.7E+02	7.1E+04
Land use	pt	4.7E+04	4.5E+01	3.5E+01	0.0E+00	9.1E+04	4.7E+02	1.4E+02	-7.8E+02	1.4E+05
Water use	m^3 water eq. of deprived water	1.3E+02	1.9E+00	4.3E-01	0.0E+00	2.1E+04	1.3E+00	1.0E+01	-3.9E+01	2.1E+04
Resource use, minerals and metals	kg Sb eq	8.3E-02	2.6E-06	3.0E-06	0.0E+00	6.7E-02	8.3E-04	9.1E-06	-2.0E-02	1.3E-01
Resource use, fossils	MJ	8.6E+03	8.0E+01	6.6E+01	0.0E+00	2.7E+05	8.7E+01	7.3E+02	-2.0E+03	2.7E+05
Additional technical information										
Primary energy consumption	MJ	8.6E+03	8.2E+01	6.6E+01	0.0E+00	2.7E+05	8.7E+01	7.3E+02	-2.0E+03	2.7E+05

Table 9-110: Life cycle costs 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)	84,432	EUR/year	325	mln. EUR/year
Electricity	11,931	EUR/year	46	mln. EUR/year
Water	35,707	EUR/year	137	mln. EUR/year
Auxiliary material 1: Detergent	280,080	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	469,368	EUR/year	1,785	mln. EUR/year

D1: Semi-professional tumble dryer

Below, the life cycle impact is provided per product (**Table 9-111**), per year of use of the product (**Table 9-112**), total impact for the EU27 for the new product (**Table 9-113**) and the impact of the stock of products in the EU27 (**Table 9-114)**.

8694 **Table 9-111: 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 Impacts	EoL Credits	Total
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	1,910	620		0	0	n.a.			**2,530**
Others	g	0	0		6,300	0	n.a.			**6,300**
Total weight	g	**60,210**	**58,920**		**6,351**	**0**	**602**			**126,083**
Energy consumption										
Electricity	kWh		9		0	23,239	0			**23,248**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	2.3E+03	1.6E+01	7.4E+00	5.4E+00	9.7E+03	2.3E+01	4.8E+01	-2.0E+02	**1.2E+04**
Ozone depletion	kg CFC-11 eq	2.5E-07	5.6E-09	8.5E-11	2.6E-10	3.6E-06	2.5E-09	1.1E-08	-2.0E-09	**3.9E-06**
Human toxicity, cancer	CTUh	2.5E-05	4.8E-09	2.0E-09	3.6E-09	1.6E-06	2.5E-07	6.1E-08	-1.7E-05	**1.0E-05**
Human toxicity, non-cancer	CTUh	2.3E-05	7.3E-07	4.8E-08	7.3E-08	3.3E-05	2.4E-07	2.8E-07	-2.5E-06	**5.5E-05**
Particulate matter	disease incidence	3.6E-04	1.4E-06	2.4E-07	3.1E-07	3.1E-04	3.6E-06	2.8E-06	-3.3E-05	**6.4E-04**
Ionising radiation, human health	kBq U235 eq	9.8E+01	6.4E+00	1.3E-01	3.3E-01	4.1E+03	1.0E+00	1.3E+01	-4.0E+00	**4.3E+03**
Photochemical ozone formation, human health	kg NMVOC eq	9.0E+00	3.6E-02	2.6E-02	2.9E-02	1.6E+01	9.0E-02	7.2E-02	-5.9E-01	**2.5E+01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Acidification	mol H+ eq	3.8E+01	5.8E-02	2.9E-02	2.3E-02	3.0E+01	3.8E-01	1.1E-01	-2.5E+00	**6.6E+01**
Eutrophication, terrestrial	mol N eq	2.8E+01	1.4E-01	1.4E-01	7.1E-02	6.0E+01	2.8E-01	2.7E-01	-1.9E+00	**8.7E+01**
Eutrophication, freshwater	kg P eq	5.1E-03	3.4E-05	4.5E-05	8.9E-05	2.0E-02	5.1E-05	7.0E-05	-1.5E-04	**2.5E-02**
Eutrophication, marine	kg N eq	2.6E+00	1.3E-02	1.2E-02	7.4E-03	5.6E+00	2.6E-02	2.5E-02	-1.6E-01	**8.1E+00**
Ecotoxicity, freshwater	CTUe	1.4E+04	9.1E+01	6.9E+01	2.5E+01	4.4E+04	1.4E+02	1.6E+02	-1.5E+03	**5.7E+04**
Land use	pt	1.5E+05	1.0E+02	5.7E+01	1.6E+03	4.2E+04	1.5E+03	1.5E+02	-2.8E+03	**1.9E+05**
Water use	m^3 water eq. of deprived water	4.2E+02	5.7E+00	6.9E-01	7.8E-01	3.3E+03	4.3E+00	1.1E+01	-4.4E+01	**3.7E+03**
Resource use, minerals and metals	kg Sb eq	2.8E-01	5.7E-06	4.9E-06	1.5E-06	2.5E-03	2.8E-03	9.6E-06	-2.6E-02	**2.6E-01**
Resource use, fossils	MJ	3.0E+04	2.9E+02	1.1E+02	5.6E+01	1.7E+05	3.0E+02	7.8E+02	-2.2E+03	**2.0E+05**
Additional technical information										
Primary energy consumption	MJ	3.0E+04	2.9E+02	1.1E+02	5.6E+01	1.8E+05	3.0E+02	7.8E+02	-2.2E+03	**2.1E+05**

* Manufacturing materials are currently double counting the raw materials column.

8697 **Table 9-112: 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		Total
								Impacts	Credits	
Materials	unit									
Plastics	g	2,446	2,446		9	0	n.a.			**4,902**
Metals	g	7,964	7,964		0	0	n.a.			**15,929**
Electronics	g	341	111		0	0	n.a.			**452**
Others	g	0	0		1,125	0	n.a.			**1,125**
Total weight	g	**10,752**	**10,521**		**1,134**	**0**	**108**			**22,515**
Energy consumption										
Electricity	kWh		2		0	4,150	0			**4,151**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	4.0E+02	2.8E+00	1.3E+00	9.7E-01	1.7E+03	4.1E+00	8.6E+00	-3.6E+01	**2.1E+03**
Ozone depletion	kg CFC-11 eq	4.4E-08	1.0E-09	1.5E-11	4.7E-11	6.5E-07	4.5E-10	2.0E-09	-3.6E-10	**6.9E-07**
Human toxicity, cancer	CTUh	4.4E-06	8.5E-10	3.5E-10	6.5E-10	2.9E-07	4.4E-08	1.1E-08	-3.0E-06	**1.8E-06**
Human toxicity, non-cancer	CTUh	4.2E-06	1.3E-07	8.6E-09	1.3E-08	5.8E-06	4.3E-08	4.9E-08	-4.5E-07	**9.8E-06**
Particulate matter	disease incidence	6.4E-05	2.4E-07	4.3E-08	5.4E-08	5.5E-05	6.4E-07	5.0E-07	-5.8E-06	**1.2E-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	1.7E+01	1.1E+00	2.4E-02	5.9E-02	7.4E+02	1.9E-01	2.4E+00	-7.1E-01	**7.6E+02**
Photochemical ozone formation, human health	kg NMVOC eq	1.6E+00	6.4E-03	4.7E-03	5.2E-03	2.8E+00	1.6E-02	1.3E-02	-1.1E-01	**4.4E+00**
Acidification	mol H+ eq	6.8E+00	1.0E-02	5.2E-03	4.1E-03	5.3E+00	6.8E-02	2.0E-02	-4.5E-01	**1.2E+01**
Eutrophication, terrestrial	mol N eq	5.0E+00	2.4E-02	2.5E-02	1.3E-02	1.1E+01	5.0E-02	4.7E-02	-3.3E-01	**1.5E+01**
Eutrophication, freshwater	kg P eq	9.1E-04	6.2E-06	8.0E-06	1.6E-05	3.5E-03	9.2E-06	1.2E-05	-2.6E-05	**4.5E-03**
Eutrophication, marine	kg N eq	4.6E-01	2.2E-03	2.2E-03	1.3E-03	1.0E+00	4.7E-03	4.4E-03	-2.9E-02	**1.5E+00**
Ecotoxicity, freshwater	CTUe	2.5E+03	1.6E+01	1.2E+01	4.4E+00	7.9E+03	2.5E+01	2.8E+01	-2.7E+02	**1.0E+04**
Land use	pt	2.6E+04	1.8E+01	1.0E+01	2.8E+02	7.5E+03	2.6E+02	2.7E+01	-5.0E+02	**3.4E+04**
Water use	m^3 water eq. of deprived water	7.5E+01	1.0E+00	1.2E-01	1.4E-01	5.9E+02	7.6E-01	1.9E+00	-7.8E+00	**6.6E+02**
Resource use, minerals and metals	kg Sb eq	5.1E-02	1.0E-06	8.8E-07	2.7E-07	4.4E-04	5.1E-04	1.7E-06	-4.7E-03	**4.7E-02**
Resource use, fossils	MJ	5.4E+03	5.1E+01	1.9E+01	9.9E+00	3.0E+04	5.4E+01	1.4E+02	-4.0E+02	**3.5E+04**
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	5.4E+03	5.2E+01	1.9E+01	9.9E+00	3.1E+04	5.4E+01	1.4E+02	-4.0E+02	**3.7E+04**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-113: EU total impact of new products sold in the year of study: D1 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**0**	**0**		**0**	**0**	**0**			**0**
Energy consumption										
Electricity	kWh		0		0	186	0			**186**
Thermal energy	MJ		0		0	0	0			**0**

