European Commission

Preparatory Study and Impact Assessment support study on professional dishwashers

Draft Report
Task 2: Preparatory Study (PS) Phase I
Sub-task 2.1 PS MEErP Tasks 1-4
Version 1.0

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Contents

1. Introduction

This preparatory study describes the results of the assessment of professional dishwasers 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) and takes into account the forthcoming 2024 revision of MEErP (Caldas et al. 2022) and is complemented by elements of the Digital Product Passport methodology. The aims and objectives of the project and a general methodological overview are detailed below.

1.1. Prior work and political context

1.1.1. Prior work: Preparatory study for ecodesign requirements of energy-using products - Lot 24: Professional washing machines, dryers and dishwashers (2011)

In 2011, the Commission published a preparatory study on a possible ecodesign measure for professional washing machines, dryers and dishwashers (Lot 24).[1] On the basis of that study and a preliminary impact analysis, the Commission discussed the results in the Ecodesign Consultation Forum in 2013, concluding that there was a significant energy, carbon and water saving potential, no existing measures addressing that potential and that the product group would also otherwise eligible for measures. The main problem was the lack of appropriate measurement standards for this product group, so upon the subsequent Consultation Forum in 2014, the Commission decided to postpone regulatory measures and the delevopment of delegated acts until such test standards were developed, and issued a standardisation mandate, which was completed in 2017.[2]

In the preparatory study for the 2022-2024 Ecodesign and Energy Labelling Working Plan, an update of the environmental improvement potential for professional dishwashers was assessed. The benefits were estimated to remain significant in 2030.

[1] See https://www.eceee.org/ecodesign/products/lot24-professional-wet-appliances/

[2] See EN 50593:2017(MAIN) Electric dishwashers for commercial use - Test methods for measuring the performance. The work resulted later in the standard IEC 63136:2019 Electric dishwashers for commercial use - Test methods for measuring the performance (successor of EN 50593:2017)

As a result, the Commission announced its intention to develop measures for professional dishwashers and included this product category in the current Ecodesign and Energy Labelling Working Plan.[3]

1.1.2. Political context

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 2009/125/EC. 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.

The Ecodesign for Sustainable Products Regulation (ESPR) entered into force on 18 July 2024. The ESPR Regulation builds on the previously existing Ecodesign Directive 2009/125/EC, 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

For the pending work under the Ecodesign and Energy Labelling Working Plan 2022-2024 which included the product category Professional Dishwashers, it was decided that this product category will not fall under the transitional regime according to Article 79 of the ESPR, but will be covered by the new Working Plan of the ESPR[4]. With the ESPR

[3] See SWD(2022) 101 final and Official Journal 2022/C 182/01

[4] Online information session of the Commission on the Ecodesign for Sustainable Products Regulation (ESPR), held on 22 May 2024

Regulation, the Commission is now preparing for the addressing of specific measures for professional dishwashers by means of delegated act.

1.2. Objectives of this preparatory study

Within this context, DG Environment launched a preparatory study on professional dishwashers 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 also investigates the environmental impacts and the ecodesign requirements that can be introduced to the product to improve certain products aspects as listed in Article 5 of Regulation (EU) 2024/1781 (durability, reliability, reusability, updgradeability, reparability...). This study will provide the necessary information for the identification of the policy options to be analysed in the subsequent impact assessment.

Overall objectives of the study can be summarised as follows:

- Conduct an ecodesign preparatory study analysing the technical, economic, environmental, market and societal aspects of professional dishwashers following the MEErP methodology Tasks 1-7;
- Carry out an Impact Assessment support study to support the potential adoption of the regulatory measure(s);
- Based on the findings of the Preparatory and Impact Assessment studies, where appropriate, provide input and support to the development of draft proposal of ESPR Delegated Act(s) and/or Energy Labelling Delegated Act(s) for professional dishwashers.
- Provide ad-hoc technical expertise and technical support to the Commission.

The current report covers MEErP Tasks 1 to 4 (Scope, Market, Users, Technologies) and shall serve as input for the first stakeholder meeting and following stakeholder consulation before starting in the second phase of the preparatory study with MEErP Tasks 5-7.

2. Methodology

2.1. Methodology background

The preparatory study follows the MEErP methodology, which has been applied to around 40 groups of energy-related-products in the framework of the Ecodesign Directive 20109/125/EC and shall also be applied in the context of preparatory studies under the ESPR. The MEErP consists of 7 tasks:

- **Task 1:** Scope
- **Task 2:** Markets
- **Task 3:** Users
- **Task 4:** Technologies
- **Task 5:** Environment
- **Task 6:** Economics
- **Task 7:** Scenarios

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. 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.

2.2. Approach of this preparatory study

2.2.1. Stakeholder consultation

To collect data and exchange with stakeholders, the following means 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-commdishwashers.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, initial interviews with stakeholders were held to allow a first identification of aspects that had changed since the 2011 preparatory study. To collect information regarding MEErP Tasks 1-4, two stakeholder consultations have been held so far:
    - A first online consultation was held between mid July 2024 and 6 September 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 Appendix 1, for the questions asked.
    - A second consultation was held between 16 September 2024 and 22 October 2024 with its focus being the collection of data for MEErP tasks 2-4. Here too, an online survey tool was used to collect information for a set of questions, see Appendix 2, for the questions asked. Furthermore, an excel file was used to collect more detailed numerical data in tabular form for some of the questions, see Appendix 3, for the questions asked.

A stakeholder meeting will be held on 12 December 2024 in Brussels to discuss and collect feedback on the first results. The meeting will focus on the preliminary results of MEErP Tasks 1-4.

3. MEErP Task 1 – Scope

3.1. Objectives of MEErP Task 1

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 professional dishwashers with the aim to define the functional unit of the product group and the possible scope of a potential regulation. MEErP Task 1 is a very important step in a preparatory study. It provides suggestions to define the scope and possible exemptions from the scope. It also provides or proposes definitions of the subject matter of the study, ideally based on existing standards, links it to existing legislation and identifies prevailing gaps to be filled by the delegated acts to be drafted.

3.2. Product category and performance assessment

3.2.1. Professional dishwashing process

As the basis for all subsequent analysis steps, the professional dishwashing process is briefly described first. The entire dishwashing process, e.g. in a large canteen, consists of several steps which are depicted in the following figure.

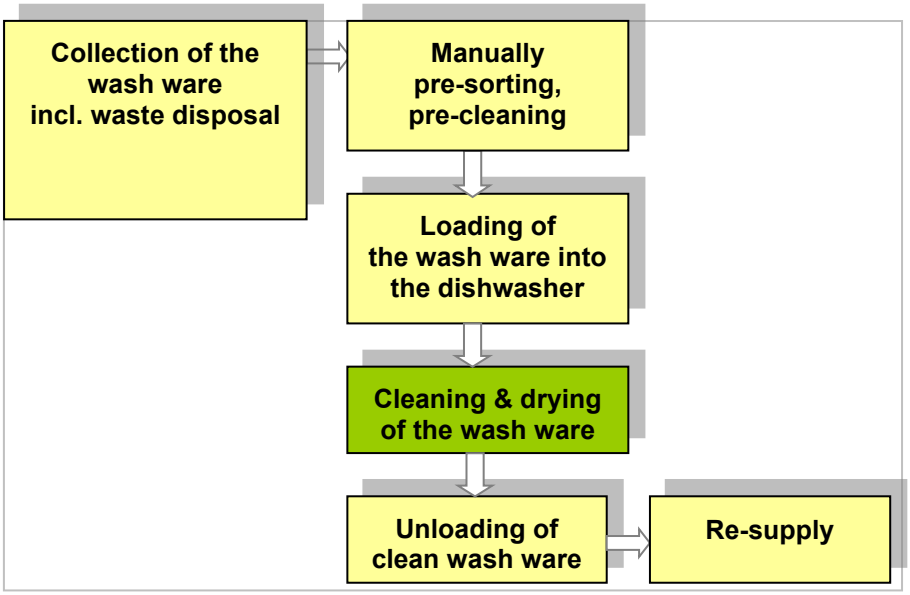

Figure 2-1: Different steps of a professional dishwashing process[5]

Only the technical cleaning and drying process and the machines used for this are in the focus of the preparatory study at hand (green box), although from customers' and costs' perspective the manual parts of the dishwashing process might be also of interest.[6]

The study also concentrates on the dishwashing machine itself and does not consider the different water quality which has an influence on the result of the dishwashing process. Most of the machines are supplied with a separate water treatment system or this can be delivered on demand[7]. Finally, the analysis ignores external accessories kits not being components of the dishwashing machines, but usually supplied together with the machines (e.g. clearing station, admission table, and external baskets).

According to the VGG glossary[8] 'dishes' is a collective term for containers and vessels which are used for preparing, cooking, arranging and serving food. It includes plates, cups, saucers and bowls made of various materials. Next to 'dishes' dishwashers are also used to clean, rinse and dry glasses, cutlery, black cookware, and other cooking utensils. The more general term of all these items that may be cleaned by a dishwasher is 'wash ware'. According to the VGG glossary, 'wash ware' constitutes all components

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5 Own figure according to VGG-brochure 'Gewerbliches Geschirrspülen und Hygiene' (professional dishwashing and hygiene), March 2006

6 In a dishwashing process, 60% to 80% of the total costs are caused by labour costs. Source: aid Infodienst: Küche und Technik – Handbuch für gewerbliche Küchen. [Kitchen and Technology – Guide for commercial kitchens]; Bonn 2005.

7 Regarding dishwasher Categories 1 and 2 (cf. Section 3.2.3.7), the water treatment system can be part of the machine itself or equipped separately. For the other categories, water treatment systems are usually separate.

8 see 'Commercial dishwashing: glossary of terms (technical information sheet No. 1)' published by Commercial Dishwashing Association, January 2008

which are cleaned in the warewasher. Their shape and material must be suitable for cleaning by machine.

In our study, we will use ‘wash ware’ as superordinated term for the different kinds of items to be cleaned.

Treatment agents like detergents and rinse aids serve to clean, disinfect, rinse and descale wash ware of large-scale catering establishments.

Detergents come as powder mixtures, as solid blocks and in paste and liquid form. Their purpose is to remove food particles from wash ware completely and to counteract any re-soiling from the detergent solution. General decontamination performance might be enhanced by the use of a disinfecting component like for example active chlorine[9].

The function of the rinse aid is to reduce the surface tension of the water in the final fresh water rinse cycle and, by lowering the interfacial tension, to achieve a uniform wetting of the cleaned wash ware. This, together with the heat stored up in the wash ware itself (from the hot detergent solution or a separate feed of hot drying air) means that rapid drying of the wash ware is achieved. This results in spotless, gleaming and dry surfaces on the washware (VGG 2010).[10]

3.2.2. Definition of professional dishwashers

In the following, existing definitions for professional / commercial dishwashers are presented. In addition, basic differences between commercial and household dishwashers are described in order to properly define the scope of this preparatory study.

3.2.2.1. Ecodesign regulation on household dishwashers

The Commission Regulation[11] with regard to ecodesign requirements for household dishwashers provides the following definition: ‘household dishwasher’ means a machine which cleans and rinses tableware, and which is declared by the manufacturer in the Declaration of Conformity to comply with Directive 2014/35/EU of the European

9 The possible usage and environmental impacts will be described in MEErP Task 6 (effects of lower washing temperatures on composition of detergents)

10 Arbeitsgemeinschaft Gewerbliches Geschirrspülen [Commercial Dishwashing Association]: Commercial dishwashing & cleaning agents (Technical information sheet No. 05); Status: 20. April 2010.

11 COMMISSION REGULATION (EU) 2019/2022 of 1 October 2019 laying down ecodesign requirements for household dishwashers pursuant to Directive 2009/125/EC of the European Parliament and of the Council amending Commission Regulation (EC) No 1275/2008 and repealing Commission Regulation (EU) No 1016/2010 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R2022

Parliament and of the Council (13) or with Directive 2014/53/EU of the European Parliament and of the Council.

In this definition for household dishwashers, reference is made to the Low Voltage Directive 2014/35/EU (see Section 3.4.1.2) as well as to the Radio Equipment Directive 2014/53/EU that needs to be considered if radio equipment is incorporated and permanently affixed into the product as it can be the case with 'smart' dishwashers, see Section 3.4.1.15).

3.2.2.2. Distinction according to Machinery Directive

Against this background, a possible general delimitation between household appliances and professional appliances is provided by the Machinery Directive 2006/42/EC,[12] in force since 29th December 2009. It clarifies the borderline between machinery for household and for professional use in order to provide greater legal certainty. Whereas for the latter machinery the scope of the Machinery Directive applies, in Article 1 (2) k 'household appliances intended for domestic use' are explicitly excluded therefrom. They belong to low voltage electrical and electronic machinery with 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) and therefore must fulfil the safety objectives of the Low Voltage Directive (2014/35/EU, see Section 3.4.1.2).

Concerning the exclusion of household appliances intended for domestic use from the scope of this preparatory study, the following clarifications are given in the '*Guide to application of the Machinery Directive 2006/42/EC*'.[13]

- The expression 'household appliances' designates equipment intended for housekeeping functions such as washing, cleaning, heating, cooling, cooking, etc. Examples of household appliances include washing machines, dishwashers, vacuum cleaners and machinery for food preparation and cooking.
- The exclusion concerns appliances 'intended for domestic use', in other words, intended for use by private persons (consumers) in the home environment. Thus appliances for the housekeeping functions mentioned above that are intended for commercial or industrial use are not excluded from the scope of the Machinery Directive.

While it is possible for a private consumer to acquire an appliance intended for commercial use or for a commerce to acquire an appliance intended for domestic use, 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

12 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2006L0042:20091215:EN:PDF

13 Guide to application of the Machinery Directive 2006/42/EC https://osha.europa.eu/en/legislation/guidelines/guide-application-machinery-directive-200642ec

his Declaration of Conformity (DoC). Evidently, this statement must accurately reflect the foreseeable use of the product.[14]

In general, the design and construction of machinery must take account of the intended use. Recital 15 of the Machinery Directive stresses that the machinery manufacturer must consider whether the machinery is intended to be used by a professional or a non-professional operator or is intended to provide a service to consumers. Annex I of the directive describes essential health and safety requirements relating to the design and construction of machinery, i.e. of appliances for commercial or industrial use.

Due to inadequacies and inconsistencies in the product coverage and conformity assessment procedures, the provisions of the Machinery 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; EU 2023c, 2023a).

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 dishwashers intended for domestic use.
- Dishwashers intended for professional use are not excluded and will therefore be in the scope of the new regulation starting from 20 January 2027 (EU 2023d, 2023b).

In summary, the Machinery Directive provides a legal principle to distinguish between devices for usage in households on the one side and professional use on the other side.

3.2.2.3. Definition according to ISO, IEC and EN standards

In **IEC 63136:2019** a **commercial dishwasher** is defined as follows: ‘electric dishwasher that is specially designed for use in commercial environments and that cleans and rinses dishes, glasses, cutlery, and, in some cases, cooking utensils by chemical, mechanical, thermal and electrical treatment’. More details on the scope and the objectives of this standard can be found in section 3.3.1.1.

EN 17735:2023 provides a definition for the term **dishwashing machine**: ‘appliance that is specially designed for use in professional environments and that cleans and rinses plates, glasses, cutlery, and, in some cases, cooking utensils by chemical, mechanical and thermal means’.

[14] l.c., page 54/337

Despite the existing definitions mentioned above, there is no official or standardised definition or delimitation between the terms professional, commercial, and industrial. CENELEC TC59X proposed that the term 'commercial' shall be used in connection with *market and market segments*. The term 'professional', however, shall be used in connection with *equipment* designed for use in commercial segments.

3.2.2.4. Definition according to labelling schemes

Professional dishwashers are currently not explicitly covered by the EU energy label or ecolabel scheme. In the U.S. Energy Star (cf. Section 3.4.5.4), however, the following definition for dishwashing machines can be found[15]: 'A machine designed to clean and sanitize plates, pots, pans, glasses, cups, bowls, utensils, and trays by applying sprays of detergent solution (with or without blasting media granules) and a sanitizing rinse.'

3.2.2.5. Distinction between professional and household dishwashers according to functional performance and technological differences

With regard to functional performance and technological differences, the boundary between household and professional use is fluent. There is a semi-professional context, where some requirements of the household and some of the professional context apply.

In *private households,* a dishwasher usually runs on average 280 cycles per year, i.e. more than 5 times per week.[16] Household dishwashers run with fresh water for each programme cycle meaning that for each cycle, the whole process water has to be heated. Further, in household dishwashers, the wash ware is often not cleaned directly after the meals so that the soil is rather dried; thus, dishwashers for households usually have a longer soaking time; for these reasons, standard programmes of household dishwashers usually have longer cycle times of up to 3 hours. However, the duration of the programme is of less importance to private users as the device runs e.g. over night or between two meals. Household dishwashers are designed to clean various kinds of wash ware (dishes, cutlery, glasses, pots and pans) at the same time, i.e. they usually have rather unspecific programmes for general use (even though some have special programmes for glasses or 'intense' programmes for highly soiled pots and pans).

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15 https://www.energystar.gov/sites/default/files/2024-08/Commercial%20Dishwashers%20Version%203.0%20Specification%20Rev.%20-%20September%202021.pdf

16 Total number of standard cleaning cycles per year as used in the 'Method for calculating the Energy Efficiency Index, Cleaning Efficiency Index, and the Drying Efficiency Index' in the COMMISSION REGULATION (EU) No 1016/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household dishwashers. Official Journal of the European Union L 293/31 from 11.11.2010

In the *professional context*, the specific requirements according to space or type of wash ware differ considerably compared to household use, leading to a variety of different types of professional dishwashers varying in e.g. size and capacity (number of wash ware or baskets to be cleaned per hour). Compared to household use, usually a higher number of items have to be cleaned in professional dishwashers. Thus, they are operated more often (in case of programme automats[17]) or for longer times (in case of conveyor-type dishwashers[18]). Moreover, in the professional context the programmes are required to be much faster than in private households.

The time requirement leads to the use of a tank system, where the detergent solution, i.e. the process water including the detergent in the required concentration, for the cleaning step is stored in a wash tank at high temperatures. The tank system saves the time used otherwise to heat up the water before each cleaning cycle. During operation the detergent solution is circulated through the dishwasher by means of a pump; to reuse the detergent solution for the next cleaning cycles, intensive water filtration takes place. The detergent solution is not changed between the cycles of the programme, but only partly replaced by hot fresh water from the final rinse zone (so called regeneration of detergent solution). The water in the tank is usually changed once a day or after each working shift.

Using a water-change system instead of a tank system makes sense in applications which are very similar to household use, the so called *semi-professional applications*, like Kindergartens or pre-schools, where the number of items to be cleaned per day is rather small (compared to other professional applications). Tank machines would not make sense due to this small amount of wash ware. As the time requirements in the semi-professional context are higher than in households, the programme cycles are shorter than in household dishwashers (from approximately 5 to less than 30 minutes). The faster programmes compared to household appliances usually lead to a higher energy consumption of these semi-professional appliances.

Sometimes only one specific type of wash ware has to be cleaned or there is enough space and needed capacity to use several dishwashers in parallel, resulting in much more specialised dishwashers compared to household use. In bars or taverns, for example, mainly glasses have to be cleaned. Therefore, special glass washers are used. In canteens a large number of wash ware has to be cleaned. For this purpose, often several dishwashers are used, with each dishwasher being specialised for a certain kind of wash ware. In large-scale catering establishments the pots and pans used are usually much bigger compared to those used in private households and thus require more spacious dishwashers.

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[17] Programme automats are dishwashers where the different steps of the dishwashing process are conducted consecutively in time. The basket(s) with the wash ware stay(s) in the same position during the whole dishwashing programme.

[18] Conveyor-type dishwashers are dishwashers where the different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the wash ware is transported through these zones, which are constructed as chambers, with openings in the transport direction. They are operated continuously within a certain period of time.

Further differences between appliances for household and professional use are:

- The **connected load** (professional dishwashers are available with higher load and three phases connectivity (400 V));
- The **detergent dosage** (manual dosing of cleaning agent in case of household dishwashers, use of tabs possible, vs. automatic detergent dosage in case of professional dishwashers);
- The **distribution channels** (professional appliances are sold directly by the manufacturers or via specialised gastronomy trade);
- The **price** (production costs of professional appliances are usually higher than household dishwashers).

The following table gives an overview of a possible delimitation between household, semi-professional and professional dishwashers.

Table 2-1: Main product groups of dishwashers according to customer segment

Group	Domestic Dishwashers	Semi-professional Dishwashers	Professional Dishwashers
Target group / Applications	Private households	Offices, small pensions, hospitals, hotels, nursing homes, restaurants, community kitchens, bed & breakfasts, institutional kitchens, kindergartens & pre-schools, schools, supermarkets	E.g. bakeries, bars, bistros, bread & bakery industry, butcheries, cafeterias, canteens, care homes, caterers, community centres, food processing industry, food retailing; hospitals, hotels, institutional kitchens, kindergartens & pre-school, marine, meat processing industry, restaurants, schools, supermarkets, etc.
Wash ware	Dishes, glasses, cutlery and further kitchen utensils	Dishes, glasses, cutlery and further kitchen utensils	Dishes, glasses, cutlery, crockery, black cookware, further kitchen utensils of large-scale catering establishments
Temporal requirements	No special requirements regarding running times (cycle times up to 3 hours)	Short running times per cycle (5 to 30 min) through higher thermal, mechanical or chemical action	Very short running times per cycle (from below 1 minute per cycle) / high dishwashing capacity per hour
Water intake	Freshwater intake for each step in the programme.	Freshwater intake for each step in the programme.	Freshwater intake only for final rinse (smaller volume than for freshwater system dishwasher)
Water treatment	None (freshwater intake)	None (freshwater intake)	Intensive filtration of the detergent solution for re-use in several cycles (tank operation)
Operating principle	Discontinuous operation in cycles	Discontinuous operation in cycles	Discontinuous operation in cycles or continuous operation
Cleaning and hygienic requirements	Good cleaning efficiency important	Good cleaning efficiency important and hygienic requirements to be met	Good cleaning efficiency important and hygienic requirements to be met
Number of baskets to be cleaned at once	Dishwashing on two or three levels possible (loading of two or three baskets possible)	Dishwashing on two or three levels possible (loading of two or three baskets possible)	Dishwashing usually on one level (in front loaders loading of only one basket possible, in conveyor-type dishwashers continuous cleaning of baskets possible)
Type of programmes	Rather unspecific programmes for various items to be cleaned in one cycle	Rather unspecific programmes for various items to be cleaned in one cycle	Specific programmes or specific appliances for different kinds of items to be cleaned.
Detergent dosage	Manual detergent dosing	Manual or automatic detergent dosing	Automatic detergent dosing
Effort for maintenance	Low effort for cleaning of dishwasher	Low effort for cleaning of dishwasher	At least daily cleaning of machine necessary[19]

[19] According to VGG 'Professional dishwashing & hygiene (2006)' machines have to be cleaned carefully after each end of operations (i.e. emptying of the tanks, cleaning of the interiors, the filter systems, the water intake and outlet, the partition curtains and the

Group	Domestic Dishwashers	Semi-professional Dishwashers	Professional Dishwashers
Power supply, heating system	Normal load connection	Normal or high load connection	Usually high load and three phases (400 V) connection; partly additionally alternative energy sources (steam, gas, warm water connection)
Product categories	Typical dimension: height x width x depth 850 x 600 x 600 mm	Typical dimension: height x width x depth 850 x 600 x 600 mm	Variable dimensions depending on amount and type of items to be cleaned and spatial possibilities.

The table shows that there are only minor differences between household and semi-professional dishwashers (main differences are the shorter running times of the programmes and the possibility to connect to higher load in case of semi-professional dishwashers). However, there are significant differences between household and semi-professional appliances on the one hand and professional ones on the other hand.

After this general delimitation of professional dishwashers, the following sections describe the individual professional products in more detail.

3.2.2.6. Definition of professional dishwashers used in this study

In the Lot 24 preparatory study from 2011, the term ‘professional’ has been used as super-ordinated term for dishwashing appliances used in commercial and / or industrial market segments. On the basis of the Ecodesign Regulation on household dishwashers and the Machinery Directive, professional dishwashers were defined as follows:

spraying systems). The reason is to avoid depositions in the machine and on the washware as these might accelerate the settling and breeding of microorganisms. (see http://www.vgg-online.de/download/merkblaetter/Gewerbliches_Geschirrspuelen_und_Hygiene.pdf)

> 'Professional dishwasher' means a machine which cleans, rinses, and dries wash ware like dishware, glassware, cutlery, and other utensils connected to the preparation, cooking, arrangement or serving of food (including drinks) by chemical, mechanical, and thermal means; which is connected to electric mains and which is designed to be used principally for commercial and industrial purposes as stated by the manufacturer in the Declaration of Conformity (DoC).

As a reference to the Machinery Directive (see section 3.2.2.2) is required in the DoC, this definition provides a clear delimitation from household appliances as defined in the Regulation on ecodesign requirements for household dishwashers (EU) 2019/2022 (see also Section 3.2.2.1):

'Household dishwasher' means a machine which cleans and rinses tableware, and which is declared by the manufacturer in the Declaration of Conformity to comply with Directive 2014/35/EU of the European Parliament and of the Council (13) or with Directive 2014/53/EU of the European Parliament and of the Council.

As this definition differs from recently established definitions for commercial dishwashers (notably in IEC 63136:2019), it is necessary to clarify which one is most appropriate for the current preparatory study and for a possible future product regulation.

This aspect was an important subject of the 1st stakeholder consultation of the current preparatory study. According to the feedback from many stakeholders, the definition of 'commercial dishwashers' as used in the IEC 63136 standard would be more appropriate and should be preferred. In this context, stakeholders suggested that it should be considered that appliances designed exclusively for industrial purposes (e.g. bottle-cleaning machines used in the food industry or machines used in other manufacturing processes) shall generally not be covered by the products subject to this preparatory study. Therefore, 'commercial' should be used in the definition instead of 'professional'. Stakeholders also recommended that the definition used by ENERGY STAR should be avoided, as this standard and its definitions are not relevant for Europe. However, it was also argued by stakeholders that the IEC 63136 definition refers only to under-counter one-tank and hood-type dishwashers (i.e., categories 2 and 3, see Section 3.2.3.7) and is not a general definition for the very heterogeneous group of dishwashers for professional / commercial use.

Based on this stakeholder feedback, it was concluded that the Lot 24 definition should be retained **for the purposes of the analytical steps of this preparatory study**, since switching to the IEC 63136 definition would *a priori* narrow the scope of the preparatory study to Undercounter one-tank dishwashers and Hood-type dishwashers only (categories 2 and 3, see Section 3.2.3.7). This proposal should not be seen as prejudging the scope of a possible future regulation, which may currently need to be narrowed down to ensure consistency with existing standards (in particular with regard to IEC 63136).

Moreover, as part of the 1st stakeholder consultation it was also asked if the term 'non-household' would be a feasible way of unambiguously delimiting professional / commercial / industrial dishwashers from household dishwashers. Following their argumentation on the definiton, many stakeholders pointed out that the term 'non-household' alone would be not sufficient for the delimitation as it does not exclude the industrial appliances. In all standards 'commercial' is used to differentiate from household dishwashers, hence introducing an additional wording is not considered to be purposeful. In order to avoid overlapping, misunderstanding or misuse of the definition the term 'commercial (non-household, non-industrial) dishwashing machines' was proposed.

On the other hand, there was also feedback from some stakeholders, who were in favour of the term 'non-household'. Nevertheless, for the purpose of avoiding confusion, we suggest that the term 'non-household' should be avoided for the time being and that 'professional' is continued to be used instead for the purposes of the preparatory study, especially since 'professional' is also used in the field and could be used in place of 'commercial'.

During the 1st stakeholder consultation, the question was raised how an external party (e.g. consumers, market surveillance) can clearly identify whether a dishwasher is a household or a professional / commercial appliance. According to stakeholder feedback, this can be achieved by referring to the intended use of the appliance as declared by the manufacturer in the instruction for use and the Declaration of Conformity. In this respect, the reference to the Machinery Directive (2006/42/EC) is considered to be a key identifier, as it excludes household appliances intended for domestic use.

According to feedback from most stakeholders, however, a clear delimitation between professional and domestic use cannot be achieved through technical parameters (e.g. stainless steel housing). One of the main reasons for this consideration was seen in the fact that components, materials and features typical for professional dishwashers are also offered for household appliances (and vice versa), thus creating a grey area that is not clearly defined.

3.2.3. Classification of professional dishwashers

3.2.3.1. European PRODCOM classification

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[20] which consists of about 4,500 headings relating to manufactured products.

[20] https://op.europa.eu/en/web/eu-vocabularies/dataset/-/resource?uri=http://publications.europa.eu/resource/dataset/prodcom2024

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. Further to the 2008 review of the NACE codes, the following table lists the code classifications PRODCOM List 2024.

Table 2-2: Extract from PRODCOM list 2024 (Source: Eurostat)

Code	Description
28.29	Manufacture of other general-purpose machinery n.e.c.
28.29.50	Dish washing machines, of the industrial type
28.29.50.00	Non-domestic dish-washing machines
28.29.85	Parts of dish washing machines and machines for cleaning, filling, packing or wrapping
28.29.85.10	Parts of dish washing machines

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 dishwashers. For example, among the dishwashers there is no further differentiation with regard to capacity or other functional performance parameters.

3.2.3.2. European customs classification

The *Harmonised Commodity Description and Coding System (HS)* of tariff nomenclature is an internationally standardised system of names and numbers for classifying traded products developed and maintained by the World Customs Organisation (WCO). The HS Nomen-clature 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 to eight or ten digits for customs or export purposes. On the basis of the Harmonised System nomenclature, there is further comprised the *Combined nomenclature (CN)*[21] which is used to classify goods when being declared to customs in the Community. Each CN subdivision has an eight digit code number, the CN code, followed by a description. The CN also include preliminary provisions, additional section or chapter notes and footnotes relating to CN subdivisions.

According to the European customs classification, the following product categories for dishwashers are distinguished.