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	1.8E+01	1.3E-01	5.9E-02	4.4E-02	7.8E+01	1.8E-01	3.9E-01	-1.6E+00	**9.5E+01**
Ozone depletion	kg CFC-11 eq	2.0E-09	4.5E-11	6.8E-13	2.1E-12	2.9E-08	2.0E-11	8.8E-11	-1.6E-11	**3.1E-08**
Human toxicity, cancer	CTUh	2.0E-07	3.8E-11	1.6E-11	2.9E-11	1.3E-08	2.0E-09	4.9E-10	-1.3E-07	**8.1E-08**
Human toxicity, non-cancer	CTUh	1.9E-07	5.8E-09	3.8E-10	5.9E-10	2.6E-07	1.9E-09	2.2E-09	-2.0E-08	**4.4E-07**
Particulate matter	disease incidence	2.9E-06	1.1E-08	1.9E-09	2.4E-09	2.5E-06	2.9E-08	2.2E-08	-2.6E-07	**5.2E-06**
Ionising radiation, human health	kBq U235 eq	7.8E-01	5.1E-02	1.1E-03	2.6E-03	3.3E+01	8.3E-03	1.1E-01	-3.2E-02	**3.4E+01**
Photochemical ozone formation, human health	kg NMVOC eq	7.2E-02	2.9E-04	2.1E-04	2.3E-04	1.3E-01	7.2E-04	5.7E-04	-4.7E-03	**2.0E-01**
Acidification	mol H+ eq	3.0E-01	4.7E-04	2.3E-04	1.9E-04	2.4E-01	3.0E-03	8.9E-04	-2.0E-02	**5.2E-01**
Eutrophication, terrestrial	mol N eq	2.3E-01	1.1E-03	1.1E-03	5.7E-04	4.8E-01	2.3E-03	2.1E-03	-1.5E-02	**6.9E-01**
Eutrophication, freshwater	kg P eq	4.1E-05	2.8E-07	3.6E-07	7.1E-07	1.6E-04	4.1E-07	5.6E-07	-1.2E-06	**2.0E-04**
Eutrophication, marine	kg N eq	2.1E-02	1.0E-04	1.0E-04	5.9E-05	4.5E-02	2.1E-04	2.0E-04	-1.3E-03	**6.5E-02**
Ecotoxicity, freshwater	CTUe	1.1E+02	7.3E-01	5.5E-01	2.0E-01	3.5E+02	1.1E+00	1.3E+00	-1.2E+01	**4.6E+02**
Land use	pt	1.2E+03	8.1E-01	4.6E-01	1.3E+01	3.4E+02	1.2E+01	1.2E+00	-2.2E+01	**1.5E+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	3.4E+00	4.5E-02	5.5E-03	6.3E-03	2.7E+01	3.4E-02	8.7E-02	-3.5E-01	**3.0E+01**
Resource use, minerals and metals	kg Sb eq	2.3E-03	4.5E-08	3.9E-08	1.2E-08	2.0E-05	2.3E-05	7.7E-08	-2.1E-04	**2.1E-03**
Resource use, fossils	MJ	2.4E+02	2.3E+00	8.5E-01	4.4E-01	1.4E+03	2.4E+00	6.2E+00	-1.8E+01	**1.6E+03**
Additional technical information										
Primary energy consumption	MJ	2.4E+02	2.3E+00	8.5E-01	4.4E-01	1.4E+03	2.4E+00	6.2E+00	-1.8E+01	**1.6E+03**

8702

8703 **Table 9-114: EU total impact of Stock of products in the year of study: D1 (values should be interpreted as multiplied by 10^6 to account**
8704 **for the actual stock numbers).**

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Others	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Total weight	g	**0.000**	**0.000**		**0.000**	**0.000**	**0.000**			**0.000**
Energy consumption										
Electricity	kWh		0		0	1,041	0			**1,042**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	1.0E+02	7.1E-01	3.3E-01	2.4E-01	4.4E+02	1.0E+00	2.2E+00	-9.1E+00	**5.3E+02**
Ozone depletion	kg CFC-11 eq	1.1E-08	2.5E-10	3.8E-12	1.2E-11	1.6E-07	1.1E-10	4.9E-10	-9.0E-11	**1.7E-07**
Human toxicity, cancer	CTUh	1.1E-06	2.1E-10	8.9E-11	1.6E-10	7.2E-08	1.1E-08	2.7E-09	-7.4E-07	**4.5E-07**
Human toxicity, non-cancer	CTUh	1.0E-06	3.3E-08	2.1E-09	3.3E-09	1.5E-06	1.1E-08	1.2E-08	-1.1E-07	**2.5E-06**
Particulate matter	disease incidence	1.6E-05	6.1E-08	1.1E-08	1.4E-08	1.4E-05	1.6E-07	1.2E-07	-1.5E-06	**2.9E-05**
Ionising radiation, human health	kBq U235 eq	4.4E+00	2.9E-01	6.0E-03	1.5E-02	1.9E+02	4.7E-02	6.0E-01	-1.8E-01	**1.9E+02**
Photochemical ozone formation, human health	kg NMVOC eq	4.0E-01	1.6E-03	1.2E-03	1.3E-03	7.1E-01	4.0E-03	3.2E-03	-2.6E-02	**1.1E+00**
Acidification	mol H+ eq	1.7E+00	2.6E-03	1.3E-03	1.0E-03	1.3E+00	1.7E-02	5.0E-03	-1.1E-01	**2.9E+00**
Eutrophication, terrestrial	mol N eq	1.3E+00	6.0E-03	6.3E-03	3.2E-03	2.7E+00	1.3E-02	1.2E-02	-8.4E-02	**3.9E+00**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Eutrophication, freshwater	kg P eq	2.3E-04	1.5E-06	2.0E-06	4.0E-06	8.9E-04	2.3E-06	3.1E-06	-6.6E-06	**1.1E-03**
Eutrophication, marine	kg N eq	1.2E-01	5.6E-04	5.6E-04	3.3E-04	2.5E-01	1.2E-03	1.1E-03	-7.3E-03	**3.6E-01**
Ecotoxicity, freshwater	CTUe	6.2E+02	4.1E+00	3.1E+00	1.1E+00	2.0E+03	6.2E+00	7.1E+00	-6.7E+01	**2.6E+03**
Land use	pt	6.6E+03	4.5E+00	2.6E+00	7.1E+01	1.9E+03	6.6E+01	6.7E+00	-1.3E+02	**8.5E+03**
Water use	m^3 water eq. of deprived water	1.9E+01	2.5E-01	3.1E-02	3.5E-02	1.5E+02	1.9E-01	4.9E-01	-2.0E+00	**1.7E+02**
Resource use, minerals and metals	kg Sb eq	1.3E-02	2.5E-07	2.2E-07	6.9E-08	1.1E-04	1.3E-04	4.3E-07	-1.2E-03	**1.2E-02**
Resource use, fossils	MJ	1.3E+03	1.3E+01	4.8E+00	2.5E+00	7.6E+03	1.4E+01	3.5E+01	-1.0E+02	**8.9E+03**
Additional technical information										
Primary energy consumption	MJ	1.3E+03	1.3E+01	4.8E+00	2.5E+00	7.9E+03	1.4E+01	3.5E+01	-1.0E+02	**9.3E+03**

8705 **Table 9-115: Life cycle costs per product and total EU expenditure: D1.**

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	1,460	EUR	12	mln. EUR/year

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Installation/ acquisition costs (if any)	58	EUR	0	mln. EUR/year
Fuel (gas, oil, wood)	0	EUR/year	0	mln. EUR/year
Electricity	929	EUR/year	44	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	44	EUR	0	mln. EUR/year
Total	**1,208**	EUR/year	**56**	**mln. EUR/year**

8706

8707 D2: Professional tumble dryer

8708 Below, the life cycle impact is provided per product (**Table 9-116**), per year of use of the product (**Table 9-117**), total impact for the EU27 for the
8709 new product (

Table 9-118**)** and the impact of the stock of products in the EU27 (**Table 9-119**).

Table 9-116: 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		Total
								Impacts	Credits	
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	1,786	620		0	0	n.a.			**2,406**
Others	g	0	0		6,300	0	n.a.			**6,300**
Total weight	g	**57,186**	**56,020**		**6,351**	**0**	**572**			**120,129**
Energy consumption										
Electricity	kWh		9		0	1,060,926	0			**1,060,935**
Thermal energy	MJ		0		0	1,804,120	0			**1,804,120**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	2.1E+03	1.5E+01	7.1E+00	5.4E+00	5.6E+05	2.1E+01	4.6E+01	-1.9E+02	**5.6E+05**
Ozone depletion	kg CFC-11 eq	2.1E-07	5.3E-09	8.2E-11	2.6E-10	1.7E-04	2.2E-09	1.0E-08	-2.0E-09	**1.7E-04**
Human toxicity, cancer	CTUh	2.3E-05	4.8E-09	1.9E-09	3.6E-09	8.5E-05	2.3E-07	5.8E-08	-1.6E-05	**9.3E-05**
Human toxicity, non-cancer	CTUh	2.2E-05	7.3E-07	4.6E-08	7.3E-08	1.6E-03	2.3E-07	2.6E-07	-2.4E-06	**1.6E-03**

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	3.4E-04	1.3E-06	2.3E-07	3.1E-07	1.5E-02	3.4E-06	2.7E-06	-3.1E-05	**1.5E-02**
Ionising radiation, human health	kBq U235 eq	9.2E+01	6.1E+00	1.3E-01	3.3E-01	1.9E+05	9.8E-01	1.3E+01	-3.8E+00	**1.9E+05**
Photochemical ozone formation, human health	kg NMVOC eq	8.4E+00	3.4E-02	2.5E-02	2.9E-02	8.1E+02	8.4E-02	6.8E-02	-5.6E-01	**8.1E+02**
Acidification	mol H+ eq	3.5E+01	5.6E-02	2.8E-02	2.3E-02	1.4E+03	3.6E-01	1.1E-01	-2.4E+00	**1.5E+03**
Eutrophication, terrestrial	mol N eq	2.6E+01	1.3E-01	1.3E-01	7.1E-02	2.9E+03	2.6E-01	2.5E-01	-1.8E+00	**2.9E+03**
Eutrophication, freshwater	kg P eq	4.6E-03	3.3E-05	4.3E-05	8.9E-05	1.6E+00	4.7E-05	6.6E-05	-1.4E-04	**1.6E+00**
Eutrophication, marine	kg N eq	2.4E+00	1.2E-02	1.2E-02	7.4E-03	2.8E+02	2.4E-02	2.4E-02	-1.6E-01	**2.8E+02**
Ecotoxicity, freshwater	CTUe	1.3E+04	8.8E+01	6.6E+01	2.5E+01	2.1E+06	1.3E+02	1.5E+02	-1.4E+03	**2.1E+06**
Land use	pt	1.5E+05	9.6E+01	5.5E+01	1.6E+03	1.9E+06	1.5E+03	1.4E+02	-2.6E+03	**2.1E+06**
Water use	m^3 water eq. of deprived water	3.9E+02	5.4E+00	6.6E-01	7.8E-01	1.5E+05	4.0E+00	1.0E+01	-4.2E+01	**1.5E+05**
Resource use, minerals and metals	kg Sb eq	2.7E-01	5.4E-06	4.7E-06	1.5E-06	3.4E-01	2.7E-03	9.2E-06	-2.5E-02	**5.8E-01**
Resource use, fossils	MJ	2.8E+04	2.7E+02	1.0E+02	5.6E+01	9.5E+06	2.8E+02	7.4E+02	-2.1E+03	**9.6E+06**

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	2.8E+04	2.8E+02	1.0E+02	5.6E+01	9.8E+06	2.8E+02	7.4E+02	-2.1E+03	**9.9E+06**

8712 * Manufacturing materials are currently double counting the raw materials column.