21 https://taxation-customs.ec.europa.eu/customs-4/calculation-customs-duties/customs-tariff/combined-nomenclature_en

Table 2-3: Classifications of dishwashers according to the HS-Classification

Code	Description
84.22	Dish washing machines; machinery for cleaning, drying, filling, closing, sealing, capsuling or labelling bottles, cans, boxes, bags, etc, machinery for aerating beverages
	Dishwashing machines
84.22.11.00	Of the household type
84.22.19.00	Of other than household type
84.22.20.00	Machinery for cleaning or drying bottles or other containers

Source: World Customs Organisation[22]

As for the PRODCOM list, this classification will also be too rough to provide a basis for defining a clear scope of professional dishwashers. For example, there is no further differentiation with regard to capacity or other functional performance parameters.

3.2.3.3. International Patent Classification

The International Patent Classification (IPC) is a hierarchical patent classification system created under the Strasbourg Agreement (1971) and updated on a regular basis by a Committee of Experts, consisting of representatives of the Contracting States of that Agreement and observers from other organisations, such as the European Patent Office. The Strasbourg Agreement is one of a number of treaties administered by the World Intellectual Property Organisation (WIPO). Patent publications from all of the Contracting States (and also most others) are each assigned at least one classification term, indicating the subject to which the invention relates, and may also be assigned further classification and indexing terms to give further details of the contents.

Each classification term consists of a symbol, such as A01B 1/00. The first letter is the 'section symbol' consisting of a letter from A to H[23]. This is followed by a two digit number to give a 'class symbol'. The second letter indicates the 'subclass' which is then followed by a 1 to 3 digit 'group number', an oblique stroke and a number of at least two digits representing a 'main group' or 'subgroup'.[24]

22 https://www.wcotradetools.org/en/harmonized-system

23 A: Human Necessities; B: Performing Operations, Transporting; C: Chemistry, Metallurgy; D: Textiles, Paper; E: Fixed Constructions; F: Mechanical Engineering, Lighting, Heating, Weapons; G: Physics; H: Electricity

24 https://www.wipo.int/edocs/pubdocs/en/wipo-guide-ipc-2024-en-guide-to-the-international-patent-classification-2024.pdf

Table 2-4: Classification of dishwashers according to International Patent Classification (IPC)

A47L 15/00	Washing or rinsing machines for crockery or table-ware
A47L 15/02	. with circulation and agitation of the cleaning liquid in the cleaning chamber containing a stationary basket
A47L 15/04	. . by reciprocating movement of the cleaning chamber
A47L 15/06	. . by means of an impeller in the chamber
A47L 15/08	. . by application of a pressure effect produced by pumps
A47L 15/10	. . by introducing compressed air or other gas into the liquid
A47L 15/12	. . by a boiling effect
A47L 15/13	. . using sonic or ultrasonic waves
A47L 15/14	. with stationary crockery baskets and spraying devices within the cleaning chamber
A47L 15/16	. . with rigidly-mounted spraying devices
A47L 15/18	. . with movably-mounted spraying devices
A47L 15/20	. . . Swingable spraying devices
A47L 15/22	. . . Rotary spraying devices
A47L 15/23	. . . . moved by means of the sprays
A47L 15/24	. with movement of the crockery baskets by conveyers
A47L 15/26	. with movement of the crockery baskets by other means
A47L 15/28	. . by lowering and lifting only
A47L 15/30	. . by rotating only
A47L 15/32	. . . rotated by means of spraying water
A47L 15/33	. . . with moving baskets submerged in the cleaning fluid
A47L 15/34	. . by lowering and lifting combined with a rotating movement
A47L 15/36	. . by a sideways motion
A47L 15/37	. with crockery cleaned by brushes
A47L 15/39	. . with brushes on movable supports
A47L 15/42	. Details
A47L 15/44	. . Devices for adding cleaning agents
A47L 15/46	. . Devices for the automatic control of the different phases of cleaning
A47L 15/48	. . Drying arrangements
A47L 15/50	. . Racks

The comparison with the former statistical product classification schemes European PRODCOM and Customs classification clearly shows that the IPC scheme offers the most detailed graduation by product design and applications; for example, items A47L 15/42 to A47L 15/50 being parts of professional dishwashers are supplementary parts even not supplied by manufacturers of dishwashers but by different suppliers (e.g. devices for adding cleaning agents are produced by special manufacturers of dosing equipment). The IPC classification provides an overview of the diversity of professional dishwashing appliances. It distinguishes e.g. between machines with stationary and moving baskets (e.g. conveyor-type machines), and provides further details on working techniques of dishwashers (e.g. with or without brushes; different kinds of spraying devices or circulation techniques of the cleaning liquid).

3.2.3.4. Categories according to ISO, IEC and EN standards

There are no ISO standards covering professional or commercial dishwashers.

Based in its definition of commercial dishwashers (see Section 3.2.2.3) **IEC 60335-2-58** distinguishes dishwashers between:

- batch dishwasher: 'appliance in which the various processes are carried out sequentially on a single load' and
- conveyor (rack or flight) dishwasher: 'appliance in which the various processes, e.g. washing, rinsing etc., are carried out, the load being moved through the various operations automatically'.

Using the same fundamental categories, EN 17735 distinguishes dishwashing machines between:

- batch dishwashing machine**:** 'dishwashing machine, in which the wash ware carrier loaded with wash ware stays in the same treatment zone during the cleaning process' and
- conveyor dishwashing machine: 'dishwashing machine in which the wash ware carriers loaded with wash ware are automatically conveyed through the machine during the cleaning process'.

As for batch dishwashing machines, a further distinction is made between the following machine designs:

- dishwashing machine in which recirculated detergent solution is used for the detergent circulation process and fresh water is used for the fresh water rinsing; the fresh water rinsing circuit is separate from the detergent circulation circuit, and;
- dishwashing machine in which fresh water is used in each detergent circulation or rinsing process; the rinsing circuit is not necessarily separate from the detergent circulation circuit.

Conveyor dishwashing machines are further distinguished between the following machine designs:

- rack conveyor dishwashing machine; dishwashing machine in which racks loaded with wash ware are conveyed through the machine automatically by a rack transporting system, and
- flight conveyor dishwashing machine; dishwashing machine in which the wash ware is conveyed through the machine automatically on an endless conveyor.

Since the scope of **IEC 63136** is limited to manually loaded under-counter one-tank and one-tank hood-type electrically heated dishwashing machines for washing plates, dishes, glassware, cutlery and similar articles, this standard only provides only a distinction between these two categories:

- under-counter one-tank dishwasher: 'manually loaded, programmable, undercounter front loader with typically one detergent circulating zone and a fresh-water rinsing process';
- hood-type dishwasher: 'manually loaded, programmable, hood-type, pass-through machine with typically one detergent-circulating zone and a fresh-water rinsing process'.

3.2.3.5. Labelling categories

As already stated in section 3.2.2.4, professional dishwashers are currently not explicitly covered by the EU energy label or ecolabel scheme.

However, the U.S. Energy Star (cf. Section 3.4.5.4)[25] distinguishes the following categories of dishwashing machines:

- Under counter: A machine with an overall height 38 inches or less, in which a rack of dishes remains stationary within the machine while being subjected to sequential wash and rinse sprays, and is designed to be installed under food preparation workspaces. Under counter dishwashers can be either chemical or hot water sanitizing, with an internal booster heater for the latter. For purposes of this specification, only those machines designed for wash cycles of 10 minutes or less can qualify for ENERGY STAR.
- Single tank, door type: A stationary rack machine designed to accept a standard 20 inch x 20 inch dish rack which requires the raising of a door to place the rack into the wash/rinse chamber. Closing of the door typically initiates the wash cycle. Subcategories of single tank, stationary door type machines include: single rack; double rack; pot, pan and utensil washers (PPU); chemical dump and fill type; and, hooded wash compartment ('hood type'). Single tank, door type models can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.
- Single tank conveyor: A conveyor machine that includes a tank for wash water followed by a sanitising rinse (pumped or fresh water). This type of machine does not have a pumped rinse tank. This type of machine may include a prewashing section ahead of the washing section and an auxiliary rinse section, for purposes of reusing the sanitising rinse water, between the wash and sanitising rinse sections. Single tank conveyor dishwashers can be either chemical or hot water sanitising, with an internal or external booster heater for the latter
- Multiple tank conveyor: A conveyor type machine that includes one or more tanks for wash water and one or more tanks for pumped rinse water, followed by a sanitising rinse. This type of machine may include a pre-washing section

[25] https://www.energystar.gov/sites/default/files/2024-08/Commercial%20Dishwashers%20Version%203.0%20Specification%20Rev.%20-%20September%202021.pdf

before the washing section and an auxiliary rinse section, for purposes of reusing the sanitising rinse water, between the power rinse and sanitising rinse section. Multiple tank conveyor dishwashers can be either chemical or hot water sanitising, with an internal or external booster heater for the latter.

- Flight type conveyor: A conveyor machine where the dishes are loaded directly on the conveyor rather than transported within a rack. This machine is also referred to as a rackless conveyor.

3.2.3.6. Functional performance classification

Building on the categorisation in the IPC and standards, professional dishwashers are classified in this section according to functional performance parameters. To better understand the differences between the described categories, first of all an overview of the primary and secondary functions and important framework requirements of professional dishwashers is given. Then the main properties to distinguish between different professional dishwashers are described. Finally, six product categories are identified as a result of this analysis of functions and the respective properties of professional dishwashers.

Primary and secondary functions of professional dishwashers

In general, the *primary function* of a dishwasher is to clean, rinse, and dry a certain amount of dishware, glassware, cutlery, and / or cooking utensils by chemical, mechanical, thermal and electric means within a given time and with respect to the spatial possibilities (see definition of dishwashers in section 3.2.2). Primary performance parameters are the cleaning and hygienic performance.

Important *secondary functions* that have to be met by professional dishwashers are related to the costs in use, they include:

- short programme duration,
- energy efficiency,
- water efficiency, and
- low detergent consumption.

In contrast to household dishwashers there are some *framework requirements* that have to be taken into account and that vary to a great extent for different customer groups of professional dishwashers. These framework requirements are:

- amount of items to be cleaned,
- types of items to be cleaned, and
- spatial requirements.

While short running cycles are an important requirement for almost each professional application, the other requirements might be very different depending on the application. These variations in the framework requirements that have to be met by professional

dishwashers are the main reason for a range of different product categories on the market, compared to e.g. dishwashers for household use which are quite similar regarding the design (i.e. mainly undercounter dishwashers using fresh water for each dishwashing cycle, with a capacity of 12-14 place settings).

Main properties of professional dishwashers

The following properties of professional dishwashing can be used to facilitate the classification of professional dishwashers into different categories (see Section 3.2.3.7):

- **Water supply**: water-change operation vs. tank systems (one-tank or multi-tank):

  Devices with *water-change operation* use fresh water for each step of the programme (prewash (optional), cleaning, and final rinsing). They are similar to domestic appliances and have similar dimensions, but are exclusively for the professional sector.

  Devices with *tank systems* are either one-tank or multi-tank machines. In *one-tank dishwashers* the detergent solution for the cleaning step is stored in a reservoir tank at high temperatures; the final rinsing is conducted with hot fresh water. During operation the detergent solution is circulated through the dishwasher by means of a pump and intensive water filtration takes place. The detergent solution is not changed between two programme cycles, but only partly replaced by hot fresh water from the final rinsing step (so called regeneration of detergent solution). The water in the tank is usually changed once a day or after each working shift. The pre-cleaning is usually conducted manually, e.g. with rinsing hoses before the wash ware is put into the dishwasher. *Multi-tank dishwashers* comprise at least one prewash zone using a reservoir tank, one cleaning zone using a reservoir tank, and a final rinse zone using hot fresh water. Before the items are put into the machine, only loose waste and leftovers are manually removed. Tank dishwashers do not make sense if only a small amount of items has to be cleaned, as time requirements are usually not as high and tank dishwashers need more effort for the cleaning of the appliance itself.

- **Operating principle of machine dishwashing**: programme automats vs. conveyor-type dishwashers

  In case of *programme automats* the different steps of the dishwashing process are conducted consecutively. The baskets with the wash ware stay in the same position during the whole dishwashing programme. In case of *conveyor-type dishwashers* the different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the wash ware is transported through these zones, which are constructed as chambers, with openings in the transport direction. Programme automats need much less space than the spacious conveyor-type dishwashers. However, the latter allow for continuous dishwashing of large amounts of wash ware in a short time.

- **Type of loading** (with regard to programme automats): front loading vs. pass through

In case of programme automats two types can be distinguished: either the basket(s) is/are put into and taken out of the dishwasher from the front (*front loading dishwasher*) or the basket(s) is/are put into the dishwasher from one side and is/are taken out of the dishwasher from the other side (*pass through or 'hood type' dishwasher*). Depending on the spatial requirements, available space and organisation of the dishwashing process (number of personnel, storing capacity of soiled wash ware, hygienic requirements and total amount of wash ware to be cleaned in a certain timeframe), these differences might impact the choice of machine categories by customers: The front loading automats need less space than pass through dishwashers; the latter are ergonomically easier to operate. Further, a separation of a dirty and a clean area is possible when using the pass through type.

- **Type of wash ware**: dishes, glasses, cutlery, pots and pans, utensils, etc.

  Some customers have to clean a certain type of items or use several dishwashers at once (e.g. bars usually mainly have to clean glasses, in large kitchens several dishwashers for different types of wash ware may be used in parallel). This means professional dishwashers are usually more specialised with regard to the wash ware compared to dishwashers for household use. Pot dishwashers for instance operate with extremely high scavenging pressure in order to dissolve incrustations. They can therefore not be loaded with glass or ordinary crockery.

In addition to these distinguishing criteria between different categories of professional dishwashers, dishwashers also vary according to the following criteria. These criteria, however, do not justify further product categories (too little technological difference or these differences inherently come along with one of the above mentioned properties):

- **Means of transport** (relevant for conveyor-type dishwashers): basket vs. conveyor belt

- n case of *basket transport* the items to be cleaned are put into baskets which are transported through the dishwasher. The items can be sorted in advance of dishwashing. In case of *belt conveyor dishwashers*, the items to be cleaned are put directly on a conveyor belt which continuously moves through the dishwasher. The items can either be sorted after dishwashing, when unloading the machine or, if there are several belt conveyor dishwashers for a different kind of items, in advance of the dishwashing process.

- **Number of baskets** that can be cleaned at the same time (relevant for programme automats):

  In case of programme automats with water-change operation (see above), it is possible to put two or three baskets at the same time into the appliance (like in case of dishwashers for household use). In programme automats with tank system (front loaders or pass through) usually only one basket can be cleaned as the tank also needs space and only one level for the basket is possible. However, there are also pass through appliances, where two baskets can be cleaned next to each other at the same time. These appliances are like two pass through appliances connected next to each other.

- **Size / format**: undercounter, cupboard size or large conveyor-type dishwashers

  Obviously, the different construction types come along with different sizes and formats of the different dishwashers. Pass through dishwashers are usually cupboard size, whereas front loading devices might be undercounter or also cupboard size.

- **Way of utilisation**: stationary or mobile

  Most professional dishwashers are used stationary in kitchens, bistros or similar locations. There are, however, also dishwashers that can be used on mobile devices (like in vehicles, tents or similar locations). These devices are usually one-tank undercounter front loaders or one-tank pass through dishwashers. There are only minor technological differences to those for stationary use, e.g. they can be operated at lower surrounding temperatures or the water can be removed completely. Therefore dishwashers for mobile use are subsumed under the respective category of dishwashers for stationary use.

3.2.3.7. Categories of professional dishwashers used in this study

Within the Lot 24 preparatory study, the following six categories were derived from the analysis of functions and framework requirements and the respective properties of professional dishwashers in the previous sections. Also other information (e.g. from the official product categories or from standards) were considered for this categorisation.

Given the high level of approval expressed in the 1st stakeholder consultation, this categorisation is also used for the forthcoming tasks in the present preparatory study.

It is important to note that the categorisation does not include an industrial category. According to stakeholder feedback, commercial dishwashers are generally not designed for industrial use, such as machines used in the food industry for cleaning receptacles/containers used as packaging for final products (e.g. bottle-cleaning machines), and machines used in manufacturing processes. Appliances for industrial use were described by stakeholders as highly individual and very different from commercial use.

Furthermore, ‘appliances designed exclusively for industrial purposes’ are explicitly excluded from the scope of IEC 60335-2-58 (see section 3.3.1.2). Interestingly, however, this term is based only on the description of the exclusion in the scope of IEC 60335-2-58 (provided in its Note 104), but there is no formal definition provided in the Terms and Definitions section of IEC 60335-2-58 or elsewhere.

Taking all of the above into account, many stakeholders argue that industrial equipment should be excluded from the scope of this preparatory study (see also related questions in section 3.5).

Category 1: Undercounter water-change dishwashers

These manually, front loaded programme automats use fresh water for each step of the programme (prewash (optional), cleaning, final rinsing). These dishwashers are similar to domestic appliances and have similar dimensions, but are exclusively for the professional sector. They are approved in accordance with the Machine Directive and intended for use, e.g. in catering establishments, day- and child-care and elderly care facilities. Main differences to domestic appliances are shorter programme duration and the possibility to connect them to higher loads (400 V).

The different steps of the dishwashing process are conducted consecutively in time, the baskets with the items to be cleaned staying in the same position during the whole dishwashing programme. Usually two baskets can be put into the dishwasher from the front side.

As for dishwashers for household use, these devices are designed to clean various kinds of items (dishes, cutlery, and glasses) at the same time, i.e. they usually have rather unspecific programmes for general use. They are undercounter dishwashers, with only small differences in size and capacity, which can be sub-categorised in free standing, integrated, fully-integrated and build-in models as in case of dishwashers for household use. Typical dimensions are (height/width/depth): 850 mm (without lit 820 mm)/600 mm/ 600 mm.

Category 2: Undercounter one-tank dishwashers

These manually front loaded programme automats use one reservoir tank with detergent solution for cleaning, and fresh water for the final rinsing. The detergent solution is constantly filtrated / regenerated. The pre-cleaning is usually conducted manually before the items are put into the dishwasher.

The different steps of the dishwashing process are conducted consecutively in time, the baskets with the items to be cleaned stay in the same position during the whole dishwashing programme. Usually only one basket can be placed into the dishwasher (loading and unloading from the front side), as the tank needs space as well. The appliances are undercounter dishwashers that can be constructed as ‘generalists’ for different items (dishes, glasses, and cutlery) or in specialised versions, i.e. only for dishes, for glasses or for cutlery respectively.

Category 3: Hood-type dishwashers

These one-tank pass through dishwashers use one reservoir tank with detergent solution for cleaning, and fresh water for the final rinsing. The detergent solution is constantly filtrated / regenerated. Pre-cleaning is conducted manually, e.g. with rinsing hoses before the items are put into the dishwasher. The different steps of the dishwashing process are conducted consecutively in time, the baskets with the items to be cleaned stay in the

same position during the whole dishwashing programme. The basket(s) is/are put into the dishwasher from one side and is/are taken out of the dishwasher from the other side. Only *one basket* can be cleaned on one level, as the tank also needs space. There are appliances, where *two baskets* can be cleaned next to each other at the same time. The appliances are usually constructed to clean different items: dishes, glasses, cutlery, pots and pans, utensils, etc.

Category 4: Utensil / pot dishwashers

These dishwashers are especially constructed for the cleaning of other items than dishes, glasses and cutlery, i.e. black cookware, pots, pans, containers, trays or other mostly large utensils. The cleaning performance is usually higher, e.g. by means of higher scavenging pressure or other stronger mechanical and chemical treatment.

Two construction types can be distinguished:

- Front loading dishwashers;
- Pass through dishwashers.

Both types are one-tank dishwashers (i.e. they use one reservoir tank with detergent solution for cleaning, and fresh water for the final rinsing, if necessary manual pre-cleaning). The pass-through dishwashers are usually loaded manually, however, some manufacturers offer special roll containers that can be filled outside the machine and then pushed into the dishwasher. The dimensions are often bigger than those of undercounter front loaders or pass through dishwashers for dishes, glasses and cutlery as the items to be cleaned are bulkier, too.

A special type of these dishwashers is the so-called **granulate dishwasher**. In these dishwashers (both front loaders and pass through) the mechanical cleaning is intensified through scouring of the wash ware (mainly black cookware) with plastic granules of different size. A granule collector catches the plastic pellets during the granule washing program. The granules can be subsequently cleaned out in a sink with a pipe-mounted sprayer.

Category 5: One-tank conveyor-type dishwashers

The different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the items to be cleaned are transported through these zones, which are constructed as chambers, with openings in the transport direction. These dishwashers use one reservoir tank for cleaning and fresh water for the final rinsing. Pre-cleaning may be conducted manually. The dishwashers can be used for different wash ware: dishes, glasses, cutlery, black cookware (pots and pans), utensils, etc. Two different transport systems are available:

- In case of the *basket transport system* the wash ware is put into baskets which are transported through the dishwasher. The items can be sorted in advance of dishwashing. The pre-cleaning is usually conducted manually with rinsing hoses before the items are put into the dishwasher.

- In case of *belt conveyor (also: flight type) dishwashers*, the wash ware is put directly on a conveyor belt which continuously moves through the dishwasher. The items can either be sorted after dishwashing, when unloading the machine or, if there are several belt conveyor dishwashers for a different kind of items, in advance of the dishwashing process. Before the items are put into the machine, usually only loose waste and leftovers are manually removed.

Category 6: Multi-tank conveyor-type dishwashers

The different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the items to be cleaned are transported through these zones, which are constructed as chambers, with openings in the transport direction. These dishwashers comprise at least one prewash zone using a reservoir tank, one cleaning zone using a reservoir tank and a final rinse zone using fresh water. The dishwashers can be used for different wash ware: dishes, glasses, cutlery, black cookware (pots and pans), utensils, etc. As with one-tank conveyor-type dishwashers, two different transport systems are available:

- *Basket transport system* (see above at one-tank conveyor-type dishwashers).
- *Belt conveyor dishwashers* (see above at one-tank conveyor-type dishwashers).

A special type of multi-tank conveyor-type dishwashers are dishwashers for the commercial cleaning of reusable boxes and containers. Serially produced dishwashers for standard packaging boxes and container dishwashers can be assigned to the professional dishwashers.

Also as part of the 2011 preparatory study, key functional and performance parameters were compiled for the six different categories. In the context of the 1st stakeholder consultation in 2024, this table has also been subject to revision. The following table shows the overview updated according to stakeholder feedback.

Table 2-5: Overview of professional dishwasher categories according to functional and performance parameters

	Category 1 Undercounter water-change dishwasher	**Category 2** Undercounter one-tank dishwasher	**Category 3** Hood-type dishwasher	**Category 4** Utensil / Pot dishwasher	**Category 5** One-tank conveyor-type dishwasher	**Category 6** Multi-tank conveyor-type dishwasher
Main properties						
Water supply	water-change operation	tank system / one-tank	tank system / one-tank	tank system / one-tank	tank system / one-tank	tank system / multi-tank
Operating principle of dishwashing machine	program automat	program automat	program automat	program automat	conveyor-type dishwasher	conveyor-type dishwasher
Type of loading	front loading	front loading	pass through	front loading or pass through	n.a.	n.a.
Type of wash ware to be cleaned	dishes, glasses, cutlery, pots and pans, utensils	mainly plates, glasses, cups, cutlery	mainly plates, glasses, cups, cutlery	black cookware, large utensils	mainly plates, glasses, cups, cutlery, trays	mainly plates, glasses, cups, cutlery, trays
Further properties						
Means of transport	n.a.	n.a.	n.a.	n.a.	basket transport or conveyor belt	basket transport or conveyor belt
Number of baskets to be cleaned at the same time	two or three (on two or three levels)	one (on one level) or two (on two levels)	one or two (on one or two levels)	one or two (on one level)	n.a.	n.a.
Size / format	undercounter	undercounter	cupboard size	undercounter or cupboard size	large conveyor-type dishwashers	large conveyor-type dishwashers
Way of utilisation	stationary	stationary ~~or mobile~~	stationary ~~or mobile~~	stationary	stationary	stationary
Heat sources	electricity	electricity	electricity	electricity, low pressure steam or hot water	electricity, low pressure steam or hot water, (natural gas - negligible)	electricity, low pressure steam or hot water, (natural gas - negligible)
Variants	freestanding, built-under, integrated and fully integrated models	freestanding and built-under models		granulate dishwasher for black cookware	dishwasher for cleaning of reusable boxes and containers	dishwashers for cleaning of reusable boxes and containers

n.a. = not applicable

Source: Task 4 report of the 2011 preparatory study on professional dishwashers; updated according to feedback from the 2nd stakeholder consultation (in red colour)

3.3. Test standards for professional dishwashers

The present preparatory study examines whether standards exist for environmental parameters or other relevant aspects that were not yet relevant in the previous 2011 preparatory study. For this purpose, a comprehensive update of the existing standards has been carried out, highlighting also where standards are missing and where amendments are required (e.g. in form of disclosure of product information or the update of minimum requirements due to technological improvements as well as the link to other interdependent aspects). This may contribute to the elimination of potential loopholes in the market.

Special focus has been set on the European initiative that has taken place in the meantime: The preparatory study to the Ecodesign and Energy Labelling Working Plan 2022-2024 informed that CENELEC created an appropriate sub-working group CLC TC59X WG2.1 on commercial dishwashers with a focus on clusters of the base cases products as defined in the preparatory study. The work resulted in the standard IEC 63136:2019 Electric dishwashers for commercial use - Test methods for measuring the performance (successor of EN 50593:2017).

In addition to the international level, we also included the consideration of standards existing on the Member State level (without any EU foundation), such as in Germany that published a new standard for hygiene (DIN 110544).

In addition to the literature review, this sub-task was mainly built on stakeholder input by consulting standardisation and market experts as well as manufacturers. In the following, the results of the analysis are presented broken down by subject area.

3.3.1. Performance

3.3.1.1. IEC 63136 (International)

IEC 63136:2019 Electric dishwasher for commercial use – Test methods for measuring the performance

This international standard is covers standard manually loaded under-counter one-tank and one-tank hood-type electrically heated dishwashing machines for washing plates, dishes, glassware, cutlery and similar articles.These machines are used in commercial kitchens, such as restaurants, canteens, hospitals and in businesses such as bakeries, butchers' shops, etc.

It does not apply to:

- undercounter water-change dishwashers;

- commercial dishwashers with transport systems (flight-type and rack conveyor dishwashers) and utensil washers as well as;
- appliances designed exclusively for industrial purposes.

Hence it is only applicable to Categories 2 and 3 as defined in Section 3.2.3.7.

IEC 63136 has been prepared by subcommittee 59A: Electric dishwashers, of IEC technical committee 59: Performance of household and similar electrical appliances. EN 50593:2017 has served as a basis for the elaboration of this standard.

Its main objective is to identify and define the principal performance characteristics of electric dishwashers for commercial use and to describe the standard methods of measuring these characteristics.

For the corresponding performance test, the standard specifies the detergent concentration, the reference detergent and rinse aid, as well as the quality and number of wash ware used for test purposes.

This standard also describes how to determine the amount of electrical energy and water used by the dishwasher for filling, running and the time required to complete a given programme, which is used to measure cleaning performance. In this context, the start-up time and the electrical power of the 'ready to use' mode are measured.

3.3.1.2. IEC 60335 (International)

IEC 60335-1:2020 Household and similar electrical appliances - Safety - Part 1: General requirements

This international standard has been prepared by IEC Committee 61 (Safety of household and similar electrical appliances) and covers safety issues of household and similar electrical appliances. Part 1 defines general requirements and is common to all electric motor appliances.

IEC 60335-2-58:2017: Household and similar electrical appliances - Safety - Part 2-58: Particular requirements for commercial electric dishwashing machines

Part 2 deals with the safety of electrically operated dishwashing machines for washing plates, dishes, glassware, cutlery and similar articles, with or without means for water heating or drying. The rated voltage being not more than 250 V for single-phase appliances connected between one phase and neutral, and 480 V for other appliances. Appliances within the scope of this standard are used in restaurants, canteens, hospitals, and commercial enterprises such as bakeries, butcheries, etc. Examples of appliances within the scope of this standard are batch dishwashers (Categories 1 to 4) and conveyor dishwashers (Categories 5 and 6).

IEC 60335-2-58 is to be used in conjunction with the IEC 60335-1 and its amendments as it supplements or modifies the corresponding clauses. The current fourth edition of

Part 2 cancels and replaces the third edition published in 2002 including its Amendment 1 (2008) and its Amendment 2 (2015).

As far as is practicable, this standard deals with the common hazards presented by these types of appliances. For example, concerning the aspect of stability and mechanical hazards, conveyor dishwashers shall not start automatically after doors or lids have been closed.

It should be noted that this standard does not apply to appliances intended for domestic use, nor to 'appliances designed exclusively for industrial purposes, for example machines used in the food industry for cleaning receptacles that serve as packaging for final products (e.g. bottle-cleaning machines), and machines used in manufacturing processes'. Sterilisers and washer-disinfectors used to treat medical materials are also excluded from the scope.

Moreover, it has to be noted that in many countries additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour, the national water supply authorities and similar authorities.

3.3.1.3. ASTM International Standards (USA / International)

ASTM International (ASTM), originally known as the American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services. In 2001, ASTM changed its name to ASTM International to reflect global participation in ASTM and worldwide use of its standards. The application of ASTM standards is voluntarily expect for publicly funded areas in the USA [26].

ASTM International has no role in requiring or enforcing compliance with its standards. The standards, however, may become mandatory when referenced by an external contract, corporation, or government. For example, ASTM Standards F1696 and F1920 are referenced in the U.S. ENERGY STAR criteria and used by manufacturers to obtain an ENERGY STAR qualification or rating (cf. Sections 3.4.5.4).

The following ASTM International standards refer to professional dishwashers, sorted in ascending order. They have been developed by Technical Committee F26 on Food Service Equipment[27] and belong to the work of the following subcommittees:

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[26] ASTM standards are voluntary in the sense that their use is not mandated by ASTM. However, government regulators often give voluntary standards the force of law by citing them in laws, regulations and codes. In the United States, the relationship between private-sector standards developers and the public sector has been strengthened with the 1995 passage of the National Technology Transfer and Advancement Act (Public Law 104-113). The law requires government agencies to use privately developed standards whenever it is at all possible. Source: www.astm.org

[27] 'Food service equipment is apparatus intended for use in commercial and institutional establishments for handling, storage, preparation, cooking, holding, display, dispensing,

- F26.01: Cleaning and Sanitation Equipment;
- F26.06: Productivity and Energy Protocol;
- F26.05: Life Cycle Cost and Sustainability.