8713

8714 **Table 9-117: 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	565	565		2	0	n.a.			**1,132**
Metals	g	2,000	2,000		0	0	n.a.			**4,000**
Electronics	g	83	29		0	0	n.a.			**111**
Others	g	0	0		292	0	n.a.			**292**
Total weight	g	**2,648**	**2,594**		**294**	**0**	**26**			**5,562**
Energy consumption										
Electricity	kWh		0		0	49,117	0			**49,117**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Thermal energy	MJ		0		0	83,524	0			**83,524**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	9.8E+01	7.0E-01	3.3E-01	2.5E-01	2.6E+04	9.9E-01	2.1E+00	-8.9E+00	**2.6E+04**
Ozone depletion	kg CFC-11 eq	9.9E-09	2.5E-10	3.8E-12	1.2E-11	8.0E-06	1.0E-10	4.9E-10	-9.1E-11	**8.0E-06**
Human toxicity, cancer	CTUh	1.1E-06	2.2E-10	8.7E-11	1.7E-10	3.9E-06	1.1E-08	2.7E-09	-7.3E-07	**4.3E-06**
Human toxicity, non-cancer	CTUh	1.0E-06	3.4E-08	2.1E-09	3.4E-09	7.3E-05	1.1E-08	1.2E-08	-1.1E-07	**7.4E-05**
Particulate matter	disease incidence	1.6E-05	6.1E-08	1.1E-08	1.4E-08	6.8E-04	1.6E-07	1.2E-07	-1.4E-06	**7.0E-04**
Ionising radiation, human health	kBq U235 eq	4.2E+00	2.8E-01	5.9E-03	1.5E-02	8.8E+03	4.5E-02	5.9E-01	-1.8E-01	**8.8E+03**
Photochemical ozone formation, human health	kg NMVOC eq	3.9E-01	1.6E-03	1.2E-03	1.3E-03	3.7E+01	3.9E-03	3.2E-03	-2.6E-02	**3.8E+01**
Acidification	mol H+ eq	1.6E+00	2.6E-03	1.3E-03	1.1E-03	6.6E+01	1.6E-02	4.9E-03	-1.1E-01	**6.7E+01**
Eutrophication, terrestrial	mol N eq	1.2E+00	6.0E-03	6.2E-03	3.3E-03	1.3E+02	1.2E-02	1.2E-02	-8.2E-02	**1.3E+02**
Eutrophication, freshwater	kg P eq	2.1E-04	1.5E-06	2.0E-06	4.1E-06	7.3E-02	2.2E-06	3.1E-06	-6.5E-06	**7.3E-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	1.1E-01	5.6E-04	5.5E-04	3.4E-04	1.3E+01	1.1E-03	1.1E-03	-7.2E-03	**1.3E+01**
Ecotoxicity, freshwater	CTUe	6.0E+02	4.1E+00	3.0E+00	1.1E+00	9.6E+04	6.0E+00	7.0E+00	-6.6E+01	**9.7E+04**
Land use	pt	6.8E+03	4.4E+00	2.5E+00	7.3E+01	9.0E+04	6.9E+01	6.6E+00	-1.2E+02	**9.7E+04**
Water use	m^3 water eq. of deprived water	1.8E+01	2.5E-01	3.0E-02	3.6E-02	7.1E+03	1.9E-01	4.8E-01	-1.9E+00	**7.1E+03**
Resource use, minerals and metals	kg Sb eq	1.2E-02	2.5E-07	2.2E-07	7.1E-08	1.6E-02	1.2E-04	4.2E-07	-1.1E-03	**2.7E-02**
Resource use, fossils	MJ	1.3E+03	1.3E+01	4.7E+00	2.6E+00	4.4E+05	1.3E+01	3.4E+01	-9.8E+01	**4.4E+05**
Additional technical information										
Primary energy consumption	MJ	1.3E+03	1.3E+01	4.7E+00	2.6E+00	4.5E+05	1.3E+01	3.4E+01	-9.8E+01	**4.6E+05**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-118: EU total impact of new products sold in the year of study: D2 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**0**	**0**		**0**	**0**	**0**			**0**
Energy consumption										
Electricity	kWh		0		0	8,169	0			**8,169**
Thermal energy	MJ		0		0	13,892	0			**13,892**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	1.6E+01	1.2E-01	5.5E-02	4.2E-02	4.3E+03	1.6E-01	3.5E-01	-1.5E+00	**4.3E+03**
Ozone depletion	kg CFC-11 eq	1.7E-09	4.1E-11	6.3E-13	2.0E-12	1.3E-06	1.7E-11	8.1E-11	-1.5E-11	**1.3E-06**
Human toxicity, cancer	CTUh	1.8E-07	3.7E-11	1.5E-11	2.8E-11	6.5E-07	1.8E-09	4.5E-10	-1.2E-07	**7.2E-07**
Human toxicity, non-cancer	CTUh	1.7E-07	5.6E-09	3.5E-10	5.7E-10	1.2E-05	1.7E-09	2.0E-09	-1.8E-08	**1.2E-05**
Particulate matter	disease incidence	2.6E-06	1.0E-08	1.8E-09	2.3E-09	1.1E-04	2.6E-08	2.0E-08	-2.4E-07	**1.2E-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	7.1E-01	4.7E-02	9.9E-04	2.5E-03	1.5E+03	7.5E-03	9.8E-02	-3.0E-02	**1.5E+03**
Photochemical ozone formation, human health	kg NMVOC eq	6.5E-02	2.6E-04	1.9E-04	2.2E-04	6.2E+00	6.5E-04	5.3E-04	-4.3E-03	**6.3E+00**
Acidification	mol H+ eq	2.7E-01	4.3E-04	2.1E-04	1.8E-04	1.1E+01	2.7E-03	8.1E-04	-1.8E-02	**1.1E+01**
Eutrophication, terrestrial	mol N eq	2.0E-01	1.0E-03	1.0E-03	5.5E-04	2.2E+01	2.0E-03	1.9E-03	-1.4E-02	**2.2E+01**
Eutrophication, freshwater	kg P eq	3.6E-05	2.5E-07	3.3E-07	6.8E-07	1.2E-02	3.6E-07	5.1E-07	-1.1E-06	**1.2E-02**
Eutrophication, marine	kg N eq	1.9E-02	9.3E-05	9.2E-05	5.7E-05	2.1E+00	1.9E-04	1.8E-04	-1.2E-03	**2.1E+00**
Ecotoxicity, freshwater	CTUe	1.0E+02	6.7E-01	5.1E-01	1.9E-01	1.6E+04	1.0E+00	1.2E+00	-1.1E+01	**1.6E+04**
Land use	pt	1.1E+03	7.4E-01	4.2E-01	1.2E+01	1.5E+04	1.1E+01	1.1E+00	-2.0E+01	**1.6E+04**
Water use	m^3 water eq. of deprived water	3.0E+00	4.1E-02	5.1E-03	6.0E-03	1.2E+03	3.1E-02	7.9E-02	-3.2E-01	**1.2E+03**
Resource use, minerals and metals	kg Sb eq	2.1E-03	4.1E-08	3.6E-08	1.2E-08	2.6E-03	2.1E-05	7.1E-08	-1.9E-04	**4.5E-03**
Resource use, fossils	MJ	2.2E+02	2.1E+00	7.9E-01	4.3E-01	7.3E+04	2.2E+00	5.7E+00	-1.6E+01	**7.4E+04**
Additional technical information										
Primary energy consumption	MJ	2.2E+02	2.1E+00	7.9E-01	4.3E-01	7.6E+04	2.2E+00	5.7E+00	-1.6E+01	**7.6E+04**

8719

Table 9-119: EU total impact of Stock of products in the year of study: D2 (values should be interpreted as multiplied by 10^6 to represent the actual stock numbers).

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Others	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Total weight	g	**0.000**	**0.000**		**0.000**	**0.000**	**0.000**			**0.000**
Energy consumption										
Electricity	kWh		1		0	165,575	0			**165,577**
Thermal energy	MJ		0		0	281,563	0			**281,563**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	3.3E+02	2.3E+00	1.1E+00	8.5E-01	8.8E+04	3.3E+00	7.2E+00	-3.0E+01	**8.8E+04**
Ozone depletion	kg CFC-11 eq	3.4E-08	8.3E-10	1.3E-11	4.1E-11	2.7E-05	3.4E-10	1.6E-09	-3.1E-10	**2.7E-05**
Human toxicity, cancer	CTUh	3.7E-06	7.5E-10	2.9E-10	5.6E-10	1.3E-05	3.7E-08	9.0E-09	-2.5E-06	**1.5E-05**
Human toxicity, non-cancer	CTUh	3.4E-06	1.1E-07	7.2E-09	1.1E-08	2.5E-04	3.5E-08	4.1E-08	-3.7E-07	**2.5E-04**
Particulate matter	disease incidence	5.2E-05	2.1E-07	3.5E-08	4.8E-08	2.3E-03	5.3E-07	4.1E-07	-4.8E-06	**2.4E-03**

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	1.4E+01	9.5E-01	2.0E-02	5.1E-02	3.0E+04	1.5E-01	2.0E+00	-6.0E-01	**3.0E+04**
Photochemical ozone formation, human health	kg NMVOC eq	1.3E+00	5.4E-03	3.9E-03	4.5E-03	1.3E+02	1.3E-02	1.1E-02	-8.7E-02	**1.3E+02**
Acidification	mol H+ eq	5.5E+00	8.7E-03	4.3E-03	3.6E-03	2.2E+02	5.5E-02	1.7E-02	-3.7E-01	**2.3E+02**
Eutrophication, terrestrial	mol N eq	4.1E+00	2.0E-02	2.1E-02	1.1E-02	4.5E+02	4.1E-02	3.9E-02	-2.8E-01	**4.5E+02**
Eutrophication, freshwater	kg P eq	7.2E-04	5.1E-06	6.7E-06	1.4E-05	2.5E-01	7.3E-06	1.0E-05	-2.2E-05	**2.5E-01**
Eutrophication, marine	kg N eq	3.8E-01	1.9E-03	1.9E-03	1.2E-03	4.3E+01	3.8E-03	3.7E-03	-2.4E-02	**4.3E+01**
Ecotoxicity, freshwater	CTUe	2.0E+03	1.4E+01	1.0E+01	3.9E+00	3.2E+05	2.0E+01	2.4E+01	-2.2E+02	**3.3E+05**
Land use	pt	2.3E+04	1.5E+01	8.6E+00	2.5E+02	3.0E+05	2.3E+02	2.2E+01	-4.1E+02	**3.3E+05**
Water use	m^3 water eq. of deprived water	6.2E+01	8.4E-01	1.0E-01	1.2E-01	2.4E+04	6.2E-01	1.6E+00	-6.5E+00	**2.4E+04**
Resource use, minerals and metals	kg Sb eq	4.2E-02	8.4E-07	7.3E-07	2.4E-07	5.3E-02	4.2E-04	1.4E-06	-3.9E-03	**9.1E-02**
Resource use, fossils	MJ	4.4E+03	4.3E+01	1.6E+01	8.7E+00	1.5E+06	4.4E+01	1.2E+02	-3.3E+02	**1.5E+06**
Additional technical information										
Primary energy consumption	MJ	4.4E+03	4.3E+01	1.6E+01	8.7E+00	1.5E+06	4.4E+01	1.2E+02	-3.3E+02	**1.5E+06**

Table 9-120: Life cycle costs per product and total EU expenditure: D2.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	8,700	EUR	67	mln. EUR/year
Installation/ acquisition costs (if any)	348	EUR	3	mln. EUR/year
Fuel (gas, oil, wood)	1,669	EUR/year	300	mln. EUR/year
Electricity	9,988	EUR/year	1,794	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	261	EUR	2	mln. EUR/year
Total	**12,088**	EUR/year	**2,165**	**mln. EUR/year**

D3: Professional cabinet dryer

Below, the life cycle impact is provided per product (**Table 9-121**), per year of use of the product (**Table 9-122**), total impact for the EU27 for the new product (**Table 9-123**) and the impact of the stock of products in the EU27 (**Table 9-124**).