ASTM F857–17: Standard specification for hot water sanitizing commercial dishwashing machines, stationary rack type

This specification covers the material, design, and performance requirements pertinent to the construction of spray-type, stationary rack commercial dishwashing machines that are manually loaded yet automatically controlled to uniformly wash, rinse, and sanitize eating and drinking utensils. Representative production models of the washers shall pass performance, operation, leakage, and energy and productivity tests, and should function satisfactorily as specified. Certification, product marking, and packaging are also considered.

ASTM F858–18: Standard specification for hot water sanitizing commercial dishwashing machines, single tank, conveyor rack type

This specification covers the material, design, and performance requirements pertinent to the construction of spray-type, stationary rack commercial dishwashing machines that are manually fed yet automatically controlled to uniformly wash, rinse, and sanitize eating and drinking utensils. Representative production models of the washers shall pass performance, operation, leakage, and energy and productivity tests, and should function satisfactorily as specified. Certification, product marking, and packaging are also considered.

ASTM F859–21: Standard specification for heat-sanitizing commercial dishwashing machines, multiple tank, conveyor rack type

This specification covers multiple tank automatic rack-type commercial dishwashing machines. Dishwashing machines shall be of the following types, styles, and classes, as specified: Type I-this machine shall be designed and supplied to accept the feeding of soiled tableware from the right side, when facing the front of the machine; and Type II-this machine shall be designed and supplied to accept the feeding of soiled tableware from the left side, when facing the front of the machine. Style 1 - steam heated; Style 2 - electrically heated; Style 3 - gas-heated; and Style 4 - pre-wash unit. Class A - injectors; Class B - heat exchange coils; Class C - natural gas; and Class D - LP gas. The construction requirements; electrical, steam and gas equipment requirements; lubrication requirements; treatment and painting requirements; and performance requirements are presented in details.

ASTM F860–07(2018)e1: Standard specification for hot water sanitizing commercial dishwashing machines, multiple tank, rackless conveyor-type

and/or the serving of food which, at the time of serving, is ready for direct consumption on or off the premises. Also included are cleaning, sanitation and ancillary items associated with food preparation and service.' Source: http://www.astm.org/COMMIT/SCOPES/F26.htm

This specification covers multiple tank, automatic rack less conveyor type, commercial dishwashing machines. These machines can be classified into two types: Type 1 machines shall be designed and supplied to accept the feeding of soiled tableware from the right side, when facing the front of the machine while Type II shall be designed and supplied to accept the feeding of soiled tableware from the left side, when facing the front of the machine. The dishwashing machines have three kinds of styles: Style 1 is a steam heated machine, with two classes namely Class A which uses injectors and Class B which uses heat exchange coils. Style 2 is an electrically heated dishwashing machine. Style 3 on the other hand is gas heated with two classes namely Class C which uses natural gas and Class D which uses LP gas. In addition, these dishwashing machines can be classified into three groups according to size and capacity: Group A, Group B, and Group C. Materials used in the manufacture of these machines shall consist of corrosion-resistant steel, corrosion resisting material, nickel-copper alloy and plastics. The dishwashing machine shall be complete so that when connected to the specified source of power, water supply, heating means (steam, electric, or gas), drainage, detergent, and rinse agent feeder as applicable, the unit can be used for its intended function. Dishwashers shall be rigid, quiet in operation, free from objectionable vibration, and so constructed as to prevent objectionable splashing of water to the outside of the machine. Operational test, leakage test, and performance profiles shall be done in order to determine the overall efficiency of the dishwashing machine.

ASTM F953-19 Standard specification for commercial dishwashing machines (stationary rack, dump type) chemical sanitizing

This specification covers manually fed, spray-type, stationary rack, automatically controlled, dump type, chemical sanitizing commercial dishwashing machines. Dishwashing machines shall be of the following types, styles, classes: type I - Straight-through model, 34 in. nominal table height. This machine is used in line with table on each side, type II - Corner model, 34 in. nominal table height. This machine is used in corner placement forming a 90° table on each side, and type III - Under counter, front load. This machine may be installed under counters; style A - single rack, and style B - double rack. No leakage shall occur when tested at pressures up to 125 % of the manufacturer's recommended supply line pressure. The dishwasher materials, construction, operation cycle, electrical equipment, lubrication, and coating shall meet the requirements prescribed.

ASTM F1021–18: Standard specification for feeders, detergent, rinse agent, and sanitizing agent for commercial dishwashing and glasswashing machines

This specification covers detergent feeders, rinse additive feeders, and sanitizing agent feeders intended to automatically maintain the concentration of additives in the wash, recirculated rinse, or non-recirculated rinse water of commercial spray- type dish-washing and glass-washing machines. Detergent, rinse additive, and sanitizing agent feeders shall be of the following types and styles: Types I, II, III, IV, V, and VI; and Style I; II; III; IV; V; and VI. Materials used shall be free from defects that would adversely affect the performance or maintainability of individual components or of the overall assembly. The feeder shall be complete so that when connected to the specified source of power (electrical or water, or both), the unit can be used for its intended function. Feeders shall be tested in accordance with specified requirements.

ASTM F1114–22: Standard specification for heat sanitizing commercial pot, pan, and utensil washing machines, stationary rack, water-driven rotary spray type

This specification covers the material, design, and performance requirements pertinent to the construction of water-driven rotary spray type, stationary rack commercial pot, pan, and utensil washing machines that are manually fed yet automatically controlled to uniformly wash, rinse, and heat-sanitize food preparation utensils. Representative production models of the washers shall pass performance, operation, leakage, and energy and productivity tests, and should function satisfactorily as specified. Certification, product marking, and packaging are also considered.

ASTM F1202-22: Standard specification for washing machines, heat sanitizing, commercial, pot, pan, and utensil vertically oscillating arm type

This specification covers the requirements for manually fed, motor-driven vertically oscillating arm type, automatically controlled, commercial pot, pan, and utensil washing machine (also referred to as 'the washer'). The washer is of one rack capacity (Type I) and is available in either Style A (one door/front loading) or Style B (three door/pass-through with front load door). Heat shall be provided to the washer through steam (Style 1) by injection (Class A) or heat exchange coil (Class B) or through electric means (Style 2). The washer and its components shall be manufactured free of defects. Piping and fittings shall be manufactured from corrosion-resisting material or heat-resisting plastic material. Valves, spray assemblies, and overflow drain shall be manufactured from corrosion-resisting materials. Tank and housing shall be constructed of corrosion-resistant steel. Scrap trays (strainers), access door/s, and legs shall be constructed of corrosion-resistant steel or other corrosion-resisting material. The pump motor shall be mounted on the tank or rigid steel base, with the pump casing being of cast iron or corrosion-resisting material. When specified, a final rinse booster heater and/or detergent feeder may be provided. The washer shall be operated at ambient room temperature. Tests for performance standards and operational compliance as well as for noise level, leakage, energy, and productivity requirements shall be performed and shall conform to the requirements specified.

ASTM F1203–06: Standard specification for washing machines—pot, pan, and utensil, heat sanitizing, commercial rotary conveyor-type

This specification covers manually fed, motor-driven rotary conveyor type, automatically controlled, commercial pot, pan, and utensil washing machines. The washer shall be of the following type, and class as specified. Motor-driven continuous rotary conveyor: type I - one door (front loading); type II - one or two door (pass-through corner operation); and type III - one or two door (pass-through straight line operation). Style and class: style 1 - steam heated; style 2 - electric heat; class A - injection; and class B - heat exchange coil. The design, construction, and performance requirements of the washing machine are presented in details. The operational test; leakage test; and energy and productivity test shall be performed to meet the requirements prescribed.

ASTM F1696-20: Standard test method for energy performance of stationary-rack, door-type commercial dishwashing machines

This test method covers the evaluation of the energy and water consumption of single-rack, door-type commercial dishwashers (hereafter referred to as dishwashers). Dishwashers may have a remote or self-contained booster heater. This test method does not address cleaning or sanitizing performance. It is applicable to both hot water sanitizing and chemical sanitizing stationary rack machines, which includes undercounter single rack machines, upright door-type machines, pot, pan and utensil machines, fresh water rinse machines and fill-and-dump machines. Dishwasher tank heaters are evaluated separately from the booster heater. Machines designed to be interchangeable in the field from high temp and low temp (that is, Dual Sanitizing Machines) and vice versa, shall be tested at both settings. Machines should be set for factory settings. If a dishwasher includes a booster heater as an option, energy should be sub metered separately for the booster heater. When the test method specifies to use the data plate or manufacturer's recommendations, instructions, specifications, or requirements, the information source shall be used in the following order of preference and documented in the test report: data plate, user manual, communication with manufacturer.

ASTM F1920-20: Standard test method for performance of rack conveyor, commercial dishwashing machines

This test method evaluates the energy and water consumption of rack conveyor, commercial dishwashing machines, hereafter referred to as dishwashers. Dishwashers may have remote or self-contained booster heater. This procedure does not address cleaning or sanitizing performance. It is applicable to both hot water sanitizing and chemical sanitizing rack conveyor machines, which include both single tank and multiple tank machines. Rackless conveyors (i.e. flight type machines) are included. Dishwasher tank heaters are evaluated separately from the booster heater. Machines designed to be interchangeable in the field from high temp and low temp (i.e. Dual Sanitizing Machines) and vice versa, shall be tested at both settings. Machines should be set for factory settings. If a dishwasher includes a prewash tank heater as an option, energy should be submetered separately for the prewash tank heater. This test method may be used for dishwashers with steam coil tank or booster heat, but not dishwashers with steam injection tank or booster heat. When the test method specifies to use the data plate or manufacturer's recommendations, instructions, specifications, or requirements, the information source shall be used in the following order of preference and documented in the test report: data plate, user manual, communication with manufacturer.

ASTM F2687–13: Standard practice for life cycle cost analysis of commercial food service equipment

This standard practice for life cycle cost analysis of commercial food service equipment is designed for producers and end-users to utilize when forecasting and (or) evaluating the life cycle costs of equipment by accounting for tangible differences in operating and maintenance costs of commercial food service equipment. Results of the analysis detailed in this standard practice are intended for budgetary purposes. The results may also be used to compare projected life cycle cost of different models from a single manufacturer, or models manufactured by multiple suppliers, or to establish when it is cost effective to replace a specific equipment versus incurring continued maintenance expenses. Major categories included in this analysis include total purchase price, service

and repair costs, preventative maintenance costs, utility operating costs and disposal costs. The results may be quantified as a yearly running total and a net present value. Inputs for this life-cycle analysis will need to come from a variety of sources, including manufacturers, service agents, utility companies, and end users. Not all input variables need be considered for effective analysis. To avoid skewing the results, sections where reliable estimates are not available should be left out of the analysis. The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

ASTM F2916-19: Standard practice for environmental impact analysis of commercial food service equipment

This practice for analyzing the environmental impact of food service equipment is intended to document the performance of food service equipment using attributes that are indicators of the appliance's environmental impact. It includes, but is not limited to, cooking, warewashing, refrigeration, ventilation, and mechanical equipment that use energy or water in a typical commercial cooking application. The method assigns points for each attribute and calculates a total score for the appliance. A specifier or purchaser of the appliance may use the individual results for certain attributes that are important in their analysis of the environmental impact of product. The results may also be used to compare the environmental impact of one model to another of the same type of equipment. The total score is not intended to provide a positive or negative judgment of a certain appliance's environmental impact. This analysis includes attributes that occur in the manufacturing, use, and disposal of a product. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

Summarising conclusions

ASTM standards correspond to the following professional dishwasher categories as defined in section 3.2.3.7:

Table 2-6: ASTM standards and corresponding dishwasher categories

Lot 24 categories	Corresponding ASTM standards[28]	
Cat. 1: Undercounter water-change	F1696 Hot water sanitizing / chemical sanitizing; stationary single-rack door type: fresh water rinse machines	
Cat. 2: Undercounter one-tank	F1696 Hot water sanitizing / chemical sanitizing; stationary single-rack door type: undercounter single-rack machines	
Cat. 3: Hood-type dishwasher	F1696 Hot water sanitizing / chemical sanitizing; stationary single-rack door type: upright door-type machines	
Cat. 4: Utensil/pot dishwasher	F1114 Heat sanitizing, stationary rack; pot, pan and utensil washing machines; water driven rotary spray F1202 Heat sanitizing; pot, pan and utensil washing machines; motor-driven vertically oscillating arm type F1696 Hot water sanitizing / chemical sanitizing; stationary single-rack door type: pot, pan and utensil machines	
Cat. 5: Conveyor-type, one-tank	F858 Hot water sanitizing, single tank, automatic conveyor rack type F1203 Heat sanitizing; pot, pan and utensil washing machines; motor-driven rotary conveyor type F1920 Hot water sanitizing / chemical sanitizing; rack conyeyor; single tank machines	
Cat. 6: Conveyor-type, multi-tank	F859 Heat-sanitizing, multiple tank, automatic conveyor rack type F860 Hot water sanitizing, multiple tank, automatic rackless conveyor type F1920 Hot water sanitizing / chemical sanitizing; rack conyeyor; multiple tank machines	
Cat. 1-4	F857 Hot water sanitizing, stationary rack type	
Cat. 1-6	F2687 Standard practice for life cycle cost analysis of commercial food service equipment ASTM F2916: Standard practice for environmental impact analysis of commercial food service equipment	
-*	F953	Chemical sanitizing, stationary rack, dump type

Source: Lot 24 Task 1 Report, updated according to current research

* Note: The present preparatory study does not take into account chemical sanitizing machinery

Summarising, ASTM standards cover material, design, and performance requirements for the different dishwasher categories addressed. The standards are typically used by end-use customers such as the federal government when purchasing products from manufacturers. They are a means to ensure the customers receive a consistent product each time they place an order. The standards include the following issues:

- Description of the material, design and construction requirements such as metal types and thickness;
- Descriptions of the different styles such as straight thru and corner type;

[28] Note: ASTM standards operate with hot water *sanitizing* processes in comparison to dishwashers in scope of this preparatory study being defined as machines operating with cleaning principle

- Various heat sources such as electric, steam or gas;
- Details that should be specified when ordering a dishwasher;
- Performance requirements stating the machines must conform to the requirements of Organisational Safety and Health Administration (OSHA), UL 921 (safety requirements, see section 3.3.1.5), and NSF/ANSI 3 (hygienic performance, see section 3.3.2.2);
- Maximum noise level of the dishwasher only, when operating, exclusive of loading, unloading, and servicing;
- Requirements for appropriate markings such as the operating times, temperatures, etc.

Finally, there is typically a reference to performance profiles such as operating energy consumption, water consumption, and productivity.

ASTM specifications apply to hot water and chemical *sanitizing* machines (for further details: see Task 6). These machines and processes, commonly used on the US market, generally require higher (sanitizing) temperatures compared to the (cleaning) temperatures of dishwashers in Europe[29]. This higher thermal minimum requirement results in higher energy consumption and lower efficiency, respectively. Therefore the ASTM standards are regarded to be not appropriate to cover European requirements and market trends and are not applied by European manufacturers.

3.3.1.4. EN 50416 (Europe)

EN 50416:2016+A1:2015 Household and similar electrical appliances - Safety - Particular requirements for commercial electric conveyor dishwashing machines

This European Standard deals with the safety of electrically operated conveyor dishwashing machines for washing plates, dishes, glassware, cutlery and similar articles (e.g. trays, food containers), with or without means for water heating or forced hot air drying. The rated voltage of the covered appliances are not more than 250 V for single-phase machines connected between one phase and neutral and 480 V for other machines. These machines are used for example in restaurants, canteens, hospitals, and commercial enterprises such as bakeries, butcheries, etc. Examples of such machines are flight type dishwashers, and rack conveyor dishwashers. These machines are designed to be connected to hot and/or cold water supply.

Requirements to avoid backsiphonage of non-potable water into the public water supply are specified in Annex CC. Machines making use of steam or hot water for heating purposes are also within the scope of this standard.

[29] Hot water sanitizing: according to NSF/ANSI minimum washing temperatures of 66 to 74°C are required depending on the dishwashing machine category; cleaning: according to EN 17735 washing temperatures of 60 to 65°C are required.

This standard does not apply to

- appliances intended for household use,
- machines which are moveable,
- gas heating appliances which are part of conveyor dishwashing machines,
- machines intended for disinfection,
- machines intended to be used on board of sea-going vessels and aircraft,
- machines designed exclusively for industrial purposes, for example machines used in the food industry for cleaning receptacles that serve as packaging for final products (e.g. bottle-cleaning machines), and machines used in manufacturing processes,
- separately driven transport devices not confined in the machine, and
- machines intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

3.3.1.5. UL 921 (USA / Canada)

UL 921 Standard for commercial dishwashers

This standard covers commercial, freestanding, undercounter, and counter-insert dishwashers, utensil-washers, and glasswashers intended for use in commercial establishments, such as kitchens of restaurants and hospitals, where they are not intended to be accessible to the public. The currently valid version of this standard is the 8th edition, which was published in 2020. The standard sets requirements in the areas of construction, safety, performance, rating and marking, as well as installation instructions. The specified performance tests do not cover any requirements regarding energy, water or detergent consumption or the cleaning and hygienic performance.

3.3.2. Hygiene

3.3.2.1. ISO 15883 (International)

ISO 15883 is an international standard especially for washer-disinfectors (WD). These appliances are used in medical as well as pharmaceutical applications (e.g. healthcare facilities or laboratories) to either prepare goods (e.g. surgery instruments, utensils, anaesthesia sets, and glassware) for later autoclaving (i.e. to remove residues like blood, protein) or to disinfect (semi sterilise) goods for later use. Temperatures range from 40 to 100°C.

According to the definition of professional dishwashers provided in section 3.2.2.6, WD do not fall under the scope of this preparatory study. The standard has been listed for completeness with regard to hygienic requirements.

ISO 15883-1:2024 Washer-disinfectors Part 1: General requirements, terms and definitions and tests

This international standard specifies general performance requirements for WD and WD accessories that are intended to be used for cleaning and disinfection of reusable medical devices. It specifies performance requirements for cleaning and disinfection as well as for the accessories that can be required to achieve the necessary performance. The methods and instrumentation required for validation, routine control and monitoring and requalification, periodically and after essential repairs, are also specified.

It does not specify requirements intended for machines for general catering purposes.

ISO 15883-2:2024 Washer-disinfectors Part 2: Requirements and tests for washer-disinfectors employing thermal disinfection for critical and semi-critical medical devices

This standard specifies requirements for washer-disinfectors (WD) that are intended for use for the cleaning and thermal disinfection, in a single operating cycle, of reusable critical and semi-critical medical devices, such as surgical instruments, anaesthetic equipment, and any non-critical devices used in conjunction with critical and semi-critical medical devices, such as bowls, dishes and receivers, utensils and glassware.

It is intended to be used in conjunction with the general requirements specified in ISO 15883-1:2024.

ISO 15883-3:2024 Washer-disinfectors Part 3: Requirements and tests for washer-disinfectors employing thermal disinfection for human waste containers

This standard specifies requirements for WD that are intended to be used for emptying, flushing, washing and thermal disinfection of non-critical devices in the form of human waste containers by one operating cycle.

It is intended to be used in conjunction with the general requirements specified in ISO 15883-1:2024, and with the requirements of ISO 15883-5:2021.

ISO 15883-4:2018 Washer-disinfectors Part 4: Requirements and tests for washer-disinfectors employing chemical disinfection for thermolabile endoscopes

This standard specifies the particular requirements, including performance criteria for WD that are intended to be used for cleaning and chemical disinfection of thermolabile endoscopes. It also specifies the performance requirements for the cleaning and disinfection of the washer-disinfector and its components and accessories which can be required to achieve the necessary performance criteria.

The methods, instrumentation and instructions required for type testing, works testing, validation (installation, operational and performance qualification on first installation),

routine control and monitoring, and requalification of WD periodically and after essential repairs, are also specified.

ISO 15883-5:2021 Washer-disinfectors Part 5: Performance requirements and test method criteria for demonstrating cleaning efficacy

This standard specifies procedures and test methods used to demonstrate the cleaning efficacy of WD and their accessories intended to be used for cleaning of reusable medical devices. It includes the test soils and methods that can be used to demonstrate the cleaning efficacy of washer-disinfectors. Acceptance criteria are included, based on visual inspection and/or a microbiological end-point as stated for each method. Where chemical detection of residual soiling is required / sought, methods can be complemented by the specific determination of a residual component of the applied test soil.

3.3.2.2. NSF/ANSI 3 (International / USA / Canada)

NSF/ANSI 3-2019: Commercial warewashing equipment

This standard establishes minimum public health and sanitation requirements for the materials, design,construction, and performance of commercial warewashing machines and their related components.

It applies to commercial dishwashing, glasswashing, and pot, pan, and utensil washing machines that wash their contents by applying sprays of detergent solutions, with or without blasting media granules, and sanitise their contents by applying sprays of hot water or chemical sanitizing solutions.

Stationary rack and conveyor machines are covered under this Standard. Equipment components and materials covered under other NSF or NSF/ANSI Standards or criteria shall also comply with the requirements herein.

In particular this standard sets requirements regarding

- materials used in the manufacture of warewashing machines (e.g. corrosion resistance, smoothness and cleanability etc.),
- design and construction (e.g. general sanitation requirements, temperature indicating devices at the wash tanks, thermostatic control of the water temperature in the tanks, etc.),
- performance (soil removal , sanitisation efficacy (hot water and chemical sanitizing), thermostat differential of dishwashing, glasswashing and pot, pan and utensil washing machines, including description of test method) and
- manufacturer’s specifications (data to be stated on a data plate (e.g. minimum temperature of wash water in the tank, minimum and maximum pressure in the final sanitizing rinse line, etc.), equipment labelling (however, no information requirements on energy and water consumption but only regarding the intended use), and operating instructions.

- Both for hot water and chemical sanitizing machines requirements regarding the water temperature and pressure are set.

NSF/ANSI 3-2019 additionally contains requirements and exemptions for warewashing equipment provided with a security package (e.g. for use in prisons etc.) and for warewashing equipment for use in marine environments (under shipboard conditions).

NSF/ANSI 3-2019 specifications apply to hot water and chemical sanitizing machines commonly used on the US market. These appliances generally require higher (sanitizing) temperatures compared to the (cleaning) temperatures of dishwashers in Europe. This higher thermal minimum requirement results in higher energy consumption and lower efficiency, respectively. Therefore this standard is regarded to be not appropriate to cover European requirements and market trends.

3.3.2.3. NSF/ANSI 29 (International / USA / Canada)

NSF/ANSI 29-2017 Detergent and chemical feeders for commercial spray-type dishwashing machines

This standard establishes minimum public health and sanitation requirements for chemical sanitizing feeders, detergent feeders, rinse agent feeders, and similar devices for commercial spray-type dishwashing machines that automatically maintain the concentration of additives in the prewash, wash, pumped rinse, or final rinse of commercial spray-type dishwashing machines. In particular the requirements by this standard cover

- the materials used,
- the design and construction,
- the performance (e.g. hydrostatic test, maintenance of solution concentration, reliability, chemical resistance, etc.) and
- the installation, operation and maintenance instructions (manual, operating instructions).

This standard established and adopted by NSF as minimum voluntary consensus standard is used internationally as well as an American National Standard (ANS).

3.3.2.4. EN 17735 (European)

EN 17735:2022: Commercial dishwashing machines – Hygiene requirements and testing

This European standard is the first to provide a standard that defines the hygiene requirements for the operation of commercial dishwashers and the procedures for corresponding tests on the dishwashers and contains guidelines for the hygienic and proper operation, care and maintenance of dishwashers. It has been prepared by Technical Committee CEN/TC 429 ‘Food hygiene — Commercial warewashing machines — Hygiene requirements and testing’.

EN 17735 is applicable to dishwashers used in commercial environments for cleaning items in contact with food, such as plates, crockery, glassware, cutlery, reusable containers and similar items. These can be found in cafés, restaurants, canteens, hospitals, snack bars and bars, etc. The standard is not applicable to household dishwashers, washer-disinfectors for the reprocessing of medical devices and machines for industrial use.

The hygiene requirements for commercial dishwashers defined by EN 17735 include, for example, specifications for the planning and design of the various machine types (programme and conveyor dishwashers). Information is provided on hygienic and professional operation, cleaning and disinfection of the wash ware and care and maintenance of the machines. It also describes the basic hygiene principles for the spatial arrangement of the dishwashers in the kitchen area and the organisation of the wash ware cycle.

3.3.2.5. DIN 10510 / 10511 / 10512 / 10522 /10544 (Germany)

This family of standards covered hygienic requirements regarding the construction, operation and maintenance of different types of professional dishwashers.

Most of the content of these German standards has been incorporated into DIN EN 17735 (see above). The previous German standards for the hygiene requirements for commercial dishwashing DIN 10510, 10511 and 10512 were withdrawn as a result. Only DIN 10522 remained.

For points that are included in the previous German standards but not in DIN EN 17735, such as type testing with glass, a residual standard is currently being developed by the responsible DIN committee in the form of DIN 15444.

DIN 10522:2006 Food hygiene – Professional cleaning of reusable boxes and reusable containers for unpackaged foodstuffs – Hygiene requirements, testing

This standard defines minimum hygiene requirements with regard to the professional cleaning of reusable boxes and reusable containers for unpackaged foodstuffs and describes the test procedures for the hygienic operation of dishwashers used for these purposes.

DIN 10522 continues to apply unchanged, as its scope of application for reusable crates and reusable containers used to store and transport unpackaged food within the commercial sector is not covered by DIN EN 17735.

DIN 10544:2024-07 Food hygiene - Commercial dishwashing machines - Additional hygiene requirements and testing

This German standard is applicable to commercial dishwashers that fall within the scope of EN 17735 (see above). DIN 10544 supplements the content of EN 17735 with the following points:

- Type testing for the cleaning of drinking vessels (e.g. glasses, cups ...);

- Extraordinary testing of dishwashers (to support the operator);
- Inspection of the cleaning of cutlery on special wash ware carriers;
- Cleaning of reusable packaging for delivery to and use by end consumers.

3.3.3. Noise

3.3.3.1. IEC 60704 (International)

IEC 60704-1:2021 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 1: General requirements

This international standard applies to electric appliances (including their accessories or components) for household and similar use, supplied from mains or from batteries. By 'similar use' is understood the use in conditions similar to those found in households, for example in inns, coffee houses, tea rooms, hotels, barber or hairdresser shops, launderettes, etc., if not otherwise specified in the IEC 60704-2 series. It does not apply to appliances, equipment, or machines designed exclusively for industrial or professional purposes.

IEC 60704-2-3:2017: Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-3: Particular requirements for dishwashers

This standard applies to single-unit electric dishwashers for household and similar use, with or without automatic programme control, for cold and/or hot water supply, for detachable or permanent connection to water supply or sewage systems, intended for placing on the floor against a wall, for building-in or placing under a counter, a kitchen worktop or under a sink, and for mounting to a wall or on a counter. Limitations for the use of this test code are given in IEC 60704-1.

3.3.3.2. 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

This international standard specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured on a surface enveloping the noise source (machinery or equipment) in an environment that approximates to an acoustic free field near one or more reflecting planes. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands or with frequency A-weighting applied, is calculated using those measurements. The methods specified in ISO

3744:2010 are suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001.

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

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

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

3.3.3.3. 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

This international standard 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).

3.3.3.4. ISO 4871 (International)

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

This international standard 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.

3.3.3.5. ISO 9614 (International)

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

This international standard 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.

3.3.3.6. ISO 11204 (International)

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

This international standard specifies a method for determining the emission sound pressure levels of machinery or equipment, at a work station and at other specified positions nearby, in any environment which meets certain qualification requirements. A work station 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 work station, 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 work station and for other specified positions. One purpose of the measurements is to permit comparison of the performance of different units of a given family of machines, under defined environmental conditions and 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 work stations and other specified positions where emission sound pressure levels are to be determined.

Appropriate positions where measurements may be made include the following: a) work station located in the vicinity of the source under test; this is the case for many industrial machines 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 work station may also lie on a specified path along which an operator moves.

3.3.4. Electromagnetic fields / electromagnetic compatibility (EMC)

3.3.4.1. IEC 62233 (International)

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

This international standard 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 the measuring of 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 household electrical appliances, electric tools and electric toys.

Appliances that are not intended for regular household use but may nevertheless be approached by the public or may be used by laymen are within the scope of this standard. This standard includes specific elements to assess human exposure:

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

The measurement methods specified are valid for appliances that range 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 within the IEC 60335 series.

IEC 61000-3-2:2018/AMD2:2024 - Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

This part of IEC 61000 applies to the limitation of harmonic currents fed into the public low-voltage supply system. It specifies limits for the harmonic components of the input current that can be caused by equipment (apparatus, devices) tested under specified conditions. It is applicable to electrical and electronic devices (equipment, installations) which have an input current of up to and including 16 A per conductor and which are intended for connection to the public low-voltage distribution network.

IEC 61000-3-3:2013+AMD1:2017+AMD2:2021 CSV Electromagnetic compatibility (EMC) - Part 3-3: 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

This international standard is concerned with the limitation of voltage fluctuations and flicker impressed on the public low-voltage system. It specifies limits of voltage changes which may be produced by an equipment tested under specified conditions and gives guidance on methods of assessment. It is applicable to electrical and electronic equipment having an input current equal to or less than 16 A per phase, intended to be connected to public low-voltage distribution systems of between 220 V and 250 V line to neutral at 50 Hz, and not subject to conditional connection. IEC 61000-3-3 has the status of a product family standard within the IEC 61000 series. This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision which takes account of the changes made in IEC 61000-4-15:2010.

3.3.4.2. EN 50366 (Europe)

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

This European standard contains 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.

3.3.4.3. EN IEC 55014 (Europe)

EN IEC 55014-1:2021 Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission

This standard specifies requirements for the emission of radiofrequency disturbances from household appliances, electric tools, and similar apparatus. Specifically, the standard applies to:

- Household appliances;
- Electric tools;
- Similar apparatus designed for use in residential, commercial, and light industrial environments.

It aims to ensure electromagnetic compatibility by limiting radio frequency emissions from common electrical and electronic devices used in homes and similar environments and provides manufacturers with the technical specifications needed to design and test products to meet EMC regulatory requirements.

EN IEC 55014-2:2021 Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 2: Immunity - Product family standard

This standard specifies electromagnetic immunity requirements for household appliances, electric tools, and similar apparatus. Specifically, the standard applies to:

- Household appliances;
- Electric tools;
- Similar apparatus powered by AC or DC (including battery-powered devices).

It covers the frequency range of 0 Hz to 400 GHz and specifies immunity requirements for:

- Continuous electromagnetic disturbances;
- Transient electromagnetic disturbances;
- Both conducted and radiated disturbances.

3.3.5. Gas

3.3.5.1. UL 921 (USA / Canada)

UL 921 Standard for commercial dishwashers

This standard covers commercial, freestanding, undercounter, and counter-insert dishwashers, utensil-washers, and glasswashers using water as the principal cleaning medium, hereafter referred to as dishwashers.

The contents of the standard have already been described in Section 3.3.1.5. However, this standard covers not only electric dishwashers, but also the gas-handling, gas-burning, and gas-control features of gas-fired dishwashers having inputs of 400 000 Btu (420 MJ) per hour or less, limited to 0.5 psig (3.45 kPa) inlet pressure for use with natural gas, manufactured gas, mixed gas, propane gas, liquefied petroleum gases, or LP gas-air mixtures. Thus, UL 921 provides further construction and performance[30] and marking requirements being unique to gas-fired dishwashers.

3.4. Legislation and environmental labelling

Professional dishwashers are already covered by a wide range of legislation at a European level, as well as by individual Member States and at an international level by third countries. Some of the regulations relate to health or safety aspects (e.g., Low Voltage Directive), while other regulations address environmental aspects or labelling (e.g. WEEE Directive, RoHS, REACH, F-Gas Regulation, Water Framework Directive, Regulation on Detergents).

3.4.1. European legislation

3.4.1.1. Machinery Directive (MD) 2006/42/EC / Regulation (EU) 2023/1230

The Machinery Directive 2006/42/EC (EC 2006a) is a revised version of Directive 98/37/EC and Member States shall apply the provisions necessary to comply with it from 29th December 2009. The Directive aims at harmonising health and safety requirements applicable to machinery, and at 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

[30] This refers to general requirements, test gases, test pressures and burner adjustments test, normal operation, undervoltage combustion test, combustion air failure test, burner operating characteristics test, pilot ignition systems test, direct ignition systems tests, and flue gas temperature for draft hood appliances test.

of linked parts or components, at least one of which moves, and which are joined together for a specific application'[31].

Before placing machinery on the market and/or putting it into service, the manufacturer or his authorised representative shall ensure that 'a risk assessment is carried out in order to determine the health and safety requirements which apply to the machinery. The machinery must then be designed and constructed taking into account the results of the risk assessment.' 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. Conformity with the requirements of the Directive is guaranteed by the official CE marking which shall be affixed to the machinery 'visibly, legibly and indelibly in accordance with Annex III'. Other markings which are likely to 'mislead third parties as to the meaning or the form of the CE marking, or both, shall be prohibited'.

One objective 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 (LVD) 2006/95/EC[32], now recast as Directive 2014/35/EU, in order to provide greater legal certainty (European Commission (EC) 2024b). Categories of low voltage electrical and electronic machinery that are excluded from the scope of the Machinery Directive are listed in Article 1 (2) (k) and they include '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 and not of the Machinery Directive. Therefore, household dishwashers are considered to be outside the scope of this directive. 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) 2024c).

In contrast, within this power rating, a machine specified by the manufacturer as intended for commercial or industrial use as well as machinery beyond these voltage limits would need to comply with requirements of the Machinery Directive. This is clarified in the Commission's guidance document: 'Thus appliances for the housekeeping functions […] that are intended for commercial or industrial use are not excluded from the scope of the Machinery Directive' (European Commission (EC) 2024c). The Machinery Directive therefore applies to all professional dishwashers 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 3.2.2.

Due to inadequacies and inconsistencies in the product coverage and conformity assessment procedures, the provisions of the Machinery 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

[31] 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.

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

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; EU 2023c, 2023a). 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 dishwashers intended for domestic use.
- Dishwashers intended for professional use are not excluded and will therefore be in the scope of the new regulation starting from 20 January 2027 (EU 2023d, 2023b).

3.4.1.2. 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 (EU 2014b). Compliance with its provisions shall 'ensure a high level of protection of public interests, such as health and safety of persons, of domestic animals and property, and to guarantee fair competition on the Union market' concerning the electrical equipment within certain voltage limits. The directive requires such equipment to be protected against hazards arising from the electrical equipment itself as well as against hazards caused by external influences. The directive covers 'all risks arising from the use of electrical equipment, not just electrical ones, but also mechanical, chemical (such as, in particular, emission of aggressive substances) and all other risks. The LVD also covers health aspects of noise and vibrations, and ergonomic aspects as far as ergonomic requirements are necessary to protect against hazards in the sense of the LVD' (European Commission 2018a).

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 (if not excluded in Annex II). As explained in European Commission (2018a), these voltage ratings refer to the voltage of the electrical input or output, not to voltages that may appear inside the equipment (European Commission 2018a).

As they are not listed under the exceptions, all dishwashers – intended for professional or for domestic use – that are within the corresponding voltage rating of the directive are therefore subject to its requirements.

3.4.1.3. Electromagnetic Compatibility (EMC) 2014/30/EU

The initial Directive 2004/108/EC has been revised and recast as Directive 2014/30/EU (EU 2014a) on the harmonisation of the laws of the Member States relating to electromagnetic compatibility. It regulates the electromagnetic compatibility (EMC) of both apparatus and fixed installations, where 'apparatus' means 'any finished appliance or combination thereof made available on the market as a single functional unit, intended for the end-user and liable to generate electromagnetic disturbance, or the performance of which is liable to be affected by such disturbance' and 'fixed installations' means 'a

particular combination of several types of apparatus and, where applicable, other devices, which are assembled, installed and intended to be used permanently at a predefined location'. Professional dishwashers can fall under both of these categories and as they are not listed among the defined exceptions, they fall within the scope of the directive if they fulfill the definitions.

According to the directive, equipment must be designed and manufactured in such a way that electromagnetic compatibility is ensured, i.e. that

(a) 'the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended' and

(b) 'it has a level of immunity to the electromagnetic disturbance to be expected in its intended use which allows it to operate without unacceptable degradation of its intended use'.

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

Directive 2002/95/EC was reviewed and recast as Directive 2011/65/EU (EU 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', to which certain dishwashers could be assigned. Professional 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. The Commission's 'Frequently Asked Questions' document (European Commission (EC) 2012) on RoHS and WEEE Directives clarifies as well that professional and industrial equipment is covered by the RoHS Directive[33].

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. Article 5(1)(a) and (b) ensure that materials and components can be included in these lists of applications under certain conditions if the inclusion does not weaken the environmental and health protection

[33] 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.'

afforded by Regulation (EC) No 1907/2006 and if one of the following conditions is fulfilled:

(a) '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',

(b) 'the reliability of substitutes is not ensured',

(c) '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[34]. In Task 4 (Technical analysis of existing products) we will evaluate whether there are existing exemptions which are of importance for the scope of this study. The Directive was recently subjected to a review process; however the process has not concluded (status October 2024) and it cannot yet be estimated whether changes shall be introduced to RoHS or not.

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

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) was introduced as European Community Directive 2002/96/EC. Following a review, it was recast as Directive 2012/19/EU (EU 2012a). The aim of the directive is 'protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste from electrical and electronic equipment (WEEE)'. It contains provisions on the design, collection, treatment, recycling and disposal of WEEE as well as on financial aspects. The responsibility for the management of waste electrical and electronic equipment is assigned to the manufacturers 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 'Dish washing machines'. These are therefore within the scope of the directive.

Very large and complex professional dish washing machines could possibly be exempted from the Directive if they can be considered as 'large-scale fixed installations'. There is

[34] 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.

no clear definition in the directive as to the size above which this is the case. There are also no clear criteria in the FAQ document for the WEEE Directive (European Commission (EC) 2014), but reference is made to the FAQ document for the RoHS Directive (European Commission (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 professional dishwashers. 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 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 V.

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.

3.4.1.6. Critical raw materials act

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' (EU 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.'

Professional dishwashers 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.[35]

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

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

[35] 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.

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 heat pumps are contained in certain professional dishwashing appliances, this requirement could apply in some cases.

3.4.1.7. Packaging Directive 94/62/EC

The purpose of the Packaging Directive (EC 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 professional dishwashers would be in scope of this legislation.

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

In November 2022, the Commission proposed to revise the Packaging and Packaging Waste Directive and has published a proposal for a Regulation on packaging and packaging waste. The shift from a Directive to a Regulation means among others that manufacturers are directly obligated by the legislation, as opposed to a Directive which

needs to be transferred to National Legislation, thus obliging Member States to ensure that e.g., manufacturers adhere to specific requirements. New articles require all packaging to be recyclable, set recycled content targets for packaging relevant for the use of plastics, require the amount of packaging to be reduced as well as a shift to reusable packaging". The requirements for the design of packaging are more specific, detailed in articles 5-10 whereas in the 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 professional dishwashers and their manufacturers.

3.4.1.8. Regulation (EU) 528/2012 – Biocidal Products

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

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

b) the authorisation of biocidal products;

c) the mutual recognition of authorisations within the Community;

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

e) the placing on the market of treated articles.

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

If such substances are used in detergents or cleaning agents in professional dishwashers, the regulation is considered relevant for this product group. In addition, biocidal products could also be used in wooden packaging for professional dishwashing appliances.

3.4.1.9. Gas Appliances Directive (GAD) Directive 2016/426/EC

The former Gas Appliance Directive 2009/142/EC (GAD) was repealed by Regulation (EU) 2016/426 on appliances burning gaseous fuels (EU 2016b). 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 appliances as well as fittings and according to the Commission's guidance document, this includes dish washing machines (European Commission (EC) 2024a).

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).

3.4.1.10. Water Framework Directive (WFD) 2000/60/EC

The purpose of the Water Framework Directive (WFD) (EU 2020) is to provide a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. More concretely, this framework is intended to prevent further deterioration and protect the status of aquatic ecosystems as well as other related ecosystems; to promote the sustainable use of water resources; to reduce discharges, emissions and losses of priority substances and to contribute to the mitigation of floods and droughts. The water management is based on so-called ‘river basins’, which are defined as ‘area[s] of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta’.

In addition to direct protective measures, the Member States are obliged to take into account the principle of recovery of the costs of water services, including environmental and resource-related costs, having regard to an economic analysis and in accordance with the polluter-pays principle. This means that the Water Framework Directive introduces two important economic principles. On the one hand, Member States should ensure that water pricing policies provide adequate incentives for users to use water resources efficiently and that the various sectors (e.g. industry, households, agriculture) make an appropriate contribution to covering the costs of water services, taking into account the polluter-pays principle. On the other hand, the Member States themselves are obliged to draw up an economic analysis of water use in accordance with Annex III.

Articles 4, 10, 11 and 16 and Annexes V, VIII, IX and X address chemical pollution. By identifying priority substances, the Water Framework Directive focuses on pollutants that pose a significant risk to or through the aquatic environment. The substances are identified through risk assessments that examine scientific evidence of the substances' hazardous properties, their contamination of European waters and other factors (e.g. quantities used). Of the 45 chemicals identified as priority substances, 21 are designated as priority hazardous substances due to their persistence, bioaccumulation and toxicity. The list of priority substances is reviewed by the European Commission at least every six years to enable the inclusion of further substances of concern. Emissions, discharges

and losses of priority substances into water bodies are to be gradually reduced and priority hazardous substances are to be completely phased out within 20 years.

It is assumed that the priority substances could be contained in the discharges of dishwashing appliances if used in the detergents applied during washing processes. In this case, the Water Framework Directive is considered relevant for the product group of professional dishwashers.

3.4.1.11. Commission Regulation (EC) No. 648/2004 – Detergents

Regulation (EC) 648/2004 (EC 2004) harmonises the following rules for the placing on the market of detergents and of surfactants for detergents:

- 'the biodegradability of surfactants in detergents;
- restrictions or bans on surfactants on grounds of biodegradability;
- the additional labelling of detergents, including fragrance allergens,
- the information that manufacturers must hold at the disposal of the Member States competent authorities and medical personnel.;
- limitations on the content of phosphates and other phosphorus compounds in consumer laundry detergents and consumer automatic dishwasher detergents'.

Surfactants and detergents containing surfactants that meet the criteria for ultimate aerobic biodegradation (as specified in Annex III) can be placed on the market without further limitations relating to biodegradability. In case that the criteria are not met, manufacturers of industrial or institutional detergents containing surfactants, and/or of surfactants for industrial or institutional detergents, may ask for derogations. For all surfactants in detergents failing ultimate aerobic biodegradation tests, the level of primary biodegradability shall be measured. If the level of primary biodegradability is lower than that stipulated in Annex II, no derogation shall be granted for this surfactants.

Furthermore, the Directive also sets limits on the content of phosphates and other phosphorus compounds (as specified in Annex VIa) and contains obligations concerning information and labelling as well as specifications concerning testing methods.

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

The former Regulation (EC) No. 842/2006 was repealed by Regulation (EU) No. 517/2014 (EU 2014c). The objective of this Regulation is to protect the environment by reducing emissions of fluorinated greenhouse gases. To achieve this objective, it

(a) 'establishes rules on containment, use, recovery and destruction of fluorinated greenhouse gases, and on related ancillary measures;

(b) imposes conditions on the placing on the market of specific products and equipment that contain, or whose functioning relies upon, fluorinated greenhouse gases;

(c) imposes conditions on specific uses of fluorinated greenhouse gases; and

(d) establishes quantitative limits for the placing on the market of hydrofluorocarbons.'

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

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

Concerning reclaimed or recycled fluorinated greenhouse gases, they 'shall be labelled with an indication that the substance has been reclaimed or recycled, information on the batch number and the name and address of the reclamation or recycling facility'.

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)[36] 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

[36] 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.'

appliances that are not installed by specialised personnel (this applies to household appliances, for example).

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

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

3.4.1.13. Commission Regulation (EC) No. 1275/2008 – Standby / Networked Standby Regulation (EU) 2023/826

The Regulation (EC) No. 1275/2008 (EC 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)[37] to work as intended is excluded from the Regulation.

[37] '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'.

'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;

(c) are dependent on energy input from the mains power source in order to work as intended; and

(d) are designed for use with a nominal voltage rating of 250 V or below, also when they are marketed for non-household or non-office use.

In the original version of the Regulation, dishwashing machines 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, dishwashing machines are no longer listed in Annex I. Therefore, professional dishwashers would not fall within the scope of this Regulation even if they fulfil criteria a) to d) (e.g. in some cases at camping grounds). Dishwashers designed for other groups than end-users are not in the scope of the regulation anyway.

Regulation (EC) No 1275/2008 will be repealed by Regulation (EU) 2023/826 of 17 April 2023 with effect from 9 May 2025. This new regulation, according to its Annex II, does not cover household dishwashers covered by Commission Regulation (EU) 2019/2022. Dishwashers designed for use other than in the households are not covered by the regulation anyway. Therefore, this new Regulation is also not considered relevant for the product group professional dishwashers of this review study.

3.4.1.14. REACH Regulation (EC) No 1907/2006

The REACH Regulation (EC) No 1907/2006 (EC 2006b) 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 professional dishwashers will be analysed in Task 4.

3.4.1.15. 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 (EU 2014b). The RED establishes a regulatory framework for the making available on the market and

putting into service in the Union of radio equipment. 'Radio equipment' is defined as 'an electrical or electronic product, which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radiodetermination, or an electrical or electronic product which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radiodetermination'. A guidance document provided by the Commission (European Commission (EC) 2018) 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' dishwashers. 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.

3.4.2. European ecolabelling

There is no **EU Ecolabel** for household or professional dishwashers themselves, but for industrial and institutional dishwasher detergents (EC o. J.). The label's criteria for this product group relate to dosage requirements, toxicity to aquatic life, biodegradability and the sustainable sourcing of palm oil components. Furthermore, they include restricted restricted or banned substances, packaging requirements and requirements for the fitness for use, automatic dosing systems, user information and information appearing on the EU label (EU Ecolabel 2024).

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

Since 2016, under the European Commission EMAS programme, 'Optimised dishwashing, cleaning and food preparation' is addressed by Best Environmental Management Practices for Tourism (BEMP) (EU 2016a). This requires EMAS-registered organisations in the tourism sector to take the relevant sectoral reference documents into account.

BEMPs addressing 'Optimised dishwashing, cleaning and food preparation' are 'to select efficient washing equipment, including trigger-operated low-flow pre-rinse spray valves, efficient dishwashers and connectionless steamers, and to monitor and benchmark water consumption in kitchen/restaurant' (EU 2016a).

Furthermore, the BEMP details several performance indicators and their considered benchmark of excellence, which are shown in Table 2-7.

Table 2-7 Specific criteria for optimised dishwashing, cleaning and food preparation in tourism facilities

Environmental performance indicators	Benchmark of excellence
- Kitchen water consumption per dining guest (l/dining guest) - Percentage of ecolabelled dishwashing and kitchen cleaning chemicals (%) - Green procurement of efficient kitchen equipment (y/n)	- Implementation of a kitchen water management plan that includes monitoring and reporting of total kitchen water consumption normalised per dining guest, and the identification of priority measures to reduce water consumption. - At least 70 % of the purchase volume of chemical cleaning products (excluding oven cleaners) for dishwashing and clean ing are ecolabelled (e.g. EU Ecolabel)

Source: Reproduced out of EU (2016).

Though these requirements are relevant for kitchens using professional dish washing appliances, it is understood to refer to the total consumption of the facility and not to consumptions at machine level.

3.4.3. 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.

3.4.3.1. French Code de la Consommation (Consumption Law), Art. L111-4 on information about the availability of spare parts

In France, manufacturers or importers are obliged by Article L111-4[38] of the 'Code de la Consommation' to provide information on the availability of spare parts to the seller. The seller in turn must inform the consumer of the availability of spare parts when the goods are purchased (Ministère de l'Économie, des Finances er de l'Industrie et Ministère chargé du Budget et des Comptes publics 2021). These information obligations concern contracts other than distance and off-premises contracts and do not therefore have to appear on the websites of professional sellers. Nevertheless, where the supply of spare parts accompanies the marketing of a good, it is considered in the interests of professionals to ensure that this information is communicated to consumers, including on the websites of manufacturers and professional sellers. The corresponding articles were later modified by further laws, which reduce the time limit for the supply of spare parts by the manufacturer or importer from two months to fifteen days, and introduce a period of availability that may not be less than five years from the time the spare parts

[38] https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000032227346/

for a certain category of electronic and electrical equipment are placed on the market. (Ministère de l'Économie, des Finances er de l'Industrie et Ministère chargé du Budget et des Comptes publics 2021). As the law is located in a chapter of the Environmental Code that relates to consumer information, it is assumed that the regulations are not relevant for professional dishwashers.

3.4.3.2. French Code de la Consommation (Consumption Law), Art. L. 213-4-1 on planned obsolocence

In France, planned obsolescence is prohibited under Article L441-2[39] 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[40] 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.

3.4.3.3. The French LOI n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire (Circular Economy Law)

Article 16[41] of the 'LOI n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire' imposes an obligation on manufacturers, importers, distributors or other marketers 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 dishwashers (Ministère de l'économie des finances et de la souveraineté industrielle et numérique 2024). From 1 January 2024, a more general durability index should be used 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[42]. So far, however, the durability index has only been applied to washing machines and televisions and not yet to dishwashers (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.

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39 https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000044330817/2021-11-17/

40 https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000044330859/2021-11-17

41 https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000041553781

42 https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000041553781

3.4.4. Labelling at Member State level

3.4.4.1. Blue Angel (Germany)

The Blue Angel also has no award criteria dishwashers per se, but for the product group 'automatic dishwashing detergents' (Blauer Engel 2022). However, the scheme is only applicable to detergents for household dishwashers and detergents for commercial use, provided that they are comparable to household dishwashers in terms of machine size and use. The label is therefore not considered relevant for the product group of professional dishwashers.

3.4.4.2. Nordic Swan (Scandinavia)

The Nordic Swan label does not have schemes related to dishwashers themselves, however, there is a scheme for dishwasher detergents for professional use. Complete dishwasher detergents, multi-component systems, rinse aids and soaking agents for professional use in institutional and large-scale kitchens can be labelled and criteria include among others[43] (Nordic Swan n. d.):

- 'Environmental properties (ecotoxicity and biodegradability) of the chemicals used in the products.
- Health properties of the chemicals used in the products. For example, no use of perfumes, CMR-classified substances or other particularly problematic substances such as endocrine disruptors and suspected endocrine disruptors on lists from the EU and national authorities.
- Efficiency tests.
- Recyclable design of the packaging (and reuse of larger packaging) which contributes to a circular economy.'

3.4.4.3. Sustainable Energy Authority (Ireland)

The Sustainable Energy Authority of Ireland (SEAI) has established incentives to encourage businesses to invest in energy saving technologies[44]. In the form of an accelerated capital allowance (ACA), businesses purchasing certain commercial dish washing 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

[43] For the full list of criteria see Nordic Swan (2024).

[44] For further details, see: Sustainable Energy Authority of Ireland (seai) o. J..

the standard deductions spread over a longer period). On this basis, the SEAI has published documents with criteria for 'Commercial Dishwashers'[45].

Commercial dishwashers are defined as 'equipment constructed in stainless steel for use in commercial kitchens and to clean and sanitise dishes, plates, utensils, glasses, trays, cups, and bowls'. To be eligible for the tax benefit, the following conditions must be met (Sustainable Energy Authority of Ireland (seai) n. d.):

- All equipment and/or components must be CE marked as required by the specific EU directive(s) and comply with requirements of RoHS and WEEE Directives.
- Appliances must have a certain maximum water consumption and a maximum idle energy rate as specified in Figure 2-2.

Appliances must incorporate a heat-recovery system to preheat rinse water to a minimum temperature of 40° C (concern only Single and Multiple Tank Rack Conveyor Dishwashers).

Dishwasher Type	Water Consumption (litres pre rack)	Idle Energy Rate (kW per hour)
Under-counter	≤3	≤0.9
Stationary Single Tank Door	≤3	≤1
Single and Multiple Tank Rack Conveyor	≤2.9	≤2.6

(Source: Sustainable Energy Authority of Ireland (seai) (n. d.)

Figure 2-2: Maximum water consumption and maximum idle energy rates

3.4.4.4. 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.

[45] See: Sustainable Energy Authority of Ireland (seai) n. d.

3.4.5. Third country legislation and labelling

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.

3.4.5.1. Minimum Energy Performance Standards (Australia)

Concerning energy efficiency, a wide range of products are already regulated in Australia. New products are regularly being considered for regulation or other programmes as well. However, until now there were no Minimum Energy Performance Standards for professional dishwashers. Labelling requirements exist, but apply only to household appliances (Australian Government 2024). New Greenhouse and Energy Minimum Standards for dishwashers were registered in October 2024 (Australian Government 2024), but it is not clear if they apply to professional appliances.

3.4.5.2. Declaration of the energy and water consumption as well as the cleaning performance in accordance with the Federal Energy Efficiency Ordinance (Switzerland)

In Switzerland, declaration requirements were introduced for commercial dishwashers, which came into force in 2024 (Swiss Federal Office of Energy 2023). From then on, energy and water consumption as well as the cleaning performance must be declared in the technical documentation as well as on a freely accessible website in accordance with the European standard EN IEC 63136:2019. Switzerland is thus taking on a pioneering role, as there are no such requirements in the EU to date. However, an energy label for commercial dishwashers does not exist (Swiss Federal Office of Energy 2023).

The declaration requirements are intended to enable the sector to better estimate operating costs and choose particularly efficient appliances. As these normally have a higher purchase price, this is particularly important in order to make overall costs more transparent. The requirements apply to new electrical appliances for commercial use. Existing appliances are exempt from the requirements. Appliances purchased abroad and directly imported must fulfil the requirements (energieschweiz 2023).

The following types of appliances are affected by the obligation (energieschweiz 2023):

- Single-tank undercounter dishwashers
- Single-tank pass-through dishwashers closed by a hood

Not affected tapes of appliances are (energieschweiz 2023):

- Water-changing undercounter dishwashers
- Conveyor and rack transport dishwashers
- Utensil dishwashers

The following product information needs to be declared (energieschweiz 2023):

- the indication whether the appliance has an integrated heat recovery or not
- an explanation of how the integrated heat recovery works, if there is one
- the test results in accordance with the European standard EN IEC 63136:2019 concerning electric dishwashers for professional use. These include
    - Energy consumption for initial filling hours) x.xxx kWh (kilowatt
    - Water consumption for initial filling x.x L (litres)
    - Initial filling time x s (seconds)
    - Number of plates per basket and cycle x (number)
    - Cleaning performance with the standard cleaning cycle x % (per cent)
    - Resoiling performance in particles per plate x particles/plate (particles per plate)
    - Energy consumption per cycle hours) x.xxx kWh (kilowatt
    - Water consumption per cycle x.x L (litres)
    - Average programme and cycle duration x s (seconds)
    - Electricity consumption of standby mode x kW (kilowatts)

3.4.5.3. Appliance and Equipment Standards Program (USA)

The Building Technologies Office (BTO) implements minimum energy conservation standards for more than 60 categories of appliances and equipment. There are standards for household dishwashers and for commercial clothes washers but not for professional dishwashers (US DOE 2022). It is therefore understood that this standard is not relevant for the product group in the focus of this study.

3.4.5.4. Energy Star Label (USA)

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 commercial dishwashers which is currently in its 3th version (US EPA/DOE 2021). Certification to this label requires the manufacturer of a dish washing appliance to comply with the eligibility

criteria, which define the minimum performance requirements and test procedures for verifying a minimum level.

A dishwashing machine is defined as a 'machine designed to clean and sanitise plates, pots, pans, glasses, cups, bowls, utensils, and trays by applying sprays of detergent solution (with or without blasting media granules) and a sanitizing rinse' (US EPA/DOE 2021). The following machine types are differentiated and specified in the document:

- Stationary Rack Machine
    - (a) Under Counter
        - — Glasswashing
    - (b) Single Tank, Door Type
        - — Pot, Pan, and Utensil (PPU)
        - — Dump and Fill
- Conveyor Machine
    - (a) Single Tank Conveyor
    - (b) MultipleTank Conveyor
    - (c) Flight Type Conveyor
- Heat Recovery Machine

These machine types are eligible for ENERGY STAR with the following exceptions: Only under counter machines designed for wash cycles of 10 minutes or less are eligible. The Version 3.0 specification only covers electric models. High temp PPU machines and non-PPU, dual sanitizing are eligible as well. Dishwashers intended for use in residential or laboratory application are not eligible under this product specification as well as 'PPU and Flight Type products which are only rated for low temp operation; steam, gas, and other non-electric models'.

The energy and water performance requirements are listed in Figure 2-3.

Table 1: ENERGY STAR Requirements for Commercial Dishwashers			
Machine Type	**Low Temperature Efficiency Requirements**		
	Idle Energy Rate*	**Washing Energy**	**Water Consumption****
Under Counter	≤ 0.25 kW	≤ 0.15 kWh/rack	≤ 1.19 GPR
Stationary Single Tank Door	≤ 0.30 kW	≤ 0.15 kWh/rack	≤ 1.18 GPR
Single Tank Conveyor	≤ 0.85 kW	≤ 0.16 kWh/rack	≤ 0.79 GPR
Multiple Tank Conveyor	≤ 1.00 kW	≤ 0.22 kWh/rack	≤ 0.54 GPR

Table 2: ENERGY STAR Requirements for Commercial Dishwashers			
Machine Type	**High Temperature Efficiency Requirements**		
	Idle Energy Rate*	**Washing Energy**	**Water Consumption****
Under Counter	≤ 0.30 kW	≤ 0.35 kWh/rack	≤ 0.86 GPR
Stationary Single Tank Door	≤ 0.55 kW	≤ 0.35 kWh/rack	≤ 0.89 GPR
Pot, Pan, and Utensil (PPU)	≤ 0.90 kW	≤ 0.55 + 0.05 x SF_{rack} †	≤ 0.58 GPSF
Single Tank Conveyor	≤ 1.20 kW	≤ 0.36 kWh/rack	≤ 0.70 GPR
Multiple Tank Conveyor	≤ 1.85 kW	≤ 0.36 kWh/rack	≤ 0.54 GPR
Single Tank Flight Type	Reported	Reported	GPH ≤ 2.975**x** + 55.00
Multiple Tank Flight Type	Reported	Reported	GPH ≤ 4.96**x** + 17.00

* Idle results should be measured with the **door closed** and represent the total idle energy consumed by the machine including all tank heater(s) and controls. The most energy consumptive configuration in the product family shall be selected to test the idle energy rate. Booster heater (internal or external) energy consumption shall be measured and reported separately, if possible, per ASTM F1696-20 and ASTM F1920-20 Sections 10.8 and 10.9, respectively. However, if booster energy cannot be measured separately it will be included in the idle energy rate measurements.
** GPR = gallons per rack; GPSF = gallons per square foot of rack; GPH = gallons per hour; **x** = maximum conveyor speed (feet/min as verified through NSF 3 certification) x conveyor belt width (feet).
† PPU Washing Energy is still in format kWh/rack when evaluated; SF_{rack} is Square Feet of rack area, same as in PPU water consumption metric.

(Source: US EPA/DOE (2021))

Figure 2-3: Energy and Water Efficiency Requirements

3.5. Open questions to stakeholders

3.5.1. Definition of professional dishwashers

Do you agree with the definition provided in Section 3.2.2.6 for the purposes of the analytical steps of this preparatory study or should industrial appliances be explicitly mentioned in the definition and excluded from its scope?

Are 'commercial' dishwashers (i.e. all six categories as defined in Section 3.2.3.7) generally not designed and used for industrial purposes (e.g. bottle-cleaning machines or machines used in manufacturing processes)?

Is the formulation on 'appliances designed exclusively for industrial purposes' provided in Note 104 of IEC 60335-2-58 (e.g. bottle-cleaning machines or machines used in manufacturing processes) sufficient to distinguish between commercial and industrial appliances?

3.5.2. Classification of professional dishwashers

Do you agree with the classification provided in section 3.2.3.7 as well as the updated overview on functional and performance parameters professional dishwashers (see Table 2-1)?