Table 9-121: 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 Impacts	EoL Credits	Total
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	3,049	990		0	0	n.a.			**4,039**
Others	g	0	0		25,100	0	n.a.			**25,100**
Total weight	g	**145,159**	**143,690**		**26,900**	**0**	**1,452**			**317,201**
Energy consumption										
Electricity	kWh		22		0	226,038	0			**226,060**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	3.6E+03	2.6E+01	1.9E+01	2.6E+01	9.5E+04	3.6E+01	1.5E+02	-3.5E+02	**9.8E+04**
Ozone depletion	kg CFC-11 eq	2.1E-07	8.9E-09	2.2E-10	1.1E-09	3.5E-05	2.2E-09	3.3E-08	-2.8E-08	**3.5E-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	4.1E-06	2.7E-09	5.1E-09	1.5E-08	1.6E-05	4.1E-08	1.8E-07	-2.2E-06	**1.8E-05**
Human toxicity, non-cancer	CTUh	4.2E-05	1.2E-06	1.2E-07	3.5E-07	3.2E-04	4.3E-07	7.8E-07	-9.3E-06	**3.5E-04**
Particulate matter	disease incidence	5.2E-04	2.8E-06	6.1E-07	1.3E-06	3.0E-03	5.3E-06	8.4E-06	-2.4E-05	**3.5E-03**
Ionising radiation, human health	kBq U235 eq	1.9E+02	1.0E+01	3.4E-01	1.4E+00	4.0E+04	2.0E+00	3.9E+01	-3.2E+01	**4.0E+04**
Photochemical ozone formation, human health	kg NMVOC eq	1.4E+01	7.0E-02	6.8E-02	1.3E-01	1.6E+02	1.4E-01	2.2E-01	-6.7E-01	**1.7E+02**
Acidification	mol H+ eq	5.6E+01	1.0E-01	7.5E-02	1.0E-01	2.9E+02	5.7E-01	3.4E-01	-1.4E+00	**3.4E+02**
Eutrophication, terrestrial	mol N eq	4.3E+01	2.7E-01	3.6E-01	3.1E-01	5.8E+02	4.3E-01	8.1E-01	-2.1E+00	**6.2E+02**
Eutrophication, freshwater	kg P eq	6.2E-03	5.8E-05	1.1E-04	3.9E-04	1.9E-01	6.2E-05	2.1E-04	-2.8E-04	**2.0E-01**
Eutrophication, marine	kg N eq	4.0E+00	2.5E-02	3.2E-02	3.2E-02	5.5E+01	4.0E-02	7.6E-02	-1.9E-01	**5.9E+01**
Ecotoxicity, freshwater	CTUe	2.8E+04	1.5E+02	1.8E+02	1.7E+02	4.3E+05	2.8E+02	4.8E+02	-7.5E+03	**4.5E+05**
Land use	pt	8.5E+04	2.5E+02	1.5E+02	6.6E+03	4.1E+05	8.6E+02	4.5E+02	-4.4E+03	**5.0E+05**
Water use	m^3 water eq. of deprived water	6.3E+02	9.5E+00	1.8E+00	4.1E+00	3.2E+04	6.4E+00	3.2E+01	-6.6E+01	**3.3E+04**
Resource use, minerals and metals	kg Sb eq	4.1E-01	1.2E-05	1.3E-05	7.7E-06	2.4E-02	4.1E-03	2.9E-05	-2.6E-02	**4.2E-01**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL Impacts	EoL Credits	Total
Resource use, fossils	MJ	4.7E+04	5.0E+02	2.7E+02	3.5E+02	1.6E+06	4.8E+02	2.4E+03	-3.8E+03	**1.7E+06**
Additional technical information										
Primary energy consumption	MJ	4.7E+04	5.1E+02	2.7E+02	3.5E+02	1.7E+06	4.8E+02	2.4E+03	-3.8E+03	**1.8E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-122: Life cycle impact per product per year of use: D3.

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	174	174		43	0	n.a.			391
Metals	g	3,234	3,248		0	0	n.a.			6,482
Electronics	g	73	24		0	0	n.a.			97
Others	g	0	0		602	0	n.a.			602
Total weight	g	3,481	3,446		645	0	35			7,607

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Energy consumption										
Electricity	kWh		1		0	5,421	0			5,421
Thermal energy	MJ		0		0	0	0			0
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	8.6E+01	6.3E-01	4.6E-01	6.2E-01	2.3E+03	8.7E-01	3.6E+00	-8.4E+00	2.4E+03
Ozone depletion	kg CFC-11 eq	5.0E-09	2.1E-10	5.3E-12	2.7E-11	8.4E-07	5.2E-11	7.8E-10	-6.7E-10	8.5E-07
Human toxicity, cancer	CTUh	9.8E-08	6.5E-11	1.2E-10	3.7E-10	3.8E-07	9.8E-10	4.3E-09	-5.2E-08	4.3E-07
Human toxicity, non-cancer	CTUh	1.0E-06	2.9E-08	3.0E-09	8.4E-09	7.6E-06	1.0E-08	1.9E-08	-2.2E-07	8.5E-06
Particulate matter	disease incidence	1.3E-05	6.7E-08	1.5E-08	3.0E-08	7.2E-05	1.3E-07	2.0E-07	-5.9E-07	8.5E-05
Ionising radiation, human health	kBq U235 eq	4.5E+00	2.5E-01	8.3E-03	3.5E-02	9.6E+02	4.8E-02	9.5E-01	-7.8E-01	9.7E+02
Photochemical ozone formation, human health	kg NMVOC eq	3.3E-01	1.7E-03	1.6E-03	3.0E-03	3.7E+00	3.3E-03	5.3E-03	-1.6E-02	4.0E+00
Acidification	mol H+ eq	1.4E+00	2.4E-03	1.8E-03	2.4E-03	6.9E+00	1.4E-02	8.1E-03	-3.4E-02	8.3E+00
Eutrophication, terrestrial	mol N eq	1.0E+00	6.4E-03	8.6E-03	7.5E-03	1.4E+01	1.0E-02	1.9E-02	-5.1E-02	1.5E+01
Eutrophication, freshwater	kg P eq	1.5E-04	1.4E-06	2.7E-06	9.5E-06	4.6E-03	1.5E-06	5.0E-06	-6.6E-06	4.8E-03

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	9.5E-02	5.9E-04	7.7E-04	7.8E-04	1.3E+00	9.6E-04	1.8E-03	-4.6E-03	1.4E+00
Ecotoxicity, freshwater	CTUe	6.7E+02	3.6E+00	4.2E+00	4.0E+00	1.0E+04	6.8E+00	1.2E+01	-1.8E+02	1.1E+04
Land use	pt	2.0E+03	6.0E+00	3.5E+00	1.6E+02	9.8E+03	2.1E+01	1.1E+01	-1.1E+02	1.2E+04
Water use	m^3 water eq. of deprived water	1.5E+01	2.3E-01	4.2E-02	9.9E-02	7.8E+02	1.5E-01	7.6E-01	-1.6E+00	7.9E+02
Resource use, minerals and metals	kg Sb eq	1.0E-02	2.8E-07	3.0E-07	1.8E-07	5.8E-04	1.0E-04	7.0E-07	-6.3E-04	1.0E-02
Resource use, fossils	MJ	1.1E+03	1.2E+01	6.6E+00	8.4E+00	3.9E+04	1.1E+01	5.7E+01	-9.1E+01	4.1E+04
Additional technical information										
Primary energy consumption	MJ	1.1E+03	1.2E+01	6.6E+00	8.4E+00	4.1E+04	1.1E+01	5.7E+01	-9.1E+01	4.2E+04

* Manufacturing materials are currently double counting the raw materials column.

Table 9-123: EU total impact of new products sold in the year of study: D3 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Materials	unit									

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL Impacts	EoL Credits	Total
Plastics	g	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**0**	**0**		**0**	**0**	**0**			**0**
Energy consumption										
Electricity	kWh		0		0	2,260	0			**2,260**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	3.6E+01	2.6E-01	1.9E-01	2.6E-01	9.5E+02	3.6E-01	1.5E+00	-3.5E+00	9.8E+02
Ozone depletion	kg CFC-11 eq	2.1E-09	8.9E-11	2.2E-12	1.1E-11	3.5E-07	2.2E-11	3.3E-10	-2.8E-10	3.5E-07
Human toxicity, cancer	CTUh	4.1E-08	2.7E-11	5.1E-11	1.5E-10	1.6E-07	4.1E-10	1.8E-09	-2.2E-08	1.8E-07
Human toxicity, non-cancer	CTUh	4.2E-07	1.2E-08	1.2E-09	3.5E-09	3.2E-06	4.3E-09	7.8E-09	-9.3E-08	3.5E-06
Particulate matter	disease incidence	5.2E-06	2.8E-08	6.1E-09	1.3E-08	3.0E-05	5.3E-08	8.4E-08	-2.4E-07	3.5E-05
Ionising radiation, human health	kBq U235 eq	1.9E+00	1.0E-01	3.4E-03	1.4E-02	4.0E+02	2.0E-02	3.9E-01	-3.2E-01	4.0E+02
Photochemical ozone formation, human health	kg NMVOC eq	1.4E-01	7.0E-04	6.8E-04	1.3E-03	1.6E+00	1.4E-03	2.2E-03	-6.7E-03	1.7E+00

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL		Total
								Impacts	Credits	
Acidification	mol H+ eq	5.6E-01	1.0E-03	7.5E-04	1.0E-03	2.9E+00	5.7E-03	3.4E-03	-1.4E-02	3.4E+00
Eutrophication, terrestrial	mol N eq	4.3E-01	2.7E-03	3.6E-03	3.1E-03	5.8E+00	4.3E-03	8.1E-03	-2.1E-02	6.2E+00
Eutrophication, freshwater	kg P eq	6.2E-05	5.8E-07	1.1E-06	3.9E-06	1.9E-03	6.2E-07	2.1E-06	-2.8E-06	2.0E-03
Eutrophication, marine	kg N eq	4.0E-02	2.5E-04	3.2E-04	3.2E-04	5.5E-01	4.0E-04	7.6E-04	-1.9E-03	5.9E-01
Ecotoxicity, freshwater	CTUe	2.8E+02	1.5E+00	1.8E+00	1.7E+00	4.3E+03	2.8E+00	4.8E+00	-7.5E+01	4.5E+03
Land use	pt	8.5E+02	2.5E+00	1.5E+00	6.6E+01	4.1E+03	8.6E+00	4.5E+00	-4.4E+01	5.0E+03
Water use	m^3 water eq. of deprived water	6.3E+00	9.5E-02	1.8E-02	4.1E-02	3.2E+02	6.4E-02	3.2E-01	-6.6E-01	3.3E+02
Resource use, minerals and metals	kg Sb eq	4.1E-03	1.2E-07	1.3E-07	7.7E-08	2.4E-04	4.1E-05	2.9E-07	-2.6E-04	4.2E-03
Resource use, fossils	MJ	4.7E+02	5.0E+00	2.7E+00	3.5E+00	1.6E+04	4.8E+00	2.4E+01	-3.8E+01	1.7E+04
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

8736

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Table 9-124: EU total impact of Stock of products in the year of study: D3 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Others	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Total weight	g	**0.000**	**0.000**		**0.000**	**0.000**	**0.000**			**0.000**
Energy consumption										
Electricity	kWh		6		0	61,520	0			**61,520**
Thermal energy	MJ		0		0	0	0			**0**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	9.8E+02	7.1E+00	5.2E+00	7.0E+00	2.6E+04	9.8E+00	4.0E+01	-9.6E+01	2.7E+04
Ozone depletion	kg CFC-11 eq	5.7E-08	2.4E-09	6.0E-11	3.1E-10	9.6E-06	5.9E-10	8.9E-09	-7.6E-09	9.6E-06
Human toxicity, cancer	CTUh	1.1E-06	7.4E-10	1.4E-09	4.2E-09	4.3E-06	1.1E-08	4.9E-08	-5.9E-07	4.9E-06
Human toxicity, non-cancer	CTUh	1.1E-05	3.2E-07	3.4E-08	9.6E-08	8.6E-05	1.2E-07	2.1E-07	-2.5E-06	9.6E-05
Particulate matter	disease incidence	1.4E-04	7.6E-07	1.7E-07	3.4E-07	8.2E-04	1.4E-06	2.3E-06	-6.7E-06	9.6E-04

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	5.1E+01	2.8E+00	9.4E-02	3.9E-01	1.1E+04	5.4E-01	1.1E+01	-8.8E+00	1.1E+04
Photochemical ozone formation, human health	kg NMVOC eq	3.7E+00	1.9E-02	1.8E-02	3.4E-02	4.2E+01	3.7E-02	6.0E-02	-1.8E-01	4.6E+01
Acidification	mol H+ eq	1.5E+01	2.8E-02	2.0E-02	2.8E-02	7.8E+01	1.5E-01	9.2E-02	-3.9E-01	9.4E+01
Eutrophication, terrestrial	mol N eq	1.2E+01	7.2E-02	9.8E-02	8.5E-02	1.6E+02	1.2E-01	2.2E-01	-5.7E-01	1.7E+02
Eutrophication, freshwater	kg P eq	1.7E-03	1.6E-05	3.1E-05	1.1E-04	5.3E-02	1.7E-05	5.6E-05	-7.5E-05	5.4E-02
Eutrophication, marine	kg N eq	1.1E+00	6.7E-03	8.7E-03	8.8E-03	1.5E+01	1.1E-02	2.1E-02	-5.3E-02	1.6E+01
Ecotoxicity, freshwater	CTUe	7.6E+03	4.1E+01	4.8E+01	4.5E+01	1.2E+05	7.7E+01	1.3E+02	-2.0E+03	1.2E+05
Land use	pt	2.3E+04	6.9E+01	4.0E+01	1.8E+03	1.1E+05	2.3E+02	1.2E+02	-1.2E+03	1.4E+05
Water use	m^3 water eq. of deprived water	1.7E+02	2.6E+00	4.8E-01	1.1E+00	8.8E+03	1.7E+00	8.7E+00	-1.8E+01	9.0E+03
Resource use, minerals and metals	kg Sb eq	1.1E-01	3.2E-06	3.4E-06	2.1E-06	6.6E-03	1.1E-03	7.9E-06	-7.1E-03	1.1E-01
Resource use, fossils	MJ	1.3E+04	1.4E+02	7.5E+01	9.5E+01	4.5E+05	1.3E+02	6.5E+02	-1.0E+03	4.6E+05
Additional technical information										
Primary energy consumption	MJ	1.3E+04	1.4E+02	7.5E+01	9.5E+01	4.7E+05	1.3E+02	6.5E+02	-1.0E+03	4.8E+05

Table 9-125: Life cycle costs per product and total EU expenditure: D3.

Product items	LCC new product		Total annual consumer expenditure in EU27	
	Value	Unit	Value	Unit
Product price	2,800	EUR	28	mln. EUR/year
Installation/ acquisition costs (if any)	112	EUR	1	mln. EUR/year
Fuel (gas, oil, wood)	0	EUR/year	0	mln. EUR/year
Electricity	964	EUR/year	345	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	84	EUR	1	mln. EUR/year
Total	1,035	EUR/year	375	mln. EUR/year

D4: Industrial pass-through tumble dryer

Below, the life cycle impact is provided per product (**Table 9-126**), per year of use of the product (**Table 9-127**), total impact for the EU27 for the new product (**Table 9-128**) and the impact of the stock of products in the EU27 (**Table 9-129**).