How relevant would you consider category 1 for the market segment of professional dishwashers? Shall it be kept in the scope of potential ecodesign measures for professional dishwashers?

Should the definition of category 1 be amended, excluding from the category the appliances that provide both water-change washing programme and classical professional programmes?

Should categories 4, 5 and 6 still be included in the scope of potential ecodesign measures, given their relatively low market relevance and the (current) lack of standards?

Would it be more suitable to introduce other / further categories in light of their effect on performance (e.g. differentiating between categories based on the energy source used for heating of water / air)?

3.5.3. Test standards for professional dishwashers

Are you aware of any other relevant standards that need to be addressed in section 3.3?

3.5.4. Legislation and environmental labelling for professional dishwashers

Are you aware of any other relevant legislations and environmental labelling requirements that need to be addressed in Section 3.4?

4. MEErP Task 2 – Markets

4.1. Objectives of MEErP Task 2

Aim of MEErP Task 2 is to provide market and cost inputs for the calculation of the EU-wide environmental impact of the professional dishwashers product group, to provide insight in the latest market trends, to establish a practical data set of prices and rates to be used in a Life Cycle Cost (LCC) calculation and to make recommendations on a potentially refined product scope in MEErP Task 1, as well as composing indications for the development on Base Cases in MEErP Task 5, e.g. by assessing the most relevant product categories from the economic / commercial perspective.

MEErP Task 2 shall include a description of the market trends including amongst others 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), share of SMEs in production and indication of the segments of the markets that SMEs are operating in, supplemented by information on market and logistical support of recyclability and availability of amounts of recycled materials related to the market size.

To facilitate the potential Impact Assessment support study, data also needs to be collected on public markets (relevant for GPP), international markets, competition issues and competitiveness of relevant EU sectors.

4.2. Generic economic data

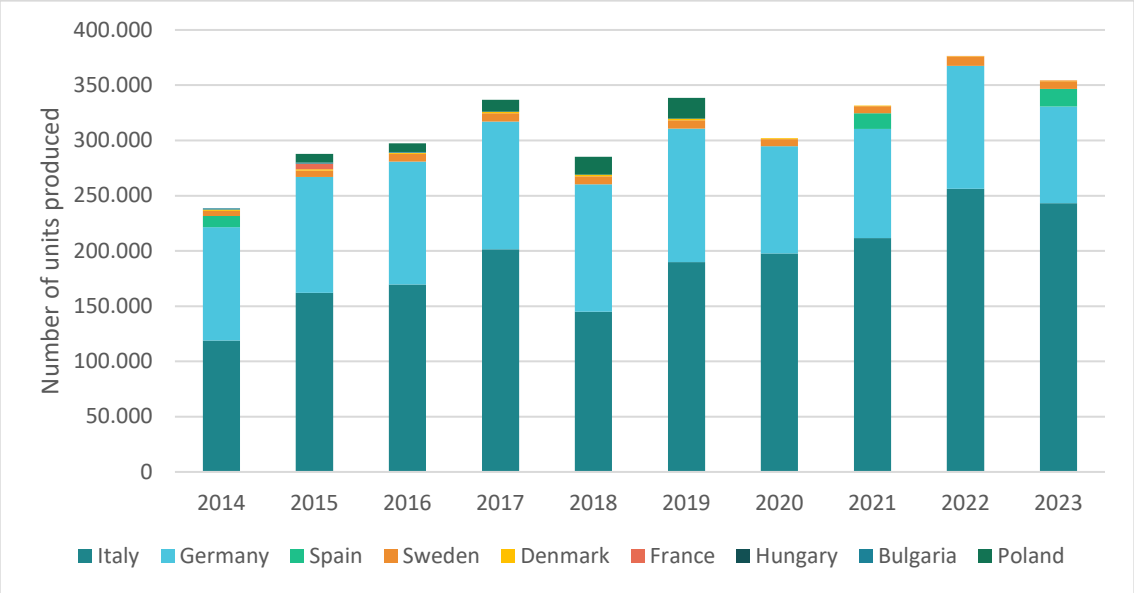
The PRODCOM database is useful for an initial analysis as it is transparent and publicly available data provided by Member States of the EU on manufacturing and production information within the EU.

4.2.1. EU Production

4.2.1.1. Unit volume

In 2023, 380,000 professional dishwashers were produced according to Prodcom data. Table 4-1 presents the number of units produced from 2014 to 2023, highlighting the locations of major manufacturing centers. However, it is important to note that data for several Member States is missing; therefore, the total should be interpreted with caution. The data is also visualised in Figure 4-1, which clearly illustrates that the primary producers within the EU27 are Italy and Germany. This figure has been relatively stable

over the past 10 years, with some larger fluctuations in the number of units produced in Italy. Together they account for 93% of the total EU27 members. Other notable countries producing more than 1,000 units per year include Sweden and Spain, although their numbers are significantly lower than those of Italy and Germany. These four Member States together account for 99.6% of all units produced within the EU27.



(Source: Prodcom)

Figure 4-1: Number of units produced from 2014-2023 per country

Another country that produced a notable number of professional dishwashers from 2015 to 2019 was Poland. However, it remains unclear whether Poland has completely ceased production of dishwashers after 2019 or simply stopped reporting data. In the next chapter, it is shown how this creates a discrepancy when analysing the estimated sales in Poland, suggesting that Poland likely stopped reporting data on their professional dishwasher production.

An additional indication of missing data is the share of unaccounted units, which compares the EU27 total directly retrieved from Prodcom with the sum of values from individual countries. In 2020, the first year for which data on Poland was no longer available, the share of unaccounted units increased. In both 2020 and 2022, when no data was available for both Spain and Poland, the share was the highest compared to other years. While these two countries likely do not account for the entire unaccounted share, they could explain a significant portion of it in the years where no data is available for either or both of the countries.

Table 4-1: Production in thousands of units per country from 2014 to 2023

Country	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bulgaria	1.1	0.7	0.6	:	:	:	:	:	:	:
Denmark	1.2	1.1	1.0	1.2	1.3	1.4	0.9	0.6	0.6	0.5
France	:	4.9	:	:	:	:	:	:	0.2	0.2
Germany	102.6	104.8	111.2	115.5	115.2	120.8	97.1	98.7	111.3	87.3
Hungary	0.0	0.3	0.2	0.2		0.0	0.0	0.0	0.0	0.0
Italy	118.8	162.2	169.6	201.5	145.1	189.9	197.7	211.6	256.1	243.3
Poland	:	7.9	7.9	10.7	16.3	18.9	:	:	:	:
Spain	10.2	:	:	:	:	:	:	14.3	:	16.0
Sweden	4.7	5.8	6.9	7.5	7.4	7.5	6.5	6.4	8.1	7.1
EU27 Total	248.4	284.0	315.9	359.1	312.3	363.5	335.3	360.0	425.0	380.0
Share unaccounted units	4.0%	-1.3%	5.8%	6.2%	8.7%	6.9%	9.9%	7.9%	11.5%	6.7%

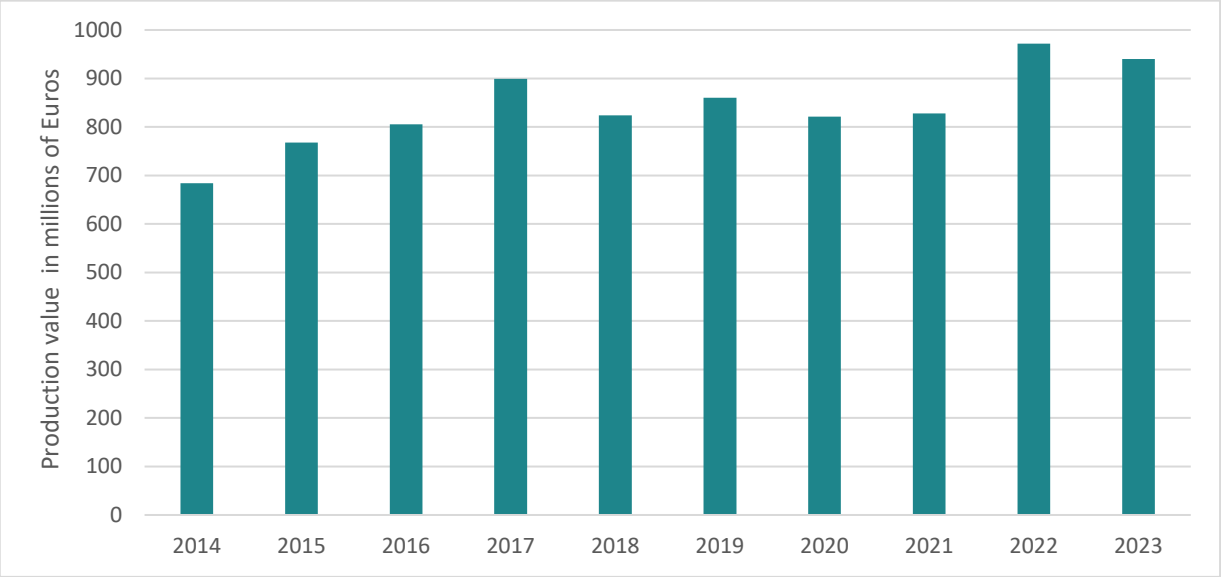
‘:‘ signifies that the information is unavailable either because it is confidential or estimated or both. All other EU 27 Member States have reported a zero production quantity over the whole period.

Countries for which all recorded years report either 0 or ‘:‘ values have been excluded.

Source: Prodcom custom database extracted 16 October 2024 https://ec.europa.eu/eurostat/databrowser/view/ds-056120__custom_13323487/default/table?lang=en

4.2.1.2. Sales value

Figure 4-2 shows the value of professional dishwashers produced according to Prodcom. The sales value of professional dishwashers produced in the EU amounted to about 940 million Euro in 2023. This is approximately 2.5 times higher than the sales value of professional washing machines and approximately 4.5 times the sales value of professional dryers.



(Source: Prodcom)

Figure 4-2: Value of EU-produced professional dishwashers in EU-27, 2014-2023

The sales data by Member State show a key distinction between the volume of units produced and the value of the sales. Table 4-2 shows Germany as having the highest sales in the EU, surpassing Italy, which was shown in Table 4-1 to produce almost 3 times as many machines. This difference can be explained by the difference in the value or type of the machines.

Germany and Italy have the largest market value, followed by Spain and Sweden. Together the four countries account for 99.1% of the total market value.

Table 4-2: Value of professional dishwashing machines produced in EU-27 by country (in millions of Euros)

Country	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bulgaria	2.5	1.8	2.5	:	:	:	:	:	:	:
Denmark	10.3	11.0	9.6	11.8	13.4	17.3	13.0	6,2	6,6	6,7
France	:	19.6	:	:	:	:	:	:	1,1	1,0
Germany	415.5	436.9	463.4	491.4	500.4	516.4	416.8	416,4	502,1	447,7
Hungary	0	0.2	0.2	0.2	:	0	0	0	0	0
Italy	180.0	226.7	237.5	293.4	199.4	209.0	295.6	324,2	347,0	384,8
Poland	:	5.0	6.1	8.9	13.2	16.2	:	:	:	:
Slovenia	0	0	0	0	0	:	2.3	:	:	:
Spain	12.7	:	:	:	:	:	:	18,3	:	26,4
Sweden	36.0	41.4	45.5	49.0	47.3	47.4	44.6	42,7	50,7	48,5
EU27 Total	683.9	768.2	805.2	899.5	823.9	860.3	821.5	828,0	972,0	940,0
Share unaccounted units	3.9%	3.3%	5.0%	5.0%	6.1%	6.3%	6.0%	2,4%	6,6%	2,7%

':' signifies that the information is unavailable either because it is confidential or estimated or both. All other EU 27 Member States have reported a zero production quantity over the whole period.

Countries for which all recorded years report either 0 or ':' values have been excluded.

Source: Prodcom custom database extracted 16 October 2024 https://ec.europa.eu/eurostat/databrowser/view/ds-056120__custom_13323487/default/table?lang=en

4.2.1.3. Share of market represented by public sector customers

No publicly-available data provides information on the share of sales made to public-sector customers.

The feedback obtained from stakeholders on the topic during the consultation held between September and October 2024 led to very scarce feedback:

- One large manufacturer stated that it sold ca. 5% of its turnover to public sector customers;
- Two manufacturers in the same group provided very contrasting figures, which may indicate a sharing of the market amoung subsidiaries of that group:
    - One manufacturer in the group sold ca. 25% of its turnover to public sector customers; whereas
    - The other answering manufacturer of the same group did not sell to institutional customers.

One difficulty stated by one manufacturer is that the resellers of products do not provide feedback to the manufacturers on their sales.

External data is also scarce, but an estimate was made based on data regarding the global commercial dishwasher market per end-user. Among the categories, educational institutions and hospitals/healthcare facilities could partly represent the public sector. Data on the share of private versus public sector in both of these end-users is not available for 2023, so proxies were used. For hospitals and healthcare facilities an estimate was used based on a 2008/2009 OECD study, which includes the share of publicly-owned hospitals per country[46]. In the absence of a total EU-27 figure, the average of the available EU-27 countries was used, which was 72%[47]. For educational institutions, the share of primary to tertiary educational partipation of students in public institutions in 2022 was used as information on the number of public schools was unavailable. The share of students in public school was approximately 80%. As a result, the total estimate of the share of the public sector would be approximately 23,6%, which is close to the number indicated by one of the stakeholders. It is also important to note that the public sector could also include other institutions other than educational institutions and hospitals, which could result in a higher share of commercial dishwashers in the public sector.

[46] OECD (2010). Health Systems Institutional Characteristics: A Survey of 29 OECD Countries

[47] Eurostat (2022). Pupils and students enrolled by education level, sex, type of institution and intensity of participation

Table 4-3: Global commercial dishwashers market by end-user 2023 in USD million (source: Global Market Insights) and the estimated share of the public sector.

End-user	2023 (USD Million)	Share of public sector (USD Million)
Restaurants/Pubs	1.179	
Hospitals and Healthcare Facilities	674	488
Educational Institutions	440	352
Commercial Kitchens and Catering	307	
Bars and Cafes	265	
Corporate Cafeterias	220	
Bakeries/Pastry Shops	154	
Others	320	
Total	**3.558**	**840**

4.2.1.4. Unit value

Professional dishwashers have a unit value that varies significantly depending on the Member State. Table 4-4 illustrates the range of unit values for non-domestic dishwashers for the Member States where data is available. The EU average unit value is €2,474. Notable differences exist between the main producing Member States, which could be attributed to the types of dishwashing machines predominantly manufactured in each country.

Table 4-4: Unit value of non-domestic dishwashing machines by country (Source: Prodcom)

Country	Unit value (in Euros)
Germany	5,127
Italy	1,582
Spain	1,647
Sweden	6,841
EU27 Total	**2,474**

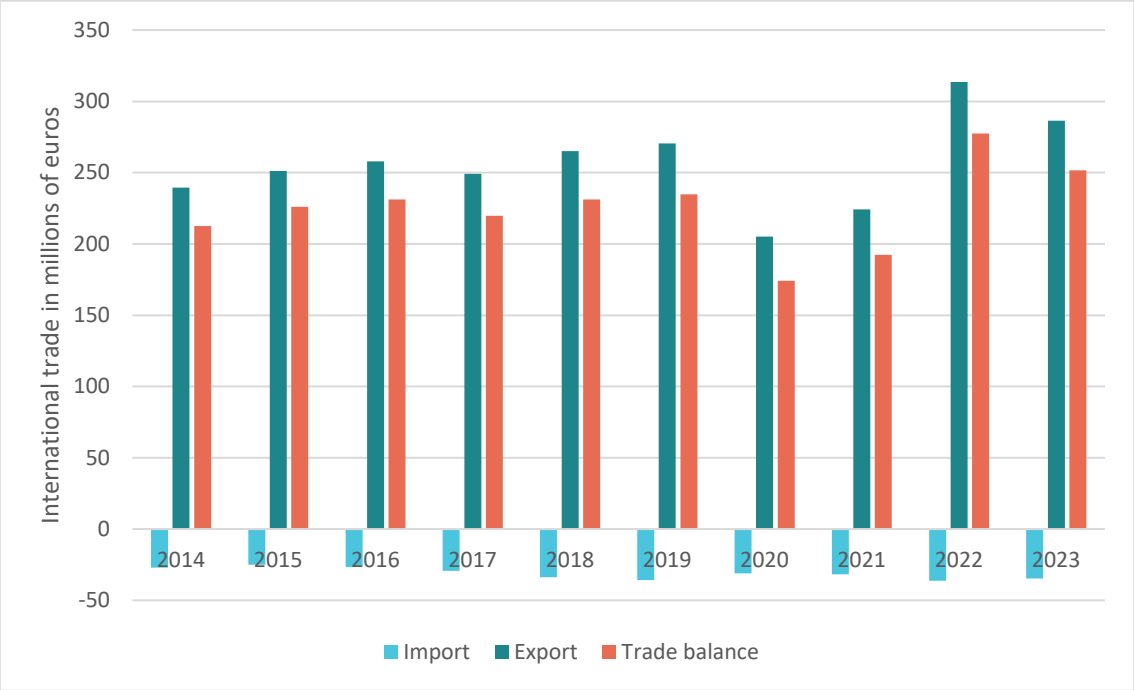
4.2.2. Extra-EU Trade

Table 4-5 presents the import and export values of trade with countries outside the EU27. Figure 4-3 clearly illustrates the trade balance, highlighting that the EU27 exports significantly more than it imports. Several countries were identified by more than one stakeholder as key destinations for EU27 dishwasher exports outside the EU27. These include Australia, Israel, Norway, Switzerland, the UK, and the USA.

Table 4-5: International trade in millions of Euros (Source: Comext)

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Import	26.9	25.0	26.6	29.3	33.9	35.9	31.0	31.8	36.2	34.6
Export	239.4	251.1	257.9	249.1	265.1	270.6	205.1	224.3	313.6	286.4
Trade balance	212.5	226.0	231.3	219.8	231.2	234.7	174.1	192.4	277.4	251.7

These figures show a clear dip during the COVID-19 pandemic. A recovery surge could explain why the values for 2022 are exceptionally high, even exceeding those of 2023. However, it remains to be seen in future years whether this decline from 2022 to 2023 will continue or stabilise.



(Source: Comext)

Figure 4-3: Import, export and trade balance of EU27 and countries outside of EU27

4.2.3. EU apparent consumption = production + import - export

Table 4-6 provides an overview of EU27 apparent consumption per country, calculated as production minus imports plus exports. For each country where production was ':', it has been assumed it is zero. This method is used because exact data is not available. However, it has led to some issues, as certain values show negative results. Poland, for example, exhibits a significant negative value. As mentioned earlier, it seems highly likely that Poland stopped reporting production data. For 2023, Poland's production data is recorded as 0, which could explain the large negative value.

Table 4-6: EU apparent consumption in value and quantity per country in 2023

	Value (in M€)	Quantity (in units)
Austria	21.2	6,538
Belgium	10.0	20,289
Bulgaria	1.3	2,998
Croatia	5.7	2,984
Cyprus	0.9	2,385
Czechia	9.5	-20,409
Denmark	10.7	-3,699
Estonia	1.3	-234
Finland	11.1	3,566
France	111.4	54,397
Germany	196.6	52,517
Greece	1.9	8,798
Hungary	4.4	6,255
Ireland	4.2	246
Italy	136.2	45,555
Latvia	1.1	601
Lithuania	0.1	-64
Luxembourg	3.9	1,136
Malta	0.7	1,162
Netherlands	35.9	9,755
Poland	-21.9	-23,100
Portugal	2.0	6,626
Romania	3.9	3,360
Slovakia	-3.8	-7,826
Slovenia	-1.7	-179
Spain	35.6	39,544
Sweden	30.3	6,939
EU27 Total	688.3	275,016

(Source: Prodcom)

4.3. Market and stock data

4.3.1. Average Product Life (in years), in service, and a rough indication of the spread (e.g. standard deviation)

Informed by the 2024 stakeholder consultation, the average estimated product lifespan is approximately 12 years, with a range extending from 7 to 17 years. However, it is important to note that differences exist between product types. Stakeholders were asked to estimate the average expected initial lifetime (in years) for each dishwasher category (without considering the extension of lifetime through refurbishment). The median of the results is shown in Table 4-7.

Table 4-7: Estimated lifespan according to stakeholder consultation from 2008 study and recent stakeholder consultation

Category	Product type	Estimated lifespan in years (2024)
Category 1	Undercounter water-change	12
Category 2	Undercounter one-tank	8
Category 3	Hood-type	8
Category 4	Utensil/Pot	9
Category 5	Conveyor-type one-tank	11
Category 6	Conveyor-type multi-tank	15

4.3.2. Installed base (‘stock’)

The number of professional dishwashers in stock should be determined by the accumulation of units entering and leaving the stock each year. This figure is unknown, as the number of units exported and imported at the EU27 level is not provided, neither by Prodcom (which reports trade figures per Member State, including intra-EU trade, which is not relevant for this study) nor by Comext (which provides data in value, but not in units). For this reason, we will use EU apparent consumption data (= production + import - export). This gives the total amount of goods available in the EU market, which includes both domestically produced and imported goods, minus the goods exported out of the EU.

The share of each category will be taken from the 2011 study as no recent available data is available. In this study, the NAFEM Size and Shape of the Industry Report 2010 was used, which is updated every two years. However, this report appears to be available as of 2012 only to members, so we could not access more recent data. The share of sales per category that is taken from the 2011 study is shown in Table 4-8.

Table 4-8: Share of sales per category

Category	Product type	Share of sales
1	Undercounter water-change	9%
2	Undercounter one-tank	59%
3	Hood-type	28%
4	Utensil/Pot	1%
5	Conveyor-type one-tank	3%
6	Conveyor-type multi-tank	1%

Source: North American Association of Food Equipment Manufacturers (2010) Size & Shape of the Industry Study Results: Full Report, reported: in DOE (2016) Energy Savings Potential and RD&D Opportunities for Commercial Building Appliances (2015 Update), available at https://www.energy.gov/sites/prod/files/2016/06/f32/DOE-BTO%20Comml%20Appl%20Report%20-%20Full%20Report_0.pdf, Table 4.3

In Table 4-9, an overview is given of the estimated amount of units sold per year. The stock is based on the share of sales and the lifespan of each category.

Table 4-9: Stock in 2023 based on share of sales and lifespan (in grey) of each category

		Category					
Year	EU27 Total (units)	1 (units)	2 (units)	3 (units)	4 (units)	5 (units)	6 (units)
2008	285,192	24,270	168,007	80,110	3,194	8,014	1,597
2009	198,162	16,864	116,737	55,664	2,219	5,568	1,110
2010	229,551	19,535	135,228	64,481	2,571	6,450	1,285
2011	221,021	18,809	130,203	62,085	2,475	6,211	1,238
2012	43,027	3,662	25,347	12,086	482	1,209	241
2013	111,600	9,497	65,744	31,348	1,250	3,136	625
2014	135,901	11,565	80,059	38,175	1,522	3,819	761
2015	183,849	15,646	108,305	51,643	2,059	5,166	1,030
2016	201,993	17,190	118,994	56,740	2,262	5,676	1,131
2017	266,542	22,683	157,020	74,872	2,985	7,490	1,493
2018	197,338	16,793	116,252	55,432	2,210	5,545	1,105
2019	242,883	20,669	143,082	68,226	2,720	6,825	1,360
2020	237,785	20,236	140,079	66,794	2,663	6,682	1,332
2021	278,957	23,739	164,334	78,359	3,124	7,839	1,562
2022	296,963	25,272	174,941	83,417	3,326	8,345	1,663
2023	275,016	23,404	162,012	77,252	3,080	7,728	1,540
Stock 2023	**2,077,125**	229,164	1,176,714	561,091	24,431	68,250	17,475

(Source: Prodcom)

4.3.3. Annual sales growth rate

Again, looking the measurement used in the EU sales and trade paragraph, since no sales value is available, the growth rate from 2022 to 2023 is -0.9%, while the average annual growth rate from 2014 to 2023 is 3.9%.

4.3.4. New & Replacement sales (derived)

To determine the replacement and new sales, the number of units in year 1 (calculated as 2023 – lifespan) is compared with the number of units at the end of their lifespan (2023). The lifespan varies by category, as shown in Table 4-8. For each category, we compare the sales in 2023 with the sales in year 1 (highlighted in grey) and sum the results across all categories. Consequently, the **total number of replacement sales in 2023 is 185,700 units**, while the **total number of new sales is 89,316 units**.

4.4. Market trends

4.4.1. General market trends

Manufacturer brochures and websites were analysed to identify important product-specific developments and trends in professional dishwashers, in order to update the information already gathered in the 2011 study.

4.4.1.1. Processing capacity

The Table 4-10 below provides the typical processing capacities of professional dishwashers, per cycle and per year.

Table 4-10: Processing capacity of professional dishwashers, per category

Product category	Number of dishes per cycle	Number of cycles per year	Number of dishes per year
1: Undercounter water-change	18 – 50	1,000	18,000 – 50,000
2: Undercounter one-tank	18 – 20	18,000 – 74,500	324,000 – 1,490,000
3: Hood-type	18 – 20	25,500 – 44,700	459,000 – 894,000
4: Utensil/pot	N/A	9,000 – 12,000	N/A
5: One-tank conveyor-type	2,000 – 3,600 dishes / hour	2,700 hours	5,400,000 – 9,720,000
6: Multi-tank conveyor-type	4,000 – 4,900 dishes / hour	2,700 hours	10,800,000 – 13,230,000

Source: Stakeholder feedback received during the second consultation September – October 2024

4.4.1.2. Energy and water consumption

The general evolution of the market goes in the direction of a reduction in energy and water consumption. The main argument is that of energy consumption, because of its high price.

The main technical features that lead to a reduction in **energy** consumption are listed in the Table 4-11 below.

Table 4-11: Claimed energy savings per technical feature of the machine

Technical feature	Claimed energy savings (%)
Heat recovery from wastewater	10
Heat recovery from condensation of process steam and from exhaust air	15
Heating using a heat pump instead of an electric resistor	35
Double-skinned construction	(not specified)

Source: Website of Winterhalter GmbH, accessed on 13 November 2024

The main technical features that lead to a reduction in **water** consumption are listed in the Table 4-12 below.

Table 4-12: Claimed water savings per technical feature of the machine

Technical feature	Claimed energy savings (%)
Water nozzle geometry	Up to 25
Eco programme	Up to 15

Source: Website of Winterhalter GmbH, accessed on 13 November 2024

4.4.1.3. Detergents

Some suppliers of professional dishwashers (mainly those targeting that market segment only) provide their own detergent products, whereas others rely on third-party suppliers.

The detergent products supplied by manufacturers of dishwashers perform the following functions:

- Washing;
- Rinsing and drying aids.

The rinsing and drying aids have become mainstream. They provide proper drying and good visual appearance of the substrates.

The market of detergent products evolves towards:

- Adaptation to the water ‘hardness’ (= concentration in calcium carbonate);
- Higher concentration;
- Recyclable plastic containers;
- Biodegradability;

- Avoidance of chlorine, of phosphates and of EDTA (Ethylenediaminetetraacetic acid, a chelator of calcium that is criticised for being poorly biodegradable, bio-accumulative[48] and toxic in case of ingestion);

4.4.1.4. Wastewater treatment

The treatment of the wastewater after its use in the machine is in general an integral part of the dishwasher, as it is the feature that enables the re-use of the water over several cycles (and hence a strong overall reduction in water use). The manufacturers hence increasingly offer in addition the filters and other equipments needed to perform this function.

4.4.1.5. Evolution of energy performance over time

Some stakeholders provided figures on the ratio between the energy consumption of the average **new** product and the energy consumption of the **average product installed**, i.e. in stock. The average age of the units in stock is close to half the lifetime duration of the product (as identified in section 4.3.1). This ratio is an indication on the progress made in energy consumption over that period of time. Table 4-13 below displays the figures provided by stakeholders. When a figure was provided by a manufacturer, this figure is retained. When no manufacturer provided data, the figures received from a technical university are provided, with the caveat that they may be of low reliability, considering the contradiction between the figures provided by that university compared to those by manufacturers in the cases where both are available.

Table 4-13: Ratio between energy consumption of new products and the average products in stock

Category of dishwasher	Ratio: Energy consumption of new product / Energy consumption of product in stock	Typical age of product in stock (= lifetime / 2)
1. Undercounter water-change	0.9	6 – 7.5 years
2. Undercounter one-tank	1.0	2.5 – 5 years
3. Hood-type	1.0	2.5 – 5 years
4. Utensil/pot dishwashers	0.95	2.5 – 5 years
5. One-tank conveyor-type	0.7*	5 – 6 years
6. Multi-tank conveyor-type	0.7*	5 – 6 years

(*) Low reliability: figures provided by technical university.

Source: Stakeholder consultation survey n°2, performed between September and October 2024.

[48] Margarete Bucheli-Witschel, Thomas Egli, Environmental fate and microbial degradation of aminopolycarboxylic acids, FEMS Microbiology Reviews, Volume 25, Issue 1, January 2001, Pages 69–106, https://doi.org/10.1111/j.1574-6976.2001.tb00572.x

4.4.1.6. Marketing of professional dishwashers and technological features

In relation to influencing customer behaviours, important aspects of manufacturers' communications regarding professional dishwashers are:

- Functionality (speed, hygiene, cleanliness and aspect of the washed cockery and utensils),
- economic and environmental aspects of the use phase (i.e. costs of energy and water consumption),
- comfort / ergonomics for the personnel using the machine.

4.4.2. Market channels and production structure

The professional dishwasher market is above all a business-to-business (B2B) market and has some key characteristics:

4.4.2.1. Sales and distribution

The majority of smaller manufacturers typically sell and distribute their products to catering equipment dealers/distributors who stock and sell several brands of professional dishwashers and usually other types of catering equipment supplies (ovens, refrigerators, plates, utensils, etc). This is particularly applicable for smaller machines such as the undercounter and hood-type machines. The catering equipment distribution and supplier network for small professional dishwasher machines is very convoluted as several supply routes are available depending on the type of end user, the end application and the type of machine bought. Because of the competition and the saturation of the market, the choice of distribution strategies is very important which is why many different ones have been developed. Machines may be purchased directly from the manufacturers, via wholesalers, various kinds of retailers or on the second-hand market. For this reason, manufacturers of small appliances generally do not keep close track of where their products end up.