Table 9-126: 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	3,326	1,080		0	0	n.a.			**4,406**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**2,869,816**	**2,867,560**		**0**	**0**	**28,698**			**5,766,075**
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	1.1E+04	1.2E+02	3.2E+02	0.0E+00	5.4E+06	1.2E+02	3.5E+03	-5.5E+03	**5.4E+06**
Ozone depletion	kg CFC-11 eq	6.4E-08	7.7E-08	3.7E-09	0.0E+00	6.2E-04	1.4E-09	8.2E-07	1.1E-09	**6.2E-04**

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, cancer	CTUh	1.5E-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	3.3E-04	2.9E-06	2.1E-06	0.0E+00	6.9E-03	3.4E-06	1.8E-05	-2.0E-04	**7.1E-03**
Particulate matter	disease incidence	1.1E-03	3.7E-05	1.0E-05	0.0E+00	5.2E-02	1.2E-05	2.1E-04	-4.0E-04	**5.3E-02**
Ionising radiation, human health	kBq U235 eq	2.5E+02	8.7E+01	5.7E+00	0.0E+00	4.8E+05	3.4E+00	9.9E+02	-6.0E+01	**4.8E+05**
Photochemical ozone formation, human health	kg NMVOC eq	2.8E+01	5.6E-01	1.1E+00	0.0E+00	4.5E+03	2.8E-01	5.2E+00	-9.4E+00	**4.6E+03**
Acidification	mol H+ eq	8.1E+01	8.4E-01	1.2E+00	0.0E+00	5.5E+03	8.2E-01	8.1E+00	-1.5E+01	**5.5E+03**
Eutrophication, terrestrial	mol N eq	8.4E+01	2.7E+00	6.0E+00	0.0E+00	1.1E+04	8.7E-01	1.9E+01	-2.8E+01	**1.2E+04**
Eutrophication, freshwater	kg P eq	1.3E-02	5.5E-04	1.9E-03	0.0E+00	2.8E+01	1.3E-04	5.1E-03	-5.0E-03	**2.8E+01**
Eutrophication, marine	kg N eq	7.8E+00	2.5E-01	5.3E-01	0.0E+00	1.3E+03	8.0E-02	1.8E+00	-2.6E+00	**1.3E+03**
Ecotoxicity, freshwater	CTUe	3.5E+04	1.7E+03	2.9E+03	0.0E+00	6.4E+06	3.7E+02	1.2E+04	-1.0E+04	**6.4E+06**
Land use	pt	3.8E+05	2.9E+03	2.5E+03	0.0E+00	5.2E+06	3.9E+03	1.1E+04	-9.4E+03	**5.5E+06**
Water use	m^3 water eq. of deprived water	8.7E+02	1.0E+02	3.0E+01	0.0E+00	3.9E+05	9.7E+00	7.9E+02	-1.8E+02	**3.9E+05**

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, minerals and metals	kg Sb eq	9.6E-01	1.6E-04	2.1E-04	0.0E+00	8.8E+00	9.6E-03	7.0E-04	-3.6E-01	**9.5E+00**
Resource use, fossils	MJ	1.2E+05	3.7E+03	4.6E+03	0.0E+00	8.5E+07	1.2E+03	5.6E+04	-4.9E+04	**8.5E+07**
Additional technical information										
Primary energy consumption	MJ	1.2E+05	3.8E+03	4.6E+03	0.0E+00	8.6E+07	1.2E+03	5.6E+04	-4.9E+04	**8.6E+07**

8748 * Manufacturing materials are currently double counting the raw materials column.

8749 **Table 9-127: 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	133	43		0	0	n.a.			**176**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**114,793**	**114,702**		**0**	**0**	**1,148**			**230,643**

Life Cycle phases --> Resource use and emissions		Raw materials	Manu-facturing*	Distri-bution	Packa-ging	Use	Maintenance & Repair	EoL	Impacts Credits	Total
Energy consumption										
Electricity	kWh		15		0	89,760	0			**89,775**
Thermal energy	MJ		0		0	2,752,067	0			**2,752,067**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	4.6E+02	4.9E+00	1.3E+01	0.0E+00	2.2E+05	4.6E+00	1.4E+02	-2.2E+02	**2.2E+05**
Ozone depletion	kg CFC-11 eq	2.6E-09	3.1E-09	1.5E-10	0.0E+00	2.5E-05	5.6E-11	3.3E-08	4.4E-11	**2.5E-05**
Human toxicity, cancer	CTUh	5.9E-07	-9.5E-09	3.4E-09	0.0E+00	2.3E-05	5.8E-09	1.8E-07	-3.8E-07	**2.4E-05**
Human toxicity, non-cancer	CTUh	1.3E-05	1.2E-07	8.2E-08	0.0E+00	2.8E-04	1.3E-07	7.0E-07	-8.2E-06	**2.8E-04**
Particulate matter	disease incidence	4.5E-05	1.5E-06	4.1E-07	0.0E+00	2.1E-03	4.6E-07	8.3E-06	-1.6E-05	**2.1E-03**
Ionising radiation, human health	kBq U235 eq	1.0E+01	3.5E+00	2.3E-01	0.0E+00	1.9E+04	1.3E-01	4.0E+01	-2.4E+00	**1.9E+04**
Photochemical ozone formation, human health	kg NMVOC eq	1.1E+00	2.2E-02	4.5E-02	0.0E+00	1.8E+02	1.1E-02	2.1E-01	-3.8E-01	**1.8E+02**
Acidification	mol H+ eq	3.2E+00	3.4E-02	5.0E-02	0.0E+00	2.2E+02	3.3E-02	3.3E-01	-5.9E-01	**2.2E+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, terrestrial	mol N eq	3.4E+00	1.1E-01	2.4E-01	0.0E+00	4.6E+02	3.5E-02	7.7E-01	-1.1E+00	**4.6E+02**
Eutrophication, freshwater	kg P eq	5.2E-04	2.2E-05	7.7E-05	0.0E+00	1.1E+00	5.4E-06	2.0E-04	-2.0E-04	**1.1E+00**
Eutrophication, marine	kg N eq	3.1E-01	9.9E-03	2.1E-02	0.0E+00	5.1E+01	3.2E-03	7.2E-02	-1.0E-01	**5.1E+01**
Ecotoxicity, freshwater	CTUe	1.4E+03	6.7E+01	1.2E+02	0.0E+00	2.5E+05	1.5E+01	4.6E+02	-4.1E+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	-3.8E+02	**2.2E+05**
Water use	m^3 water eq. of deprived water	3.5E+01	4.0E+00	1.2E+00	0.0E+00	1.5E+04	3.9E-01	3.1E+01	-7.0E+00	**1.5E+04**
Resource use, minerals and metals	kg Sb eq	3.9E-02	6.6E-06	8.4E-06	0.0E+00	3.5E-01	3.9E-04	2.8E-05	-1.4E-02	**3.8E-01**
Resource use, fossils	MJ	4.7E+03	1.5E+02	1.8E+02	0.0E+00	3.4E+06	4.9E+01	2.3E+03	-2.0E+03	**3.4E+06**
Additional technical information										
Primary energy consumption	MJ	4.7E+03	1.5E+02	1.8E+02	0.0E+00	3.4E+06	4.9E+01	2.3E+03	-2.0E+03	**3.4E+06**

* Manufacturing materials are currently double counting the raw materials column.

Table 9-128: EU total impact of new products sold in the year of study: D4 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0	0		0	0	n.a.			**0**
Metals	g	0	0		0	0	n.a.			**0**
Electronics	g	0	0		0	0	n.a.			**0**
Others	g	0	0		0	0	n.a.			**0**
Total weight	g	**0**	**0**		**0**	**0**	**0**			**0**
Energy consumption										
Electricity	kWh		0		0	2,693	0			**2,693**
Thermal energy	MJ		0		0	82,562	0			**82,562**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	1.4E+01	1.5E-01	3.8E-01	0.0E+00	6.5E+03	1.4E-01	4.2E+00	-6.6E+00	**6.5E+03**
Ozone depletion	kg CFC-11 eq	7.7E-11	9.3E-11	4.4E-12	0.0E+00	7.4E-07	1.7E-12	9.8E-10	1.3E-12	**7.5E-07**
Human toxicity, cancer	CTUh	1.8E-08	-2.8E-10	1.0E-10	0.0E+00	7.0E-07	1.7E-10	5.4E-09	-1.1E-08	**7.1E-07**
Human toxicity, non-cancer	CTUh	4.0E-07	3.5E-09	2.5E-09	0.0E+00	8.3E-06	4.0E-09	2.1E-08	-2.4E-07	**8.5E-06**
Particulate matter	disease incidence	1.3E-06	4.4E-08	1.2E-08	0.0E+00	6.3E-05	1.4E-08	2.5E-07	-4.8E-07	**6.4E-05**