Professional dishwashers sold directly to users from the manufacturer tend to be larger dishwashers (conveyor-type) and are usually tuned to customer-specific specifications or requirements upon purchase. They indeed require more intensive support services (training, servicing).

Catering equipment dealers often service and maintain the dishwasher products and can also be dedicated (affiliate) suppliers of one or a few particular dishwasher brands. They do not operate walk in shops but make site visits to the customers. Companies include mostly SMEs with large businesses as well comprising the operators. Equipment may be sold through several channels depending on the company: in dedicated retail outlets, online or as part of a full project management service.

4.4.2.2. Manufacturers

The B2B nature of the professional dishwasher market makes it much less transparent than the household dishwasher market. This poses difficulties when attempting to characterise the market in terms of sales, stock, prices and even brands. As there is not a large number of professional dishwasher manufacturers, it is considered relevant to list them for the sake of characterising the market.

The Table 4-14 below provides a non-exhaustive list of manufacturers, based on the members' lists of some national associations of equipment manufacturers. Companies identified as 'large' are those with presence in several Member States.

Table 4-14: Non-exhaustive list of EU-based manufacturers of professional dishwashers

Name of the company	Large company	Member State of headquarters
Miele & Cie. KG	Y	DE
Meiko	Y	DE
Hobart GmbH	Y	DE
Winterhalter Gastronom GmbH	Y	DE
Onnera S.Coop	Y	ES
ALI Group	Y	IT
Electrolux Professional AB	Y	SE
Nor:disk Clean Solutions AB	Y	SE
EKU Grossküchentechnik GmbH		DE
PALUX AG		DE
Stierlen GmbH		DE
Jemi S.A.		ES
Sammic S.L.		ES
Angelo Po Grandi Cucine s.p.a. (part of Marmon Retail Technologies Company)		IT – USA
Adler s.p.A.		IT
Aristarco S.p.A.		IT
BSD S.p.A		IT
Elframo S.p.A		IT
InoxBim		IT
Omniwash s.r.l.		IT
Silanos s.r.l		IT
SMEG S.p.A.		IT
Wexiödisk AB		SE

Source: Web sites of manufacturers' associations, consulted on 14 November 2024:

HKI - Industrieverband Haus-, Heiz- und Küchentechnik

EFCEM Italy

Branschforeningen For Storkoksleverantorer (BFS)

FELAC

In general, these companies provide **maintenance** and **repair** services of their own products, in addition to the manufacture of new products. In addition, the company sandoro GmbH, a subsidiary of Winterhalter, has been identified as performing **refurbishment** services, i.e. the processing of used equipment to make them into fully operational equipment with an extended lifetime.

4.4.2.3. Industry associations

The European Federation of Catering Equipment Manufacturers (EFCEM)[49] gathers the manufacturers of all catering equipment, which includes equipment for food preparation, cooking, refrigeration and washing of dishes and utensils. It is represented in the

[49] https://www.efcem.info/

European policy-making field by the federation of technology industries Orgalim[50]. Its national members are:

- SYNETAM - Union des Fabricants D'Equipements et D'Ustensiles pour les Arts Culinaires des Grandes Cuisines[51] (France)
- HKI - Industrieverband Haus-, Heiz- und Küchentechnik[52] (Germany)
- Verband der Hersteller von gewerblichen Geschirrspülmaschinen e.V.[53] (Germany)
- SEEME - (Association of Catering Equipment Companies)[54] (Greece)
- IFSA - Irish Foodservice Suppliers Alliance[55] (Ireland)
- EFCEM Italy[56] (Italy);
- BFSN - Bransjeforening for Storkjøkkenleverandører i Norge[57] (Norway)
- APIRAC[58] (Portugal);
- Branschforeningen For Storkoksleverantorer (BFS)[59] (Sweden);
- FELAC - Federación Española de Asociaciones de Fabricantes de Maquinaria para Hostelería, Colectividades e Industrias Afines[60] (Spain)
- FEA - Food Service Equipment Association[61] (United Kingdom).

50 https://orgalim.eu/en/

51 http://www.syneg.org/

52 http://hki-online.de/de

53 https://vgg-online.de/

54 https://seeme.com.gr/

55 http://www.ifsa.eu.com/

56 http://www.efcemitalia.it/

57 http://www.bfsn.no/

58 http://www.apirac.pt/

59 http://bfs.se/

60 http://www.felac.com/

61 http://www.fea.org.uk/

4.4.3. Trends in product design / features

The consultation of manufacturers in 2024 provided the feedback of Table 4-15 below on the presence of resource-saving technical features of professional dishwashers (saving of energy or of materials – along the Circular Economy paradigm).

Table 4-15: Presence of resource-saving technical features of professional dishwashers

Technical feature	Category of feature	Number of manufacturers citing the feature as present	
		in their products	in all products of the market
Heat exchanger	Energy saving	7	5
Automatic dosing of detergents	Detergent saving	7	5
Improved thermal insulation	Energy saving	7	5
Improved rinsing systems	Customer satisfaction	7	3
Improved maintainability / repairability / capacity to be upgraded or refurbished (ease of dis-assembly and re-assembly, ease of access to servicing area, modular design)	Circular Economy	6	5
Additional warm/hot water connection	Energy saving	6	4
Waste water heat recovery	Energy saving	6	4
Improved ergonomics of operation (load carrying, temperature, humidity, noise)	Working conditions	6	3
Heat pump	Energy saving	4	2
Steam-operated heating	Energy saving	4	2
Recovery of wash water	Water saving	3	3
Wash process with lower temperature	Energy saving	3	2
Electronic stop controls (disconnect the machine from the mains supply at programme end or after last user activity)	Energy saving	3	2
Reduced wear and stress imposed on dishes / utensils	Circular Economy	3	0
Use of recycled metals	Circular Economy	2	2
Improved recyclability (avoidance or clear marking of substances of concern, separability of parts made of different materials)	Circular Economy	2	1
Automatic adaptation of programme to load and to soiling level of dishes / utensils	Energy + water + detergent saving	2	0
Automatic weigthing system/ automatic load control	Energy + water + detergent saving	1	1
Gas-operated heating	Energy saving	0	1
Use of recycled plastics	Circular Economy	0	0

Source: Stakeholder consultation survey n°2, performed between September and October 2024. A total of 7 manufacturers provided answers to these questions.

As can be seen in this table, the features most implemented relate to energy and water saving, which has an immediately positive impact on operating costs by the customer. Similarly, the Circular Economy feature most implemented relates to ease of maintenance and repair, which has a direct impact on availability of the appliance, and hence on the daily operations of the customer. On the other hand, features having mainly an environmental impact but none on the customer's experience or profit (e.g. use of recycled materials, recyclability) are less popular.

4.4.4. Innovations

The study enabled the consultant team to identify some innovative concepts in the field of professional dishwashing. Further BAT will be described in Task 4.

4.4.4.1. Granule dishwashing

The Swedish-based company Nor:disk developed **granule-based** dishwashing for the removal of dirt from cooking utensils, which often are difficult to clean[62]. The granules are used as a complement to water and detergent, and do not replace them. The cylinder-shaped granules have been developed to have the adequate shape, density and hardness to remove dirt, while still preserving the surface of the utensils. They are used in conjunction with a dedicated family of dishwashers and exist in two versions: fossil-based plastics and a 'bio' version based on calcium salt, rapeseed oil and biodegradable polyesters that is claimed to be biodegradable in soils.

4.5. Consumer expenditure base data

4.5.1. Average EU end-user prices

The average unit price of dishwashing equipment, based on Eurostat data, is provided in section 4.2.1.4 above. An investigation made in the online catalogues of resellers of products led to the maximum end-user prices per segment listed in Table 4-16 below.

62 https://www.nordiskclean.com/products-services/products/

Table 4-16 Observed end-user prices of professional dishwashers

Product category	Minimum observed price (EUR exl. VAT)	Maximum observed price (EUR exl. VAT)	Member State and reseller
1: Undercounter water-change	1,632.00	4,290.00	FR (Pro-Electro)
1: Undercounter water-change 2: Undercounter one-tank °	975.74	6,798.00	FR (Metro)
	1,556.00	5,249.00	DE (Gastro Hero)
	1,486.13	4,167.00	EE (FourniResto)
	995.99	6,527.99	UK* (Industrial Warewashers.com)
	1,319.52	2,778.19	PL (GastroProdukt)
2: Undercounter one-tank	1,770.00	9,547.00	FR (Pro-Electro)
3: Hood-type	1,640.27	10,921.00	FR (Metro)
	2,727.00	11,298.00	DE (Gastro Hero)
	1,799.99	16,799.99	UK* (Industrial Warewashers.com)
	5,679.00	18,434.00	FR (Pro-Electro)
4: Utensil/pot dishwashers	2,346.00	15,497.99	UK* (Industrial Warewashers.com)
	3,609.00	16,679.00	DE (Gastro Hero)
	8,069.00	18,929.00	FR (Pro-Electro)
5: One-tank conveyor-type	10,679.99	15,899.99	UK* (Industrial Warewashers.com)
	11,249.00	15,749.00	DE (Gastro Hero)
6: Multi-tank conveyor-type	17,299.99	28,649.99	UK* (Industrial Warewashers.com)
	13,069.00	32,449.00	DE (Gastro Hero)

(°) Online sellers often do not provide in a clear way whether the dishwasher uses freshwater or a recycled water tank

(*) Based on 1 GBP = 1.20 EUR (Source European Central Bank: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-gbp.en.html)

Souce: Own elaboration, based on consultation of online suppliers of dishwashers performed on 18 November 2024

4.5.2. Consumer prices of consumables

4.5.2.1. Electricity costs

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). Two consumption bands for the electricity rate at industrial rates (IA – < 20 MWh and IB – 20-499 MWh) are presented below. These are the relevant consumption bands for the professional dishwashers, as results from the computations made in Tasks 3 and 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[63].

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 4-17 and Table 4-18) hence present the price of electricity at two dates:

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

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

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

Table 4-17. Price of electric energy for non-household uses, in EUR/kWh (prices excluding VAT and other recoverable taxes and levies), Consumption band IA = annual consumption below 20 MWh

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
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 4-18: Price of electric energy for non-household uses, in EUR/kWh (prices excluding VAT and other recoverable taxes and levies), Consumption band IB = annual consumption from 20 MWh to 499 MWh

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
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

4.5.2.2. Water costs

The New International Benchmarking Network for Water and Sanitation Services (New IBNet)[64], set up by the World Bank, provides an international benchmark for the price of water, by obtaining data from utilities. The Table 4-19 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 EU 27 Member States (except Ireland).

Table 4-19: Average, minimum and maximum prices of water from utilities in EU Member States, in EUR / m^3, for a consumption of 15 m^3 / month

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)

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

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

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

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.

4.5.2.3. Detergent costs

The market in Europe (European Union 27 + UK + CH + NO) for household detergents for dishwashing was split in 2023, as described by the European Association of detergents and maintenance products (AISE), is summarised in Table 4-20 below.

Table 4-20: EU (+UK+CH+NO) market of household detergents for dishwashing, 2023

Category of household dishwashing detergent	Value of European market in 2023 (EUR bio.)	% of total
Automatic dishwashing	3.6	62.1%
Hand dishwashing	2.2	37.9%
All	5.8	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 'kitchen and catering' detergents is however provided, and amounted to **EUR 2.0 bio.** in 2023, experiencing a +6% growth compared to 2022 values.

The investigation of online resellers leads to the prices per litre of washing detergents and of rinsing agents in the Table 4-21 below.

Table 4-21: Prices per litre of washing detergent and of rinsing agents

Type of product	Minimum observed price (EUR excl.VAT / litre)	Maximum observed price (EUR excl.VAT / litre)	Member State and reseller
Washing detergent	3.90	3.90	FR (Best-Hygiene.com)
	4.09	6.67	DE (Gastro-Hero)
	1.87	5.82	FR (RueDeLHygiene.fr)
	3.40	4.10	DE (Intergastro.de)
Rinsing agent	2.80	2.80	FR (Best-Hygiene.com)
	3.90	4.91	FR (RueDeLHygiene.fr)
	2.15	7.00	DE (Intergastro.de)

Source:Consultation of online resellers of detergent products, consulted 18 November 2024

From the composition of some 'packaged deals' offered online[65], it appears that ca. 6 to 7 litres of washing detergent are used for 1 litre of rinsing agent. The amount of detergent (and of rinsing agent) needed per cycle or per dish were not provided in the information collected.

[65] E.g. https://www.chefook.com/fr/produits-de-lavage/

4.5.3. Repair and Maintenance costs

In the previous preparatory study of 2011, stakeholders had commented that service contracts are usually included as part of the purchase of professional dishwashing products. The exact nature of the contracts can vary and depends on the type of equipment, complexity and capital cost. Normally, more sophisticated and expensive machines 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 the manufacturers. For larger more complex products, especially conveyor-type dishwashers, the manufacturer typically services the product as these products are also typically sold directly from the manufacturer themselves.

As a preliminary estimate of the maintenance and service costs of professional dish-washing appliances, an indication can be taken from the size of the new equipment market versus the 'spares and service' (spare parts including accessories, repairs and maintenance) market in the UK. In total, the UK spares and service market was 44% of the value of the new foodservice equipment market in 2006.[66] This indicates that for the entire lifetime of a foodservice product, the total **maintenance costs are 44% of the initial purchase costs**. This value will be used to estimate the life cycle costs of dishwashing products later in the study (it is therefore assumed that the professional dishwashers have average maintenance and repairs costs, in comparison with other foodservice equipment, including prime cooking and refrigeration equipment).

Stakeholders have commented that the most common items for maintenance on professional dishwasher products are water pumps, control panels, heating elements and doors. All of these components in professional dishwashers are easily replaceable and generally justify maintenance rather than replacing the entire dishwasher. According to manufacturers, the most common cause for professional dishwasher breaking is operator misuse or abuse.

4.5.4. Installation costs

The installation costs apply only for the larger equipment (categories 5 and 6: conveyor dishwashers). The stakeholders provided no data in the survey regarding these installation costs.

[66] Catering Equipment Suppliers' Association (CESA) 2007, The UK Market for Foodservice Equipment – The authoritative report on the UK market

4.5.5. Disposal tariffs/ taxes (€/product);

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

Stakeholders have commented that many professional dishwasher units can be refurbished and resold as second-hand products by dealers in a fairly buoyant second-hand market (around 5-10% of the annual sales, according to manufacturers' estimates). These products generally are given new water pumps, control panels and heating elements, as the most common items to fail.

According to stakeholders, dishwashers that are not refurbished are almost always recycled for scrap parts. A large majority of the materials in professional dishwashers 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 dishwashers on purchase and delivery for new dishwashers, and may even provide the customer with a discount for the salvaged product.

As a result, this study will assume the disposal costs for professional dishwashers are 0 Euro per product.

4.6. Recommendations

4.6.1. Refined product scope from the economical/ commercial perspective

No market has been identified as 'niche' in the study. The larger the appliances (typically: categories 5 and 6 – conveyor dishwashers), the smaller their numbers. However, their processing capacity per unit and duration of operation per year result in an annual througuput that is also ca. 10 times larger (cf. section 4.4.1.1). Thus, the environmental impact of the whole stock of these appliances needs to be assessed in detail further in the study to check whether they deserve being discarded from the scope of the study or not.

4.6.2. Barriers and opportunities for Ecodesign from the economical/ commercial perspective

Based on the the technical features already present in the existing products on the market (cf. section 4.4.3), the main opportunities for ecodesign could consist in:

1. Consolidating the already dominant features to ensure that they are the norm for <u>all</u> products present on the market:
   (a) Wastewater heat recovery using a heat exchanger
   (b) Automatic dosing of detergents

(c) Improved thermal insulation

(d) Improved maintainability / repairability / capacity to be upgraded or refurbished (ease of dis-assembly and re-assembly, ease of access to servicing area, modular design)

(e) Additional warm/hot water connection

2. Introducing some features that would provide a clear environmental benefit, even if they still are not often present:

(a) Use of recycled metals

(b) Improved recyclability (avoidance or clear marking of substances of concern, separability of parts made of different materials)

4.7. Open questions to stakeholders

The following questions found no answer in publicly-available documents and in the feedback received in the stakeholder survey. They would deserve being asked again to stakeholders:

- What is the split, in number of units, between the production of each category of professional dishwashers?
- What is the share of sales made (directly or indirectly) to public sector customers?
- What are the installation costs, in absolute value or as share of the price of the dishwashing machine itself?
- What are the recent figures for repair and maintenance costs, in absolute value or as share of the price of the dishwashing machine itself?
- What is the quantity of detergent (and of rinsing agent) needed per cycle or per dish?

5. MEErP Task 3 – Users

5.1. Objectives of MEErP Task 3

Objective of MEErP Task 3 is the identification, retrieval and analysis of data on user (= professional customers) behaviour and associated environmental impacts during the use phase of professional dishwashers in scope. User behaviour can be influenced by product design and information. Relevant user parameters are an important input for the assessment of the environmental impacts of the products in scope during their use and end-of-life phase. Task 3 of the MEErP deals with system aspects of the use phase of ErP with direct or indirect energy consumption effect. In addition, the consumption of water and detergents as well as the occurrence of microplastics in the wastewater stream from dishwashers plays a role in this type of appliance. Further, information on the End-of-Life behaviour and local infrastructure in the context of professional dishwashers is collected in this task.

In the 2011 preparatory study, it was clearly identified that the energy and water consumption in the use phase were most relevant for many of the environmental impacts investigated for professional dishwashers. However, at that time there were no test standards available to measure the performance of professional dishwashers on a comparable basis. The data provided by different stakeholders were not based on standardised values. Against this background, MEErP Task 3 focuses its analysis on the question if there are significant differences between the ideal consumption (as stated in some of the technical data sheets) and the consumption in practice during the use phase. The aim of this preparatory study is also to investigate whether more precise values can now be determined for the parameters that could not be specified in the 2011 preparatory study or could only be specified on the basis of assumptions, if the standards developed in the meantime are now applied.

Compared to household dishwashers, professional dishwashers are very expensive to purchase and are used more intensively or for significantly longer periods of time. As a result, and due to the fact that the use phase of the appliances accounts for a large part of the total energy consumption and most of the environmental pollution, there is a fundamental risk that existing appliances will be operated with significant efficiency disadvantages compared to new appliances. Against this background, this work package should also examine the extent to which users are willing to refurbish their existing equipment or, conversely, to purchase refurbished appliances if this measure can bring existing equipment up to the efficiency standard of new appliances. Finally, in order to facilitate the potential modelling of impacts on the repair sector in the Impact Assessment support study, Task 3 will also seek for information with regard to the average number of hours per year for maintenance and/or repair of the appliances.

5.2. Applications, typical capacity and use intensity of professional dishwashers

5.2.1. Applications and market segments

Different customer requirements result in a range of professional dishwasher categories available on the market. Table 5-1 gives an overview of the main applications and the respective capacity ranges of these dishwasher categories thus providing a first indication of a possible use intensity of professional dishwashers. As mentioned in section 4.2.1.3 above, there is little data on the public market share for professional dishwashers and further feedback from stakeholders is welcome.

Table 5-1: Main applications and market segments of professional dishwashers according to spatial requirements

Dishwasher category	Applications / Market Segments	Main operator / User type	Spatial requirements
No 1 Undercounter water-change	Bars, bistros, (small) restaurants, offices, community centres, clubhouses, motorway service areas, hospitals, hotels, bed & breakfasts, institutional kitchens, Kindergartens & pre-schools, schools, supermarkets	Mainly private customers and non trained personnel (with few exemptions)	Rather limited space available / required
No 2 Undercounter one-tank	(Small) restaurants, hotels, conference centres, bars, clubhouses, gas filling stations, motorway service areas, day-care-homes, bakeries, butcheries, old age homes	Non and trained personnel	Rather limited space available / required
No 3 Hood-type	Institutional kitchens, care homes, bars, school and small company canteens, filling stations, motorway service areas, restaurants, bakeries, butcheries	Non and trained personnel	Requires a medium amount of space. Used in separate kitchen or dishwashing rooms
No 4 Utensil/Pot	Institutional kitchens, bread and bakery, industry butcheries, hypermarkets	Trained personnel	Requires a medium amount of space
No 5 Conveyor-type one-tank	Medium company canteens, hospitals, cafeterias, caterers, hotels	Trained personnel	Requries a medium to large amount of space
No 6 Conveyor-type multi-tank	Large company canteens, hospitals, cafeterias, caterers	Trained personnel	Requires a large amount of space

Source: Task 3 report of Lot 24, 2011

According to the Task 3 report of the 2011 preparatory study the six categories of professional dishwashers are used in the following segments – assuming that this has not changed over time:

Undercounter water-change appliances (category 1) are mostly used in semi-professional contexts like bars, small restaurants or offices with mainly non trained personnel. The machines are very similar to dishwashers for household use (both technologically and with regard to user conditions) and are usually used if the conditions are equivalent or similar to household conditions, e.g. only a rather small amount of wash ware is to be cleaned per day and time does not matter as much as in other professional

applications (cycle times are longer compared to tank machines, however much shorter than in household dishwashers).

Undercounter tank machines (category 2) are usually used by non-trained, but also trained persons in bars, bistros, small restaurants, offices, clubhouses, hotels, conference centres, gas stations, motorway service stations, day-care homes, bakeries, butcheries and elderly homes. Due to the shorter cycle time, they have a higher capacity than professional water-change models. They make only sense if a certain amount of wash ware has to be cleaned as the water in the tank has to be heated and the dishwasher is kept in 'ready to use' mode between the dishwashing cycles.

Hood-type dishwashers (category 3) are more ergonomically to handle compared to undercounter dishwashers as the baskets are put on a table next to the dishwasher and pushed into the machine after loading. The filled (quite heavy) basket usually does not have to be carried by the user but only the empty ones. They are used if enough space is available and usually if more wash ware is to be cleaned compared to undercounter dishwashers. They are more seldom used in small restaurants or bars. Users are non-trained, but also trained persons.

Utensil/pot dishwashers (category 4) are used to clean heavily soiled pots and pans and other large utensils. They are used by trained personnel in institutional kitchens, restaurants, bread and bakery industries, butcheries, hypermarkets etc.

Conveyor-type dishwashers with one or more tanks (categories 5 and 6) require a relatively large number of items to be cleaned per day and also a large amount of space. They are only used by trained staff in medium and large company canteens, hospitals, caterers, and hotels.

5.2.2. Use intensity of professional dishwasher categories

5.2.2.1. Capacity range of professional dishwashers

Table 5-2 below gives an overview of the capacity ranges, i.e. the annual number of dishes washed, for the different categories of professional dishwashers. The left column shows the data from the 2011 preparatory study, while the right column shows the feedback retrieved from the stakeholder consultation and an analysis of product data sheets.

It appears that the performance information is not based on standard methods (at least they are not mentioned); some data sheets include a note that the values given may vary depending on local conditions (water inlet temperature / power supply) and feedback from one manufacturer in the stakeholder consultation is that they don't have information on operator usage that would give a typical standard or average as the real application varies widely from operator to operator.

Table 5-2: Capacity ranges and typical capacities of the six categories of professional dishwashers

Dishwasher category	Capacity range (in brackets: typical capacity); values 2011 [dishes/hour]	Capacity range (in brackets: typical capacity); updated values 2024 [dishes/hour][67]
No 1 Undercounter water-change	80-300[68] **(200)**	285-500 **(285)**
No 2 Undercounter one-tank	300-800 **(550)**	220-850 **(550)**
No 3 Hood-type	500-1,300 **(860)**	180-2,160 **(1,080)**
No 4 Utensil/Pot	10-30 cycles/ hour[69] **(20 cycles/ hour)**	4-40 cycles/hour **(15 cycles/hour)**
No 5 Conveyor-type one-tank	1,500-2,000[70] **(1,750)**	800-2,520 **(1,800)**
No 6 Conveyor-type multi-tank	1,700-6,000[71] **(3,600)**	900-8,000 **(3,600)**

Sources: left column: Task 3 report of Lot 24, 2011; right column: stakeholder consultation and review of manufacturers' product datasheets, 2024

[67] According to the analysed product datasheets, capacity is mostly given in 'racks per hour' with 18 dishes (standard plates) per rack (categories 2, 3, 5 and 6). For category 1, a conversion factor of 19 dishes per rack was found in the datasheets.

[68] Different throughput rates with cold water supply at 15°C or cold and hot water supply (hot water 65°C).

[69] The capacity of utensil/pot dishwashers is measured in cycles per hour as no dishes but large cooking utensils are cleaned that considerably vary in size.

[70] Some dishwashers of category 5 on the market use extreme high capacity of up to 5,000 dishes per hour. This is however not considered as 'typical' capacity range.

[71] Some dishwashers of category 6 on the market use extreme high capacity of up to 14,000 dishes per hour. This is however not considered as 'typical' capacity range.

Based on a review of product datasheets for category 1 (undercounter water-change), it appears that there is no typical average capacity, but that there are rather two capacity classes; a smaller one with approximately 285 dishes per hour (15 racks per hour) and a larger one of approximately 456 dishes per hour (24 racks per hour), calculated at 19 plates per rack. For the purposes of this study, it is assumed that the smaller category is more prevalent in the market and is therefore taken as the typical capacity. According to stakeholder feedback, this type of machine, unlike the other categories, cleans 2 to 3 baskets at a time. The load per wash cycle is therefore very mixed. In the other categories, each basket tends to be washed with a single type of dishes.

For category 2, the initial values of the 2011 preparatory study were mostly confirmed by the stakeholder consultation of 2024. Depending on the product portfolio of individual manufacturers, the capacity range has widened slightly at the lower and the upper limits. Feedback on the typical capacity was still around 540, 550 or 600 dishes per hour with one manufacturer stating that these figures were only theoretical and would be lower (more like 360 dishes per hour) if loading and unloading of the machine was taken into account. Another manufacturer stated that in recent years, for category 2, programmes with lower productivity (as low as 72 dishes/hour) have been required to achieve more stringent hygienic results. This is also applies to category 3.

For category 3 (hood-type), the analysis of the data sheets now shows a wider range compared to the 2011 data. Hood-type dishwashers with a capacity of 10 racks per hour, i.e. 180 dishes per hour, were found at the lower end and machines with a capacity of 120 racks per hour, i.e. 2160 dishes per hour at the upper end. The typical capacity within this range seems to be 60 racks per hour, i.e. 1080 dishes per hour. These capacities are those given in the product data sheets for plates; for cleaning glassware, the capacities of the machines appear to be higher.

Based on stakeholder feedback and a review of product datasheets for category 4 (utensils/pots), the overall capacity range for this category has also widened compared to the 2011 data. At the lower end, there could be as few as 4 racks per hour, while at the upper end, there were very large machines with up to 40 racks per hour were found. Stakeholder feedback suggested a typical capacity of 10 to 15 cycles per hour.

For category 5 (conveyor belt), stakeholder feedback largely confirmed the initial 2011 data for the typical capacity (1600 or 1800 dishes per hour). The overall capacity range has widened at the lower and the upper end (double rack machines with up to 140 racks per hour) compared to 2011. For category 6, some stakeholders confirmed the initial 2011 data including the typical capacity, while also providing data on a wider range at both the lower and upper ends. In both categories, lower productivity programmes have been required in recent years to achieve more stringent hygiene results. One stakeholder commented that for category 6, it does not make much sense from a technical point of view to mix ‘belt’ and ‘basket’ machines in the same category.

5.2.2.2. Annual number of dishes washed

For comparison, Table 5-3 still shows the estimated use intensity in cleaned dishes per year for the different categories of professional dishwashers as presented in the **2011 preparatory study**. The data are based on the following parameters:

- Maximum capacity: number of dishes per cycle (categories 1, 2 and 3) and number of dishes per hour (categories 5 and 6),
- number of wash cycles per day (applicable to categories 1 to 4),
- estimated time span per day in active mode,
- estimated number of working days per year, and
- estimated typical workload (in %).

These input data were used to calculate the annual number of dishes[72] (category 4: cycles) cleaned per category, which served as input for the further calculations of the energy, water and detergent consumption per dish and/or per cycle and also per year under ideal and real conditions.

[72] For comparison of the capacity rating and typical use intensities of professional dishwasher categories, the term ‘dishes’ usually refers to standard sized plates of the same size.

Table 5-3: Typical intensity of use of the different dishwasher categories (2011)

Dishwasher category	Average capacity per cycle or per hour[73]	Number of cycles per day	Time in active mode per day[74]	Working days per year	Typical workload of basket/belt[75]	Number of dishes / cycles per year
No 1 Undercounter water-change	30 dishes/cycle[76]	5	1h 30	200	80%	24,000 dishes
No 2 Undercounter one-tank	18 dishes/cycle	55	1h 50	300	80%	237,600 dishes
No 3 Hood-type	18 dishes/cycle	80	2h 40	300	80%	345,600 dishes
No 4 Utensil/Pot	not applicable	30	2h 08	300	60%	9,000 cycles
No 5 Conveyor-type one-tank	1,750 dishes/hour	not applicable	3h 30	330	75%	1,515,900 dishes
No 6 Conveyor-type multi-tank	3,600 dishes/hour	not applicable	4h 30	330	75%	4,009,500 dishes

Based on the updated typical capacities in Table 5-2 above and further stakeholder feedback from the 2024 online survey, Table 5-4 shows an update of the estimated use intensity in cleaned dishes per year for the different categories of professional dishwashers that will be used for the further purposes of this study.

[73] In case of rack (basket) dishwashers the capacity is mostly given in 'racks per hour'. In case of belt conveyor dishwashers the capacity is given in dishes per hour. Here, 'dishes per hour' is chosen to make the numbers comparable between the categories and because the capacity in racks per hour is ambiguous as the rack size (i.e. the number of dishes per rack) varies between manufacturers. Assumed conversion factors in the 2011 study: 30 dishes per rack (category 1) and 18 dishes per rack (categories 2, 3, 5 and 6).

[74] Calculations based on stakeholder feedback (2011) with regard to distributed usage of different programme durations.

[75] The typical workload is included in this table to calculate the typical number of dishes cleaned per year. Its influence on the specific consumption values will be considered in the following sections.

[76] Undercounter water-change dishwashers work with two or three baskets. These are usually designed for a mixed loading, i.e. including cups, saucers, large and small plates plus cutlery. For reasons of better comparability with the other dishwasher categories in the 2011 preparatory study a capacity of 30 dishes was taken as basis.

Table 5-4: Typical intensity of use of the different dishwasher categories (2024)

Dishwasher category	Typical capacity	Number of cycles per day	Time in active mode per day[77]	Working days per year	Typical workload of basket/belt [78]	Number of dishes / cycles per year
No 1 Undercounter water-change	50 dishes/cycle (stakeholder feedback)	5	1h 00 to 1h 30	200	75%	37,500 dishes
No 2 Undercounter one-tank	550 dishes/hour (see Table 5-2)	--	2h 00	300	80%	264,000 dishes
No 3 Hood-type	1,080 dishes/hour (see Table 5-2)	100	2h 40	300	80%	691,200 dishes
No 4 Utensil/Pot	15 cycles/hour (see Table 5-2)	60	4h 00	300	60%	10,800 cycles
No 5 Conveyor-type one-tank	1,800 dishes/hour (see Table 5-2)	not applicable	9h 00	330	80%	4,276,800 dishes
No 6 Conveyor-type multi-tank	3,600 dishes/hour (see Table 5-2)	not applicable	9h 00	330	80%	8,553,600 dishes

Text in red: updated data compared to 2011 values

For category 1 (undercounter water-change), calculations using the typical capacities shown in Table 5-2 (285 dishes per hour when cleaning 15 racks of 19 plates per hour), assuming one hour per day and the same values for working days per year and percentage of work load, would result in a slightly higher number of 42,750 dishes cleaned per year than the values provided by stakeholders as shown in Table 5-4 above.

Stakeholder feedback on category 2 (undercounter one-tank) was contradictory, probably because the number of cycles per day depends strongly on the type of foodservice operation and the overall capacity of the dishwasher used. While few stakeholders agreed with the initial 2011 values as an average normal use, one stakeholder considered the initial 55 cycles per day to be probably above average; also because not always standard dishes / plates are washed but other objects (glasses, cups, …). On the contrary, one stakeholder suggests that 250 cycles per day and 5 hours per day in active mode should be considered as average. Another stakeholder suggests 3 hours per day in active mode for chains or heavy duty, which would result in 388,800 dishes per year, which would be significantly higher than the 2011 data. Finally, one stakeholder's suggests 40 racks per hour (assuming 18 dishes per rack) and 1,5 hours per day in active mode, resulting in 259,200 dishes per year. However, 720 dishes per hour) would be significantly higher than the typical capacity shown in Table 5-2 (550 dishes per hour), which is also based on stakeholder feedback.

Based on this information, a slightly higher usage intensity seems to be given compared to the 2011 data; for further calculcations for this category of professional dishwashers, a typical capacity of 550 dishes per hour and 2 hours of active mode time is taken into account, resulting in 264,000 dishes cleaned per year; this value is used as the updated basis.

[77] Based on stakeholder feedback (2024)

[78] The typical workload is included in this table to calculate the typical number of dishes cleaned per year. Its influence on the specific consumption values will be considered in the following sections.

For category 3 (hood-type), some stakeholders agreed with the initial values from the 2011 study as an average for normal use. However, there was also feedback that 80 cycles per day was probably an underestimate, with one stakeholder suggesting that 150 cycles per day and 3 h 50 per day in active mode should be consider. For heavy use, another stakeholder suggests a working time of 4.5 hours per day, resulting in 800,000 dishes to be cleaned per year. On the other hand, in its product brochure, the manufacturer Hobart uses 100 cycles per day at 2,160 dishes per hour and 312 working days per year to calculate the energy savings of its hood-type machine[79]. One stakeholder suggests 60 racks per hour at 18 dishes per rack (which would be in line with the typical usage intensity for this category as shown in Table 5-2); with the initial 2.40 hours, this would result in 691,200 dishes per year; this updated value will be taken for the further purpose of this study.

For category 4 (utensils/pots), some stakeholders agreed with the initial values presented in the 2011 study. Another stakeholder suggested a higher number of hours in active mode (4 hours per day). Using a typical capacity of 15 cycles per hour as shown in Table 5-2, this results in 60 cycles per day and 10,800 cleaning cycles per year, slightly higher than the 2011 values. However, one stakeholder commented for this category of professional dishwashers that the number of cycles per day depends very much on the typology of the end user (butchery, bakery, food lab, or other).

For categories 5 and 6, one stakeholder confirmed the initial data from the 2011 study, another one sees too much variability in the applications to make a meaningful estimate. One stakeholder considers that the time in active mode should not be considered less than 9 hours per day. One stakeholder considers the typical basket or conveyor load for these dishwasher types to be 80% rather than 75% and the typical capacity to be slightly lower for category 5 (1,600 dishes per hour) and higher for category 6 (4,500 dishes per hour) compared to the 2011 values. To calculate the updated data, the typical capacity values as shown in Table 5-2 were taken, and the other data were replaced by the stakeholder input. In particular, due to the estimated longer time in active mode per day, the total number of dishes cleaned per year with these machine types more than doubles compared to the 2011 values.

5.2.3. Detergent consumption

According to the preparatory study of 2011, the use of the types of detergents and rinse aids available depends on the type and size of the dishwashing machine, but in the majority of professional dishwashing machines the dosage of the detergent and rinse aid is made automatically. There is a focus on safe dosing applications via closed systems, i.e. no customer contact with the product.

[79] Source: https://www.hobart-spuelmaschinen-gastroxtrem.de/media/pdf/f9/94/0f/HB_146232cfc1702d03_Prospekt_PR-778-K_AUP.pdf, page 10

According to 2024 stakeholder feedback, the category 1 dishwashers typically use a detergent and rinse aid in one product, mainly in powder or tablet form. Categories 2 to 6 mainly use liquid dosing, or alternatively solids in an automatic dosing system.

According to the 2011 preparatory study, there are differences in water hardness across Europe and even within countries. These result in the need for different detergents products or different dosing levels to cope with the water hardness. Country differences also exist in the type of soil that needs to be cleaned. For example, Germany tends to need products that can handle with high levels of starch whereas the UK is more concerned with tea and coffee staining and the ability to clean them. Customer perception of product effectiveness can depend on whether the product can clean these specific soils. Together with different cost acceptance by customers, these lead to significant variations in product dosage over various European countries.

The 2011 preparatory study stated that the concentration of detergent is usually between 2 and 4 g/litre and the concentration of rinse aid is about 0.2 to 0.5 g/litre. During the course of that study, stakeholders agreed on an average value for the composition and the use of detergent and rinse aid across different EU countries. Therefore, for all dishwasher categories the following concentration values have been taken: concentration of detergent: 3.00 g/litre, and concentration of rinse aid: 0.35 g/litre (see update below). Rinse aid consumption will not be regarded separately. It is assumed that rinse aid is directly correlated with the water and detergent consumption and therefore it is integrated with the detergent consumption. An integrated detergent and rinse aid concentration of 3.35 g/litre was assumed in 2011.

One stakeholder in the 2024 consultation stated that, to their knowledge, the concentration of both detergents and rinse aids has decreased over the years. The products (which are then diluted in the dishwasher) are more concentrated for sustainability reasons and, therefore, need to be diluted more before use. Another stakeholder suggested a concentration of 0.30 g/litre for the rinse aid (0.1 g/litre for machines with a reverse osmosis system).

- Concentration of detergent: 3.00 g/litre,
- Concentration of rinse aid: 0.30 g/litre.

In absence of updated data on detergent concentration, the current preparatory study uses an **integrated detergent and rinse aid concentration of 3.30 g/litre**.

5.3. Ideal user behaviour

5.3.1. Ideal operating conditions and user behaviour

Information by manufacturers about energy, water and detergent consumption of professional dishwashers is usually given under 'ideal' use conditions. This means, that

- the machine is in an optimum condition;
- Manual external pre-washing of the dishes is not included;
- the initial filling and preheating of the machine is not included;
- 'standard' crockery is used (e.g. porcelain plates, 26 cm in diameter, weighing 600 g, with a certain degree of soiling), while under real-life conditions the crockery may vary from user to user;
- the dishwasher capacity is fully used;
- the detergent and rinse aid are used in the required form and concentration, and
- the most frequently used dishwashing programme is used;
- energy consumption in low-power modes (e.g. 'ready to use' or end-of-programme mode) is not included;
- the appliances run continuously;
- the cleaning of the machine at the end of the day is not included.

5.3.2. Energy, water and detergent consumption under ideal conditions

For comparison, Table 5-5 still shows the estimated energy, water, and detergent / rinse aid consumption in continuous use per 100 dishes for the different categories of professional dishwashers as presented in the **2011 preparatory study**.

The figures show the consumption values of average technology dishwashers (excluding specific BAT) available on the market back in 2011. The data have been used to calculate the energy, water and detergent consumption during the use phase under ideal conditions in order to give an impression of the environmental relevance of the different dishwasher categories and to subsequently determine the influence of other user behaviour parameters that were not considered under ideal conditions (see section 5.4)

Table 5-5: Specific energy, water and detergent consumption of an average dish-washers during continuous use under ideal conditions (2011)

Dishwasher category	Energy consumption (in brackets: range)	Water consumption (in brackets: range)	Detergent / rinse aid consumption (in brackets: range)
	kWh/100 dishes[80]	litre/100 dishes	g/100 dishes
No 1 Undercounter water-change	4.3[81]	80	268
No 2 Undercounter one-tank	1.6 (1.2-2.0)	16 (equals 2.9 l per cycle)	54
No 3 Hood-type	1.7 (1.5-2.0)	16	54
No 4 Utensil/Pot	0.5 kWh per cycle	5.2 litre per cycle	17 g per cycle
No 5 Conveyor-type one-tank	2.0 (1.8-2.3)	13 (11-15)	44
No 6 Conveyor-type multi-tank	2.0 (1.6-2.3)	12 (11-13)	40

Source: Task 3 report of 2011 preparatory study on professional dishwashers

Based on stakeholder feedback from the 2024 online survey, Table 5-6 shows an update of the specific energy, water and detergent (including rinse aid) consumption of average dishwashers during continuous use under ideal conditions for the different categories of professional dishwashers that will be used for the further purposes of this study. One stakeholder remarked that in general, detergent and rinse aid consumption is less than what was presented in the final report of 2011, however, not providing updated values.

For category 1, stakeholder feedback suggests lower energy and water consumption compared to the 2011 data. For detergents, still the 2-4 grams per litre (see section 5.2.3) is still assumed, so the detergent consumption per 100 dishes remains unchanged.

One stakeholder agrees with the 2011 values for categories 2, 3, and 4. However, some stakeholders provided updated data for these categories.

For category 2, for example, for the energy consumption a range of 1.5 to 2.5 kWh per 100 dishes was provided with suggested averages of 1.5, 1.65 and 2.2 kWh; for the purposes of the study, the mathematical mean of the range (2.0 kWh) seems to be appropriate.

For the water consumption, one stakeholder believes that 2,5 litres/cycle is closer to the actual situation. There seems to be a large gap between low-tier (single wall, pressure booster) and top-tier machines (double wall, atmospheric booster).

[80] In case of category 4, values are given per cycle.

[81] Programme ‘Universal’, cold water supply (direct electricity consumption of the dishwasher is lower when connected to warm water supply (1.7 kWh/100 dishes)).

Other stakeholders even go lower with 11 to 13.3 grams per 100 dishes; the value of 12.2 grams per 100 dishes equals 2.2 litres per cycle. It should be noted that the product datasheets for this product category give different information on water consumption (litres per rack or litres per cycle, some even without any unit). For example, water consumption for category 2 dishwashers was found to be 1.7-2.0 litres per rack, or 3 litres per cycle in the product datasheets. Regarding the consumption of detergents and rinse aids, two stakeholders suggested a lower consumption of 40 grams and one stakeholder only 34 grams per 100 dishes. The average is used for the further calculations. One stakeholder points out that the detergent consumption for undercounter single-tank and hood-type dishwashers is defined according to EN IEC 63136 and for utensil/pot dishwashers according to ENAK (per cycle) with 2 ml/l (at a density of 1,4) detergent consumption and 0,2 ml/l rinse aid consumption. However, the actual detergent and rinse aid consumption is likely to vary from these standard conditions.

For category 3 (hood-type dishwashers), stakeholders suggest a slightly higher energy consumption (around 2.0 kWh per 100 dishes) compared to the 2011 data. On the other hand, the water consumption seems to be lower now, at 2.3 to 2.5 litres per cycle, i.e. approximately 12 to 14 litres per 100 dishes. Finally, the detergent and rinse aid consumption is lower than in 2011, ranging from 34 to 44 grams per 100 dishes.

For category 4 (utensil/pot dishwashers), both the energy and the water consumption appear to be slightly higher compared to the 2011 data, while detergent consumption remains unchanged.

Finally, for categories 5 and 6, one stakeholder informs that due to the wide range of conveyor type machines there are no data that referring to x/100 dishes, but proposes to discuss a calculation approach to obtain the data in the best way according to DIN EN 17735 as a reference. Only one stakeholder suggests that the energy consumption for category 6 could be half of what was reported in 2011. As long as this is not confirmed by other stakeholders, the study will use the existing values for further calculations. For both categories, lower values were proposed for the water and detergent consumption compared to 2011 data. For category 6, a water consumption of 8 litres per 100 dishes (which equals to 1.45 liters per rack) appears to be closer to the actual situation.

Table 5-6: Specific energy, water and detergent consumption of an average dish-washers during continuous use under ideal conditions (2024)

Dishwasher category	Energy consumption (in brackets: range)	Water consumption (in brackets: range)	Detergent / rinse aid consumption (in brackets: range)
	kWh/100 dishes[82]	litre/100 dishes	g/100 dishes
No 1 Undercounter water-change	2.25 (2.0-2.5)	42 (35-50)	268
No 2 Undercounter one-tank	2.0 (1.5-2.5)	12.2 (11-13.3) (equals 2.2 l per cycle)	37 (34-40)
No 3 Hood-type	2.0 (2.02-2.1)	12.5 (11-14)	39 (34-44)
No 4 Utensil/Pot	0.85 (0.7-1.0) kWh per cycle	6.0 (5.0-7.0) litre per cycle	17 (15-20) g per cycle
No 5 Conveyor-type one-tank	2.0 (1.8-2.3)	12 (11-13)	36
No 6 Conveyor-type multi-tank	2.0 (1.6-2.3)	8 (7-9)	24

Source: Stakeholder feedback from the 2024 survey; text in red: updated data compared to 2011 values

Based on the annual number of dishes or cycles given in Table 5-2, the following Table 5-7 shows the updated annual consumption of energy, water and detergent (including rinse aid) for each of the six dishwasher categories under ideal conditions in 2024.

Table 5-7: Annual energy, water and detergent consumption of different professional dishwashers under ideal condition in 2024 (in brackets: 2011 data)

Dishwasher category	Number of dishes or cycles per year	Energy consumption	Water consumption	Detergent/rinse aid consumption
		kWh/year	litres/year	kg/year
No 1 Undercounter water-change	37,500 (24,000)	844 (1,032)	15,750 (19,200)	101 (64)
No 2 Undercounter one-tank	264,000 (237,600)	5,280 (3,802)	32,208 (38,016)	98 (128)
No 3 Hood-type	691,200 (345,600)	13,824 (5,875)	86,400 (55,296)	270 (187)
No 4 Utensil/Pot	10,800 cycles (9,000) cycles	9,180 (4,500)	64,800 (46,800)	184 (153)
No 5 One-tank conveyor-type	4,276,800 (1,515,900)	85,536 (30,318)	513,216 (197,067)	1,540 (667)
No 6 Multi-tank conveyor-type	8,553,600 (4,009,500)	171,072 (80,190)	684,288 (481,140)	2,053 (1,604)

Source: Calculated based on stakeholder inputs from the 2024 survey; text in red: updated data compared to 2011 values

[82] In case of category 4, values are given per cycle.

Due to the increased typical number of cycles or dishes cleaned per year in all dishwasher categories, there is also an increase in the consumption of energy, water and detergent including rinse aid. Although the specific consumption values may decrease, such as for example for the detergent consumption in dishwasher category 6, this is offset by the assumption that the time in active mode per day is 9 hours instead of 4 hours as assumed in the 2011 report.

An undercounter water-change dishwasher (category 1) cleaning about 37,500 dishes per year will consume about 844 kWh energy and 15,750 litres of water during continuous operation under ideal conditions. The water consumption is connected with a detergent and rinse aid consumption of 101 kg per year. The energy and water consumption of a multi-tank conveyor-type dishwasher is of a different order: around 171,072 kWh of energy and 684,288 litres of water, plus 2 tonnes of detergent and rinse aid, are used to wash around 8.5 million dishes per year.

5.4. Real life user behaviour

Dishwasher datasheets usually state energy, water and detergent/rinse aid consumption under ideal conditions as described in section 5.3. However, there are several reasons why there are significant differences between ideal and actual consumption:

(a) **User behaviour** during continuous operation is usually not ‘ideal’:

  (i) Customer segments: Machines are used differently depending on the customer segment;

  (ii) Workload: Baskets and belts are not fully loaded, resulting in higher consumption per capacity (although this effect can be mitigated by modern measurement and control technology);

  (iii) Other programmes: Consumption data usually represent the consumption of the most used programme, but the machines are also used in other programmes. In addition, the machines are used with different crockery than the standard crockery, due to changes in customer behaviour in company canteens since the end of the Covidien pandemic.

  (iv) Incorrect operation: Errors in user behaviour lead to increased consumption. Several types of misuse can be distinguished (e.g. incorrect dosage of detergent and rinse aid).

(b) The energy and water used for the **initial filling** of the tanks (water and detergent consumption, heating) and for heating and cleaning the machines are not included in the consumption data.

(c) When the dishwasher is switched on, it often operates in low-power modes (e.g. ‘ready to use’ or standby mode), which can represent a relatively long period of time and corresponding additional **standby consumption**.

In the following sections we will describe these parameters in more detail and show their possible influence compared to the consumption under ideal conditions.

5.4.1. Influence of user behaviour

5.4.1.1. Partial workload

Based on stakeholder feedback from the 2024 survey, Table 5-8 shows the average additional consumption of energy, water and detergent/rinse aid (in percent) at typical workloads compared to full load use of the appliances. For comparison, the values obtained in the 2011 preparatory study are still shown in brackets.

Table 5-8: Additional consumption at real-life workload (brackets: 2011 data)

Dishwasher category	Average workload	Increase of … due to partial workload		
		specific energy consumption	specific water consumption	specific detergent / rinse aid consumption
No 1 Undercounter water-change	75% (80%)	10% (15%)	20% (25%)	25% (25%)
No 2 Undercounter one-tank	80% (80%)	20% (7.5%)	20% (25%)	20% (25%)
No 3 Hood-type	80% (80%)	20% (7.5%)	20% (25%)	20% (25%)
No 4 Utensil/Pot	60% (60%)	40% (7.5%)	40% (30%)	40% (30%)
No 5 Conveyor-type one-tank	80% (75%)	25% (10%)	25% (10%)	25% (10%)
No 6 Conveyor-type multi-tank	80% (75%)	30% (10%)	30% (10%)	30% (10%)

Source: Stakeholder feedback from the 2024 survey; text in red: updated data compared to 2011 values

For categories 2, 3, and 4, one stakeholder considers that values from the year 2011 are still valid, another stakeholder confirms the 2011 values for categories 2 to 6. Another manufacturer states that they don't have any information on operator usage that would provide a typical standard or average, as the actual application varies greatly from operator to operator. One stakeholder estimated that the average capacity utilisation of category 5 and 6 dishwashers is closer to 80% than 75%, while another stakeholder stated that the utilisation is close to 100% at peak times. Finally, one stakeholder proposed alternative values for the increase in specific energy, water and detergent consumption, some lower and some higher than the 2011 values. Suggestions for new specific values that differ significantly from the 2011 values are highlighted in yellow – further stakeholder feedback is welcome.

For example, for category 1, partial loading of the basket at 75% results in an increase in specific energy consumption of around 10% compared to full loading. This is because almost the same amount of energy is used for 25% fewer dishes. As a result, the energy consumption per dish washed increases. However, as fewer dishes need to be heated

compared to full load, the additional energy consumption only increases only by about 10%. If the dishwasher is operated at lower than average load, the specific water consumption of a category 1 dishwasher would increase by 20% and the specific detergent consumption by 25%. The dishwasher cannot not fully compensate for the partial load and reduce the energy, water and detergent consumption in the same order.

The concentration of the detergent solution must always be kept at a constant level (a lower concentration would result in inadequate cleaning results; on the other hand, overdosing should be avoided as it may result in undesirable detergent residues on the wash ware and is also a cost factor). The concentration of the detergent depends on the amount of water to clean the dishes. Therefore, the proportional increase in specific water consumption due to a partial load leads to a corresponding increase in detergent consumption. According to the 2011 preparatory study, a reduced workload of dishwashers of category 2, 3 and 4 dishwashers typically results in only small additional energy consumption for several reasons: Fewer dishes need to be heated compared to category 1; energy not used for rinsing is used to heat the tanks, resulting in some energy savings. Based on feedback from a stakeholder who considers the increase in the specific energy consumption to be higher than the 2011 values, these principles should be discussed to agree on the final values for the further purposes of the study.

According to the 2011 preparatory study, it was assumed that a proportion of conveyor-type dishwashers (categories 5 and 6) would detect empty spaces in the basket or on the conveyor and consequently use less water for the rinse cycle, resulting in reduced energy, water and detergent consumption. Despite the partial adaptation of the dishwashing process, it was estimated in 2011 that the reduced load would lead to an increase in energy, water and detergent consumption of around 10% at 75% workload[83]. Based on stakeholder feedback in 2024, the increase in the specific consumption values could be higher (25 to 30%).

5.4.1.2. Use of other programmes

The performance of the dishwashing process depends on four factors:

- thermal action (i.e. water temperature),
- mechanical action,
- chemical action (i.e. detergent concentration), and
- cycle time.

The selection of the dishwashing programme also influences the energy, water and detergent/rinse aid consumption. In the 2011 preparatory study, in addition to the

[83] In 2011 at that time according to DIN 10510:2008 (Professional dishwashing with multi-tank conveyor-type dishwashers – Hygiene requirements, procedure testing; page 17); meanwhile, this standard is withdrawn and integrated in EN 17735, see section 3.3.2.4.

'standard' programme[84], i.e. most commonly used programme at that time, two other common programmes were defined for the six categories of professional dishwashers, as shown in the table below, each with a short and a long running cycle. These programmes differed from the basic programme mainly in terms of duration and corresponding cleaning performance. To achieve a good hygienic result, the detergent needs some time to dissolve the soil. Therefore, a minimum wash time is required.

Professional dishwashers are generally characterised by high cleaning performance with short programme durations. According to the 2011 preparatory study, a single wash cycle (without drying) in the basic programme of a tank-type dishwasher typically takes around 120 seconds. In order to achieve a good cleaning result, the other factors need to be adjusted accordingly. Short cycles of between 60 and 90 seconds are associated with a reduced cleaning performance of the dishwashing process, as the other influencing parameters (water temperature, mechanical action and detergent concentration) are kept constant compared to the basic programme. As a result, shorter cycles are usually only used for less soiled dishes. Correspondingly, longer wash cycles have a better cleaning performance and are usually used for more heavily soiled dishes.

The situation is slightly different water-change machines. As it is easier to change, for example, the water temperature (as there is no need to heat a full wash tank), shorter programme durations do not necessarily result in lower cleaning performance, as they can be combined with higher temperatures. Depending on the type of dishes to be washed, the degree of soiling and the time requirements of the situation, several programmes can be selected.

The following table (based on the 2011 preparatory study), shows a shorter and a longer programme compared to the basic setting ('universal' programme) for undercounter water-change machines with the same characteristics as professional tank dishwashers: in the case of the shorter programme the other parameters are (mainly) kept constant, resulting in a lower cleaning performance (i.e. suitable for less soiled dishes) and lower consumption parameters. The situation is reversed for the longer programme. The key parameters set out in The original table from the 2011 preparatory study was part of the 2024 stakeholder consultation and stakeholders were asked to provide feedback or update the data. It can be seen that, depending on the technology and the dishwashing process the consumption of energy, water, and detergent/rinse aid in the long and short running cycles can be different compared to the 'standard' programme. However, the overall impact of these differences is quite small compared to the total real life consumption of energy and water (see rows 'Average consumption in comparison to standard consumption' in the table below).

For comparison, the 2011 data are retained in the table (in brackets) and the range of new data is shown in red. The updated programme durations correspond to those in the product datasheets (see section 6.2.2 for technical characteristics of existing products). In general, the number of wash programmes has increased; whereas in 2011 only 3 programmes were available in all dishwasher categories, in 2024 there are 10-13 programmes for category 1, up to 10 programmes for category 2, 3-9 programmes for

[84] In 2011, there was no mandatory standard / standard programme for measuring the energy, water and detergent consumption of professional dishwashers. Therefore, the text in this section referring to the 2011 data uses the term 'standard' programme which is equivalent to the most used programme.

category 3, 3-4 programmes for category 4, up to 5 programmes for category 5, and 3-10 programmes for category 6.

Table 5-9, based on feedback from stakeholders in 2011, are:

- Duration of the wash cycle,
- Frequency of use of the different programmes,
- Impact of other programmes on energy, water and detergent consumption compared to the basic setting (assumed to be 100%).

The original table from the 2011 preparatory study was part of the 2024 stakeholder consultation and stakeholders were asked to provide feedback or update the data. It can be seen that, depending on the technology and the dishwashing process the consumption of energy, water, and detergent/rinse aid in the long and short running cycles can be different compared to the 'standard' programme. However, the overall impact of these differences is quite small compared to the total real life consumption of energy and water (see rows 'Average consumption in comparison to standard consumption' in the table below).

For comparison, the 2011 data are retained in the table (in brackets) and the range of new data is shown in red. The updated programme durations correspond to those in the product datasheets (see section 6.2.2 for technical characteristics of existing products). In general, the number of wash programmes has increased; whereas in 2011 only 3 programmes were available in all dishwasher categories, in 2024 there are 10-13 programmes for category 1, up to 10 programmes for category 2, 3-9 programmes for category 3, 3-4 programmes for category 4, up to 5 programmes for category 5, and 3-10 programmes for category 6.

Table 5-9: Programme selection and its influence on energy, water and detergent consumption (2011, 2024)

Type of programme		Duration of programme	Share of programme	Relative consumption of		
				Energy	Water	Detergent
No 1: Undercounter water-change						
A	Basic setting	7 min (16 min)	45% (80%)	-	-	-
B	Short running cycle	5 min (6 min)	45% (10%)	-54%	-35%	0%
C	Long running cycle	35-60 min (20 min)	10% (10%)	+16%	+31%	0%
Average consumption in comparison to standard consumption				*77%*	*87%*	*87%*
No 2: Undercounter one-tank						
A	Basic setting	120 sec	70%	-	-	-
B	Short running cycle	60-90 sec (60 sec)	25%	-10%	0%	0%
C	Long running cycle	240 sec (180 sec); up to 630 sec for hygiene-focused programmes	5%	+10%	0%	0%
Average consumption in comparison to standard consumption				*98%*	*100%*	*100%*
No 3: Hood-type						
A	Basic setting	84-120 sec (120 sec)	80%	-	-	-
B	Short running cycle	45-60 sec (60 sec)	15%	-10%	0%	0%
C	Long running cycle	150-210 sec (180 sec); up to 630 sec for hygiene-focused programmes	5%	+10%	0%	0%
Average consumption in comparison to standard consumption				*99%*	*100%*	*100%*
No 4: Utensil / Pot dishwashers						
A	Basic setting	150-360 sec	60%	-	-	-
B	Short running cycle	90-180 sec	10% (5%)	-10%	0%	0%
C	Long running cycle	300-540 sec, up to 1,200 sec	30% (35%)	+10%	0%	0%
Average consumption in comparison to standard consumption				*102%*	*100%*	*100%*
No 5: One-tank conveyor-type						
A	Basic setting	40-120 sec (120 sec)	80% (90%)	-	-	-
B	Short running cycle	90 sec	10%	-25%	-25%	-25%
C	Long running cycle	180 sec	10% (0%)	+50%	+50%	+50%
Average consumption in comparison to standard consumption				*103%*	*103%*	*103%*
No 6: Multi-tank conveyor-type						
A	Basic setting	24-120 sec (120 sec)	80%	-	-	-
B	Short running cycle	12-90 sec (90 sec)	10%	-25%	-25%	-25%

Type of programme		Duration of programme	Share of programme	Relative consumption of		
				Energy	Water	Detergent
C	Long running cycle	40-180 sec (180 sec)	10%	+50%	+50%	+50%
Average consumption in comparison to standard consumption				*103%*	*103%*	*103%*

Source: 2011 preparatory study; stakeholder feedback from the 2024 survey; text in red: updated data compared to 2011 values

5.4.1.3. Maloperation

Maloperation of professional dishwashers can affect the energy, water, detergent and rinse aid consumption. The main reasons for incorrect operation of professional dishwashers are as follows:

- The wrong programme has been selected and the washing process must be repeated because the result is not satisfactory.
- The concentration of the detergent and rinse aid is insufficient and the result is not acceptable. The washing process must be repeated. This happens when the detergent or rinse aid container is empty and the user does not pay attention to the corresponding signal.
- The detergent concentration is too high, resulting in cords and stripes (detergent residue on the dishes).
- Belt dishwashers tend to stop when the items are not removed at the end of the belt. If such breaks occur and the machine is not put into standby mode, the specific energy and water consumption increases significantly.

The dosage of the detergent and rinse aid can be determined by

- Specialist service providers,
- the dishwasher manufacturer or
- the operators of the dishwashers.

In the first two cases, detergent misdosing is rare, because service providers and manufacturers have a strong interest in achieving good dishwashing results using as little detergent as possible, and will therefore take great care to ensure that the correct concentration of detergent and rinse aid is available. In the third case, incorrect dosing may occur from time to time, e.g. in the case of untrained personnel.

The impact of operator error is difficult to quantify as it can vary greatly from user to user and also depends on how the dishwashing process is organised in general. For example, in market segments with professional dishwashers, where manual programme settings and dosage are used by untrained personnel, the error rate may be higher than in market segments with highly trained personnel and machines with higher degree auf automation. In the absence of differentiated feedback from customers, the 2011 preparatory study assumed that the impact on the energy, water and detergent consumption is on average in the range of +10% of the nominal consumption of the dishwashers for categories 1 to 4 and + 5% of the nominal consumption of the dishwasher for categories 5 and 6.