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	3.0E-01	1.0E-01	6.9E-03	0.0E+00	5.8E+02	4.0E-03	1.2E+00	-7.2E-02	**5.8E+02**
Photochemical ozone formation, human health	kg NMVOC eq	3.3E-02	6.7E-04	1.4E-03	0.0E+00	5.4E+00	3.4E-04	6.3E-03	-1.1E-02	**5.5E+00**
Acidification	mol H+ eq	9.7E-02	1.0E-03	1.5E-03	0.0E+00	6.6E+00	9.8E-04	9.8E-03	-1.8E-02	**6.7E+00**
Eutrophication, terrestrial	mol N eq	1.0E-01	3.2E-03	7.2E-03	0.0E+00	1.4E+01	1.0E-03	2.3E-02	-3.3E-02	**1.4E+01**
Eutrophication, freshwater	kg P eq	1.5E-05	6.6E-07	2.3E-06	0.0E+00	3.3E-02	1.6E-07	6.1E-06	-6.0E-06	**3.3E-02**
Eutrophication, marine	kg N eq	9.3E-03	3.0E-04	6.4E-04	0.0E+00	1.5E+00	9.6E-05	2.1E-03	-3.1E-03	**1.5E+00**
Ecotoxicity, freshwater	CTUe	4.2E+01	2.0E+00	3.5E+00	0.0E+00	7.6E+03	4.4E-01	1.4E+01	-1.2E+01	**7.7E+03**
Land use	pt	4.6E+02	3.4E+00	2.9E+00	0.0E+00	6.2E+03	4.6E+00	1.3E+01	-1.1E+01	**6.7E+03**
Water use	m^3 water eq. of deprived water	1.0E+00	1.2E-01	3.5E-02	0.0E+00	4.6E+02	1.2E-02	9.4E-01	-2.1E-01	**4.6E+02**
Resource use, minerals and metals	kg Sb eq	1.2E-03	2.0E-07	2.5E-07	0.0E+00	1.1E-02	1.2E-05	8.4E-07	-4.3E-04	**1.1E-02**
Resource use, fossils	MJ	1.4E+02	4.5E+00	5.5E+00	0.0E+00	1.0E+05	1.5E+00	6.8E+01	-5.9E+01	**1.0E+05**
Additional technical information										
Primary energy consumption	MJ	1.4E+02	4.6E+00	5.5E+00	0.0E+00	1.0E+05	1.5E+00	6.8E+01	-5.9E+01	**1.0E+05**

Table 9-129: EU total impact of Stock of products in the year of study: D4 (values should be interpreted as multiplied by 10^6 to account for the actual stock numbers).

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	0.000	0.000		0.000	0.000	n.a.			**0.000**
Metals	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Electronics	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Others	g	0.000	0.000		0.000	0.000	n.a.			**0.000**
Total weight	g	**0.000**	**0.000**		**0.000**	**0.000**	**0.000**			**0.000**
Energy consumption										
Electricity	kWh		10		0	59,968	0			**59,977**
Thermal energy	MJ		0		0	1,838,622	0			**1,838,622**
PEF Impact categories	unit									
Climate change, total	kg CO_2 eq	3.1E+02	3.3E+00	8.5E+00	0.0E+00	1.4E+05	3.1E+00	9.3E+01	-1.5E+02	**1.4E+05**
Ozone depletion	kg CFC-11 eq	1.7E-09	2.1E-09	9.8E-11	0.0E+00	1.7E-05	3.8E-11	2.2E-08	3.0E-11	**1.7E-05**
Human toxicity, cancer	CTUh	3.9E-07	-6.3E-09	2.3E-09	0.0E+00	1.6E-05	3.9E-09	1.2E-07	-2.5E-07	**1.6E-05**
Human toxicity, non-cancer	CTUh	8.9E-06	7.8E-08	5.5E-08	0.0E+00	1.8E-04	9.0E-08	4.7E-07	-5.5E-06	**1.9E-04**
Particulate matter	disease incidence	3.0E-05	9.9E-07	2.7E-07	0.0E+00	1.4E-03	3.1E-07	5.5E-06	-1.1E-05	**1.4E-03**

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	6.7E+00	2.3E+00	1.5E-01	0.0E+00	1.3E+04	9.0E-02	2.6E+01	-1.6E+00	**1.3E+04**
Photochemical ozone formation, human health	kg NMVOC eq	7.4E-01	1.5E-02	3.0E-02	0.0E+00	1.2E+02	7.5E-03	1.4E-01	-2.5E-01	**1.2E+02**
Acidification	mol H+ eq	2.2E+00	2.3E-02	3.3E-02	0.0E+00	1.5E+02	2.2E-02	2.2E-01	-3.9E-01	**1.5E+02**
Eutrophication, terrestrial	mol N eq	2.2E+00	7.1E-02	1.6E-01	0.0E+00	3.1E+02	2.3E-02	5.1E-01	-7.4E-01	**3.1E+02**
Eutrophication, freshwater	kg P eq	3.4E-04	1.5E-05	5.1E-05	0.0E+00	7.4E-01	3.6E-06	1.4E-04	-1.3E-04	**7.4E-01**
Eutrophication, marine	kg N eq	2.1E-01	6.6E-03	1.4E-02	0.0E+00	3.4E+01	2.1E-03	4.8E-02	-6.9E-02	**3.4E+01**
Ecotoxicity, freshwater	CTUe	9.3E+02	4.5E+01	7.9E+01	0.0E+00	1.7E+05	9.8E+00	3.1E+02	-2.7E+02	**1.7E+05**
Land use	pt	1.0E+04	7.7E+01	6.6E+01	0.0E+00	1.4E+05	1.0E+02	3.0E+02	-2.5E+02	**1.5E+05**
Water use	m^3 water eq. of deprived water	2.3E+01	2.7E+00	7.9E-01	0.0E+00	1.0E+04	2.6E-01	2.1E+01	-4.7E+00	**1.0E+04**
Resource use, minerals and metals	kg Sb eq	2.6E-02	4.4E-06	5.6E-06	0.0E+00	2.4E-01	2.6E-04	1.9E-05	-9.7E-03	**2.5E-01**
Resource use, fossils	MJ	3.2E+03	9.9E+01	1.2E+02	0.0E+00	2.3E+06	3.3E+01	1.5E+03	-1.3E+03	**2.3E+06**
Additional technical information										
Primary energy consumption	MJ	3.2E+03	1.0E+02	1.2E+02	0.0E+00	2.3E+06	3.3E+01	1.5E+03	-1.3E+03	**2.3E+06**

8756

Table 9-130: Life cycle costs 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
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	1,500	EUR	2	mln. EUR/year
Total	**76,866**	EUR/year	**2,320**	mln. EUR/year

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
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
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

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)
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
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

8763

Annex VIII – Substances of Concern

1. Introduction of Task

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.

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 non-household 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. Semi-professional 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.

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.

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 organizations for both manufacturing and recycling, as well as national representatives.

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 the perspective 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 chemicals or occupational-safety law.

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 SoC.

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.

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).

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, Art. 31 also obliges any supplier of a substance or mixture to provide a Safety Data Sheet (SDS) free of charge whenever it is classified as hazardous, is persistent, bioaccumulative or toxic (PBT/vPvB), appears on the Candidate List of SVHCs, or falls under 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.

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 don't 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.

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 Professional dishwasher 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 Professional dishwashers 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 Considerations on information and performance requirements

5.1 Information requirements

Article 7 of the ESPR mandates that any product containing a Substance of Concern must be accompanied by standardized 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.

5.2 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 SHVC 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 Professional dishwasher 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 Harmonized 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 harmonized 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 bill of materials, including all components and spare parts.

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 bill of materials, 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, organization 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.

5.3 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.

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 Harmonized 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 delegate 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.

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)

9171

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		

9172

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

9173

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.

3. 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

9174

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.

9175

- 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

9176

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.

9177

- 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.

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.

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9183

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

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9184

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).

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_r	L.5.11	Drum volume	(l)
$\overline{W_{total}}$	L.5.9.7	Total energy consumption	(kWh)
$\overline{W_e}$	L.5.9.3	Total electric energy consumption	(kWh)
$\overline{W_{st}}$	L.5.9.5	Total steam energy consumption	(kWh)
$\overline{W_g}$	L.5.9.4	Total gas energy consumption	(kWh)
$\overline{W_w}$.	L.5.9.2	Total hot water energy consumption	(kWh)
W_{fq}	L.5.10	Energy consumption/kg load	(kWh/kg)
$\overline{t_r}$	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)
$\overline{V_m}$	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.

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 D.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_r	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_{fq}	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.

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9185

- 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.

9186

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

9187
9188

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)	

Annex XII – DPP use cases and derived requirements

Green colour indicates use-cases that are seen potentially relevant by the project team – to be validated by the stakeholders. To note, “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	-	-
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	-	-

Stakeholder	Use-case (CE-goal)	Information to be provided	Feasible with EPREL / DPP	Public data	Confidential	Granularity	Hierarchy	Data carrier	Offline available	Machine readable
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)
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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