While more than half of the stakeholders who responded to the 2024 survey felt that the values from 2011 were still valid, some stakeholders disagreed with these assumptions.

One stakeholder argued that it is extremely difficult to estimate these percentages. Without having any real, solid data to support this claim and with the caveat that there is a huge variation in each category depending very much on the specific installation/type of customer, the stakeholder estimates that the impact of misuse on conveying machines (categories 5 and 6) should be higher, at least taking into account the fact that these machines quite often do not work at full load and thus some energy is wasted on empty spaces (even if many machines today have some means to prevent/limit this kind of misuse).

Two stakeholders confirm +10% for category 1 as these machines are mainly used by untrained users and because there are many more individual programmes depending on the very different loads (including having 2 baskets per cycle). On the other hand, for categories 2 to 4 they suggest that the impact of misuse is lower than in 2011, at +5%, as the automatic programme starts after the door is closed, making misuse impossible.

Although in individual cases, different tolerances may be necessary in individual cases for specific types of equipment, as noted by one stakeholder, for the purposes of this study an average value needs to be established to provide a rough estimate of the potential impact of maloperation. Based on the 2024 stakeholder feedback, the following values will be used:

- Category 1: +10% of the nominal consumption of the dishwashers
- Categories 2 to 4: +5% of the nominal consumption of the dishwashers
- Categories 5/6: +7.5% of the nominal consumption of the dishwashers

5.4.2. Influence of initial filling and heating of tanks

The consumption data for dishwashing machines do not include the initial filling and heating of the wash tanks at the start of the process (applicable to all tank machines, i.e. categories 2 to 6). This amount of energy, water and detergent needs to be taken into account as it may represent a significant part of the consumption figures. Of course the importance depends on the intensity of use of the dishwashers. The more dishwashing cycles (or hours of cleaning) performed, the lower the proportion of energy and water used for the initial filling and heating of the wash tanks.

It is also relevant whether the first filling is done with cold or hot water (see section 5.6.1). In the case of hot water there is no additional energy demand of the dishwasher itself.

In order to calculate the annual water and energy demand of the initial filling and heating of the wash tanks the following parameters must be specified:

- Number of working days per year,
- Number of working shifts per day (as the wash tanks have to be emptied and refilled each time),
- Volume of the wash tanks,
- Temperature of inlet water (15°C) and operating temperature of wash tanks (60°C), i.e. the temperature difference for heating the inlet water is 45 K. In the case of hot water load, no additional direct energy is required by the dishwasher to heat the detergent solution of the first load,
- Heat capacity of water, which is 4.19 kJ/(kg*K), and
- Efficiency of the heating process which is assumed to be 90% for .

Table 5-10 shows the parameters for the different dishwasher categories with updated information from the 2024 analysis of product datasheets and stakeholder consultation.

Table 5-10: Input parameters for calculation of consumption through initial filling and heating of wash tanks (2024)

Dishwasher category	Number of working days per year[85]	Number of working shifts per day	Volume of wash tank(s)[86] (in brackets: assumed average)	Operating temperature of wash tank(s)[86] (in brackets: assumed average)
No 1 Undercounter water-change	200	n.a.	n.a.	n.a.
No 2 Undercounter one-tank	300	2	8-25 litres **(15)**	55-65°C **(60°C)**
No 3 Hood-type	300	2	14-60 litres **(40)**	55-65°C **(60°C)**
No 4 Utensil / Pot	300	2	60-130 litres **(100)**	55-65°C **(60°C)**
No 5 One-tank conveyor-type	330	2	70-130 litres **(120)**	55-65°C **(60°C)**
No 6 Multi-tank conveyor-type	330	2	130-750 litres, with an average of 100-400 litres per single tank (a machine can have multiple tanks) **(250)**	55-65°C **(60°C)**

n.a. not applicable

With these assumptions the annual energy consumption (i.e. only the direct energy demand by the dishwasher itself), water and detergent consumption of the two initial loads and the initial heating of the tank water per working day can be calculated. The 'cold water filling' column shows the amount of electricity required to heat the cold water at 15°C to a temperature of 60°C. The 'hot water filling' column shows the amount of energy (e.g. gas) required to heat the water (same temperature difference (60°C – 15°C = 45°C). The amount of energy required for hot water filling is slightly higher than for cold water filling because of the assumed 10% efficiency loss of the boiler.

85 cf. Table 5-3

86 cf. machine characteristics as shown in section 6.2.2

Table 5-11: Energy, water and detergent consumption for two initial fillings and heating of wash tanks per working day (2024)

Dishwasher category	Energy consumption		Water consumption	Detergent consumption
	Cold water filling	Hot water filling		
	kWh/year	kWh/year	litres/year	kg/year
No 1 Undercounter water-change	n.a.	n.a.	n.a.	n.a.
No 2 Undercounter one-tank	471	524	9,000	29.7
No 3 Hood-type	1,257	1,397	24,000	79.2
No 4 Utensil/Pot	3,143	3,492	60,000	198.0
No 5 One-tank conveyor-type	4,148	4,609	79,200	261.4
No 6 Multi-tank conveyor-type	8,642	9,602	165,000	544.5

n.a. not applicable

5.4.3. Influence of low-power modes consumption

Off-mode energy consumption is not taken into account: For the smaller dishwashers, the off-mode consumption is negligible compared to the total energy consumption.[87] According to the 2011 preparatory study, large conveyor-type dishwashers are disconnected from the circuit by a power switch so no power is consumed in off-mode at all. Therefore, off-mode has not been considered in the following sections and tasks. In the 2024 stakeholder consultation, all responding stakeholders confirmed that off-mode consumption is not relevant for professional dishwashers (less than 1 kWh per year).

For household dishwashers, the aim is to reduce the standby consumption (when the user does not switch off the appliance after use) by setting low standby ecodesign requirements. Normally, this do not affect the usability of the appliance. The higher standby consumption of professional dishwashers compared to household appliances is due to the continuous heating of the tank in order to avoid long preheating times (‘ready to use’ mode). Due to their wash tank that has to be preheated and kept on a certain heat level, categories 2 to 6 have to be kept in a ‘ready to use’ mode between the dishwashing cycles. For categories 2 and 3, the measurement of the power consumption of the ‘ready to use’ mode is specified in IEC 63136 (see section 3.3.1.1).

Category 1 machines do not have a ‘ready to use’ mode; due to their water-change technology they can be used immediately. However, they may not be switched off immediately at the end of the programme and therefore remain in ‘left-on mode’ for some time. The 2024 stakeholder consultation confirmed the category 1 values.

[87] Assumption of the 2011 preparatory study: Cat. 1 is comparable to household dishwashers. Within the initial Ecodesign preparatory study for household dishwashers, the off-mode consumption of household dishwashers has been calculated with 0.00016 kWh/h for 8,000 hours/year being in off-mode; resulting in an annual off-mode consumption of around 1 kWh. In the professional context, this consumption might even be lower as machines are more often operating thus reducing the hours in off-mode.

In the 2011 preparatory study, the standby time ('ready to use' mode for tank dishwashers, 'left on' mode for water-change dishwashers) of each category was calculated (see Table 5-12), based on the assumptions of the average active running time as shown in Table 5-3 and the stakeholder feedback on the total time switched on[88].

The current preparatory study did not update the different time clusters but rather asked for feedback on the calculated 2011 data. Based on the current stakeholder feedback in 2024, different values were provided for the average daily use time of the machines when switched on, and also slightly different estimates for the hours per day that the professional dishwashers are in 'ready to use' mode. In particular, there may still be a discrepancy in the time clusters when considering the 2024 stakeholder feedback on the time in 'active mode', see Table 5-4. On the other hand, no significant deviations were reported by stakeholders for the value ranges for standby consumption ('ready to use' mode for tank dishwashers, 'left on' mode for water-change dishwashers) compared to the 2011 values, so these still seem to be valid.

Table 5-12: Typical time in low-power modes and standby consumption of professional dishwashers (2011, 2024)

Dishwasher category		Time in low power modes in hours per day		Standby consumption (range in kWh/h)
	Average use time (switched on) in hours per day	Ready to use mode	Left-on-mode	
No 1 Undercounter water-change	4,0	n.a.	2.6	0.01
No 2 Undercounter one-tank	10 | 14 (10,0)	6 | 12 (8.4)	n.a.	0.1-0.2 (0.25)
No 3 Hood-type	10 | 14 (10,0)	7 | 10 (7.5)	n.a.	0.1-0,40 (0.35)
No 4 Utensil / Pot	10 | 12 (10,0)	7 | 11 (7.4)	n.a.	0.1-1.00 (1.00)
No 5 One-tank conveyor-type	10 | 15 (10,0)	7 | 8 (6.5)	n.a.	0.80-2.10 (0.80)
No 6 Multi-tank conveyor-type	10 | 15 (10,0)	6 | 8 (5.5)	n.a.	1.5-2.2 (2.00)

Source: Stakeholder feedback from the 2024 survey; text in red: updated data compared to 2011 values

n.a. not applicable

As can be seen, dishwashers with higher capacities and more intensive use have lower standby times. On the other hand, their standby power consumption is higher, mainly due to energy losses from the tanks. Keeping the water tanks at high temperatures causes losses through convective heat transfer and steam generation. Additional consumption can be caused by the ventilation system and the electronic control system. Multi-tank conveyor dishwashers have the highest standby consumption. The average standby energy consumption of these machines is estimated to be around 2 kWh per

[88] According to stakeholders' feedback in 2011, the machines of category 2 to 6 are usually switched on for approximately 10 hours a day, while category 1 is switched on for 4 hours.

hour. On the other hand water-change dishwashers (category 1) have very low energy consumption values in their 'left on' mode.[89]

5.4.4. Influence of external process steps

According to the 2011 preparatory study, the manual pre-cleaning of the wash ware as well as the manual cleaning of the dishwashing machines after the running cycles might cause considerably further water and energy consumption in the whole washing process. The inclusion of the whole process from dirty to clean (including the pre-soak and pre-cleaning of the wash ware as well as the machine cleaning) would be rather desirable. However, the water and energy[90] consumption is strongly dependent on the specific user behaviour, the soiling of the wash ware and the machines, the existing infrastructure and other factors[91]. Further, there is no standard measurement method and thus no reliable data to record the average consumption through external pre-cleaning of the wash ware or cleaning of the machines. Thus, the manual process steps outside the dishwashing machines were excluded from the scope and were not included in the consumption values under real-life usage conditions of the 2011 study.

For the updated 2024 preparatory study, the situation has not changed, i.e. also for the current calculations do not take into account external processes such as pre-cleaning of dishes or cleaning of the machine.

5.4.5. Energy, water and detergent consumption under real-life usage conditions

The following table summarises the different influencing parameters of the above sections and shows the annual consumption of energy, water and detergent (including rinse aid) for each of the six dishwasher categories under real-life usage conditions. The results show that under real-life conditions the additional consumption of energy, water, detergent and rinse aid might be significantly higher compared to ideal conditions. The lower energy and water consumption values for category 1 dishwashers in comparison to the 2011 values can be explained by an increase in the use of short cycle times. For the tank-type machines, the 2011 preparatory study only considered one initial filling of the tanks per day in its calculation of the energy and water consumption, although the data suggest two shifts per day. The one additional tank filling per day makes a significant contribution to the total energy and water consumption. Also, the energy consumption of tank-type machines due to their 'ready to use' mode has not been included in the calculation of the real life energy consumption in 2011. Finally, for categories 3, 5 and 6,

[89] Note: Formally, professional dishwashers do not fall under the Commission Regulations (EC) No. 1275/2008 and (EU) 2023/826 on standby and networked standby, cf. Task 1).

[90] Energy consumption: due to the use of warm water for cleaning.

[91] For example, the use of active filter systems can reduce the dirtiness of the wash water through the separation of food residues during the dishwashing process and transporting them out of the machine.

the cycle times and the number of dishes washed per year have increased significantly compared to the 2011 values, according to stakeholder feedback.

Table 5-13: Annual energy, water, and detergent consumption (real life conditions) (2011, 2024)

Dishwasher categories	Number of dishes or cycles per year	Annual energy consumption per appliance (kWh)	Annual water consumption per appliance (litres)	Annual detergent consumption per appliance (kg)
No 1 Undercounter water-change	37,500 (24,000)	826 (1,254)	18,483 (25,920)	124 (87)
No 2 Undercounter one-tank	264,000 (237,600)	7,685 (5,253)	49,260 (55,822)	152 (188)
No 3 Hood-type	691,200 (345,600)	19,599 (8,258)	132,000 (86,650)	417 (292)
No 4 Utensil / Pot	10,800 cycles (9,000) cycles	19,938 (8,913)	153,960 (89,520)	465 (294)
No 5 One-tank conveyor-type	4,276,800 (1,515,900)	125,166 (37,703)	772,042 (255,686)	2,340 (865)
No 6 Multi-tank conveyor-type	8,553,600 (4,009,500)	253,951 (102,229)	1,123,003 (643,645)	3,419 (2,146)

Source: own calculations

The tables below show in detail the additional energy, water and detergent consumption due to partial workload, use of different programmes, maloperation, first fill, and standby.

Table 5-14 Additional energy consumption (real life conditions)

Dishwasher categories	Ideal energy consumption (kWh/year)	Additional energy consumption (kWh/year) due to…					Real energy consumption
		… partial workload	… different programmes	… mal-operation	… initial fillings	… stand-by*	
No 1 Undercounter water-change	844	84	-192	84	n.a.	5	826
No 2 Undercounter one-tank	5,280	1,056	-106	264	471	720	7,685
No 3 Hood-type	13,824	2,765	-138	691	1,257	1,200	19,599
No 4 Utensil / Pot	9,180	3,672	184	459	3,143	3,300	19,938
No 5 One-tank conveyor-type	85,536	21,384	2,138	6,415	4,148	5,544	125,166
No 6 Multi-tank conveyor-type	171,072	51,322	4,277	12,830	8,642	5,808	153,951

* Categories 2 to 6: standby = consumption due to ‘ready to use’ mode

Table 5-15: Additional water consumption (real life conditions)

Dishwasher categories	Ideal energy consumption (litres/year)	Additional energy consumption (kWh/year) due to…					Real water consumption
		… partial workload	… different programmes	… mal-operation	… initial fillings	… stand-by*	
No 1 Undercounter water-change	15,750	3,150	-1,992	1,575	n.a.	n.a.	18,483
No 2 Undercounter one-tank	32,208	6,442	0	1,610	9,000	n.a.	49,260
No 3 Hood-type	86,400	17,280	0	4,320	24,000	n.a.	132,000
No 4 Utensil / Pot	64,800	25,920	0	3,240	60,000	n.a.	153,960
No 5 One-tank conveyor-type	513,216	128,304	12,830	38,491	79,200	n.a.	772,042
No 6 Multi-tank conveyor-type	684,288	205,286	17,107	51,322	165,000	n.a.	1,123,003

Table 5-16: Additional detergent consumption (real life conditions) of dishwasher categories

Dishwasher categories	Ideal detergent consumption (kg/year)	Additional energy consumption (kWh/year) due to…					Real detergent consumption
		… partial workload	… different programmes	… mal-operation	… initial fillings	… stand-by*	
No 1 Undercounter water-change	101	25	-13	10	n.a.	n.a.	124
No 2 Undercounter one-tank	98	20	0	5	30	n.a.	152
No 3 Hood-type	270	54	0	14	79	n.a.	417
No 4 Utensil / Pot	184	74	0	9	198	n.a.	465
No 5 One-tank conveyor-type	1,540	385	38	116	261	n.a.	2,340
No 6 Multi-tank conveyor-type	2,053	616	51	154	545	n.a.	3,419

5.4.6. Best practice in sustainable product use

The 2011 preparatory study identified a number of measures to optimise user behaviour and consumption parameters of professional dishwashers. These included

- Training, incentives and responsibilities of machine operators
- Automated information and control systems
- One-button machines for ease of use and to reduce misuse
- Sensor systems to regulate the water consumption

A more detailed discussion of these partly technical improvement options (Best Available Technologies, BAT) will be provided in Task 4.

5.5. End-of-Life behaviour

5.5.1. Product use & stock life

Stakeholder feedback from the 2024 consultation suggests that professional dishwashers are used for a relatively long time, with differences between the six categories (see also Table 4-6 in section 4.3.1). This should also be seen in the context of the high intensity of use compared to household dishwashers. One stakeholder states that the machines are repaired for as long as it is economically viable and then scrapped which means that the life time shown below can be considered as the life of the stock (time between purchase and disposal).

Table 5-17: Estimated lifespan according to stakeholder consultation (2024)

Category	Median of estimated lifespan in years (in brackets: range of answers)
Category 1 Undercounter water-change	12 (7-15)
Category 2 Undercounter one-tank	8 (7-10)
Category 3 Hood-type	8 (7-10)
Category 4 Utensil/Pot	9 (8-10)
Category 5 Conveyor-type one-tank	11 (10-15)
Category 6 Conveyor-type multi-tank	15 (10-17)

Source: Stakeholder consultation 2024

5.5.2. Maintenance and repair practice

According to the 2011 preparatory study, high-capacity professional dishwashers are usually serviced regularly. The maintenance of the machines has a preventive function and signs of wear and tear can be detected and remedied at an early stage. Companies with a high demand for dishwashing, and therefore a high risk in case of failure, usually have a service and inspection contract with the manufacturer or a specialised service provider. This seems to be less common for the smaller untercounter dishwashers. Due to the relatively high initial cost of professional dishwashers, it is likely that damaged machines will be repaired rather than replaced. At some point, however, the user will replace the machine with a new one. The maintenance and repairs are almost exclusively done at the customers' premises. No additional transport of the devices is necessary. In this context, it is important that customer service can provide a qualified technician quickly when needed.

The table below shows the stakeholder feedback on estimates of the average number of maintenance operations per year per dishwasher category. The range is quite wide with manufacturers' estimates tending to be at the lower end (1 to 4 maintenance operations per year). According to one manufacturer, there are specifications for each machine regarding the scope and intervals of maintenance, but the manufacturer usually does not know whether the operator is following these specifications.

Table 5-18: Estimated average frequency of maintenance and repair actions (2024)

Category	Estimated average frequency of maintenance actions (numbers per year) (median; in brackets: range)	Estimated average frequency of repair actions (numbers during lifetime) (median; in brackets: range)
Category 1 Undercounter water-change	1.5 (1-10)	12 (1-15)
Category 2 Undercounter one-tank	4.5 (1-15)	55 (1-60)
Category 3 Hood-type	4.5 (1-15)	55 (1-60)
Category 4 Utensil/Pot	2 (1-18)	4 (1-50)
Category 5 Conveyor-type one-tank	3 (1-30)	4 (1-75)
Category 6 Conveyor-type multi-tank	3 (1-30)	4 (1-75)

Source: Stakeholder consultation 2024

There are also examples of professional dishwashers designed to make maintenance easier: For example, there are machines that don't need to be moved for maintenance, thanks to the front panel access to the components.[92]

Typical treatment at the end of the first service life of professional dishwashers is, for example a check of the sealings, tubes and settings and parameters for the hygienic cleaning result.

Based on the 2024 stakeholder consultation, the following table provides an overview of the most important priority parts for each dishwasher category in terms of repair needs and spare parts. These are parts related to the dosing system, electronics, switches, pumps, thermostats and temperature sensors, heating elements, and for categories 5 and 6 also conveyor belts and curtains.

[92] https://tools.electroluxprofessional.com/Mirror/Doc/BR/BR_BR-9JE00171_1_5_1_21_EPR-Glasswasher-Undercounter-Brochure_25-06-2024_LR%20(1).pdf?version=1731707140

Table 5-19: Most important priority parts in terms of necessary repairs / spare parts

Category	Most important priority parts in terms of necessary repairs / spare parts
Category 1 Under-counter water-change	- Parts of the dosing system are maintenance parts. - Parts related to the water circulation system e.g. circulation pump, piping. - Electronics and dosing pumps.
Category 2 Under-counter one-tank	- Parts of the dosing system are maintenance parts. - Parts related to the water circulation system e.g. circulation pump, piping. - Electronics and dosing pumps. - Pumps, heating elements, chemical dispensers, printed circuit boards (PCBs) - Thermostats and temperature sensors
Category 3 Hood-type	- Parts of the dosing system are maintenance parts. - Parts related to the water circulation system e.g. circulation pump, piping. - Electronics and dosing pumps. - Pumps, heating elements, chemical dispensers, printed circuit boards (PCBs) - Boiler thermostats and boiler pressure switches.
Category 4 Utensil/Pot	- Parts of the dosing system are maintenance parts. - Parts related to the water circulation system e.g. circulation pump, piping. - Electronics and dosing pumps. - Pumps, heating elements, printed circuit boards (PCBs) - Pump contactors and boiler pressure switches.
Category 5 Conveyor-type one-tank; **Category 6** Conveyor-type multi-tank	- Parts of the dosing system are maintenance parts. - 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. - Conveyor belts, curtains

Stakeholders were also asked on typical upgrade and repair activities, required time and costs of the repair of professional dishwashers. It has to be noted that the values and information provided below are only exemplary for a few repair activities performed by responding stakeholders and therefore cannot be generalised to the whole sector.

- **Upgrade activities**, time to carry this out and average cost of spare part:
    - Categories 2 and 3: Installation of pumps for detergent; 1 hour; 200 €
    - Categories 5 and 6: Installation of pumps for detergent and rinse aid; 2 hours; 350 €
- **Repair activities**, time to carry this out and average cost of spare part:
    - Category 2:
        - Replacement of the regulation thermostat; 0.5 hour; 40 €
        - Replacement of probes; 0.5 hour; 55 €
        - Replacement of a component (not specified); 0,75 hour; 100 €
    - Category 3:
        - Replacement of boiler safety thermostat; 0.5 hour; 54 €
        - Replacement of boiler pressure switch; 1 hour; 54 €
        - Replacement of a component (not specified); 0,75 hour; 100 €
    - Category 4:
        - Replacement/Checks auxiliary pump contactor; 0.5 hour; 47 €
        - Replacement of boiler pressure switch; 1 hour; 54 €
        - Replacement of a component (not specified); 0,75 hour; 100 €
    - Categories 5 and 6:
        - Replacement of probes; 1 hour; 24 €
        - Replacement of boiler heating elements; 1 hour; 150 €

When asked about the average labour rate for carrying out the upgrade and/or repair activities, stakeholders replied that this depended heavily on the labour rates in each country. The range suggested was between 60, 90 and 130 Euros per hour in Europe. One stakeholder indicated that, as a manufacturer, their repair interventions are not very frequent and are invoiced to the dealer, not to the end-user.

5.5.3. Estimated second hand use

According to the 2011 preparatory study, customers can sell the dishwasher on the second-hand market if their dishwashing needs change over time. Disadvantage for buyers may be that they usually do not get a warranty for the product. In some cases manufacturers or their dealers may act as intermediaries when one of their customers wants to trade in a working appliance and another customer is looking for a used appliance. The 2011 study report estimates that the market for used dishwashers is around 5-10% of annual sales.

However, stakeholder feedback from the 2024 survey suggests that most dishwashers do not have a second life in this sense. They are repaired for as long as it is economically viable and then scrapped. For example, in categories 5 and 6, heavily used dishwashers are scrapped after 8 - 10 years when they are no longer repairable. In about half of the listings, the transport dishwashers have a service life of 15 years or more. Even for components, there does not seem to be a trade in used spare parts, as is the case for example in the automotive sector.

5.5.4. Collection rates, by fraction

At the end of their use time, the professional dishwashers become e-waste. Consequently, they are professionally dismantled and then disposed of properly, as required by the WEEE Directive.

Stakeholder feedback from the 2024 consultation suggests that refurbishment is not practiced as refurbished equipment is not in demand for hygiene reasons. Regular maintenance leads to a significant increase in lifetime and this approach is generally used for high-priced professional dishwashers. Refurbishment of used equipment is the exception, and is usually only carried out on relatively new equipment as the machines really wear out at the end of their life. One manufacturer thinks that categories 2 and 3 could potentially be refurbished.

Almost no professional dishwasher will end up in landfill, as the materials (mostly stainless steel) are too valuable. For this reason, the products are always recycled for parts or materials.

Stakeholder feedback suggests the following market shares for end-of-life treatment for all categories of professional dishwashers:

- Recycling: 85%
- Incineration: 12%
- Landfill: 3%

According to the 2011 preparatory study, large dishwashers are usually taken back by the manufacturer of the new machine at the end of their life as most of the machine is made of valuable stainless steel. The machine is sold to recycling companies. The smaller undercounter machines will be collected by certified scrap dealers.

According to the stakeholder feedback from the preparatory study in 2011, the owner of the old dishwasher will usually receive a small amount of money from the scrap dealer, in the range of 50 to 100 Euro, depending on the raw material prices. Calculations based on scrap prices at that time resulted in about 80 Euro for a category 2 dishwasher. Due to the increase in metal prices in recent years, the revenue will be higher today, at around 110 Euro as shown below.

Table 5-20: Estimation of revenues from scrap metal fraction exemplified for an undercounter one-tank dishwasher (category 2)

Material / Component	Weight in g	Revenues from scrap (€/kg)[93]	Resulting revenues
Stainless steel	49 760	1.70	84,59 €
Pumps (copper)	2 500	6.80	17.00 €
Pumps (stack of sheets)	2 500	0.05	0.13 €
Pumps (stainless steel wave)	2 250	1.70	3.83 €
Pumps (Al)	2 250	1.10	2.48 €
Cable (copper)	1 100	4.20	4.62 €
Total	**112.65 €**		

Source: own calculations based on Bill of Material (see section 6.3.1.2) and current prices of scrap

[93] https://schrottpreise-aktuell.org/, sighted on 18/11/2024

5.6. Local Infrastructure

5.6.1. Water supply

The water for the dishwashing process can be obtained from municipal supplies or from self-supply (e.g. fresh water taken from wells, springs, rivers and, theoretically, rainwater, which mainly needs to be pre-treated before use in dishwashers). Water acts as a heating medium, a transport medium and a solvent for detergents and soil, as well as transmitting the mechanical action of the dishwasher to the dishes.

Professional dishwashers can be connected either to a cold and/or hot water supply. Water-change dishwashers (category 1) often have two valves, allowing them to be connected either to cold tap water only or to both cold and hot tap water. According to stakeholder feedback in 2011, connection to hot water only is not useful as low temperature programmes are also available and in these cases the temperature of the hot water would be too high; furthermore, if options such as heat recovery or water treatment system (softening) are included, the appliance requires cold water at the inlet. Connection to a hot water tap is more common for category 1 as more water needs to be heated to the desired temperature per cycle (cf. Table 5-22).

According to the 2011 preparatory study, one-tank undercounter and hood-type dishwashers (categories 2 and 3) mostly have only one valve for the water supply. Both the water for the initial filling of the wash tanks and the water for continuous operation are taken from this valve. This allows either cold or hot water to be supplied. Again based on 2011 data, a small percentage of hood-type, utensil/pot and one-tank conveyor-type dishwashers (categories 3, 4 and 5) and a large percentage of multi-tank conveyor-type dishwashers have two (or more) valves, with the first valve being used for continuous operation and the other(s) for the separate filling of the tank(s). It is then possible to have the initial filling of the wash tanks hot warm water and use cold water for the continuous wash cycle. Filling the tanks with hot water results in a shorter initial heating time of the wash tanks to be in the ‘ready to use’ mode. It is assumed that these principles and percentages are still valid – feedback from stakeholders is welcome.

Table 5-21: Number of water inlet valves of professional dishwashers (2011 data)

Dishwasher category	1 valve	2 or more valves
No 1 Undercounter water-change	0%	100%
No 2 Undercounter one-tank	100%	0%
No 3 Hood-type	99%	1%
No 4 Utensil/Pot dishwashers	80%	20%
No 5 One-tank conveyor-type	60%	40%
No 6 Multi-tank conveyor-type	20%	80%

Source: 2011 preparatory study for professional dishwashers

The following table gives an overview of possible options and the share of dishwashers sold or installed with the respective option. It is assumed that these principles and percentages are still valid – feedback from stakeholders is welcome.

Table 5-22: Water connection of professional dishwashers (2011 data)

Dishwasher category	Only cold water connection	Cold and hot water (continuous operation)	Hot water (initial filling) Cold water (final rinse)	Only hot water connection (for initial filling and final rinse)
No 1 Undercounter water-change	50%	50%	-	-
No 2 Undercounter one-tank	80%	-	-	20%
No 3 Hood-type	75%	-	-	25%
No 4 Utensil/Pot dishwashers	70%	-	5%	25%
No 5 One-tank conveyor-type	60%	-	35%	5%
No 6 Multi-tank conveyor-type	60%	-	35%	5%

Source: 2011 preparatory study for professional dishwashers

Typical water inlet temperature is 15°C (cold water). Tank temperatures are between 55°C and 65°C (warm water) (see section 6.2.2).

In general, hot water connection leads to shorter programme times and lower energy consumption of the dishwasher itself. However, the overall environmental and economic advantage of the connection to hot water supply strongly depends on the type of water heating outside the appliance and other infrastructural parameters, like length and insulation of the stub water line.

5.6.2. Energy supply / water heating

There are different options for heating the water inside the dishwasher. Based on stakeholder feedback from the 2024 consultation, the following table shows the proportion of dishwashers sold or installed with different types of water heating.

The basic option is electric heating. Under-counter and hood-type dishwashers (categories 1, 2 and 3) are only available with electric heating. According to stakeholders, other types of heating do not make sense as they would require too much effort for little benefit, as the throughput is lower and the necessary infrastructure is often not available.

Stakeholders confirmed that the initial data from the 2011 preparatory study are still up to date for categories 1 to 3. For categories 4 and 5, the share of electricity for water heating has actually increased, in category 4 close to 100% and in category closer to 95% electricity and 5% low pressure steam. Electricity is also increasingly used for water heating in category 6, with figures ranging from 80 to 90%.

Tank heating with natural gas no longer plays a role. One reason for this may be the strict building regulations regarding ambient air conditions. The stakeholder survey did not reveal any information on the use of solar energy to heat water tanks, so this approach does not seem to be used in practice yet.

Table 5-23: Types of water heating in professional dishwashers (2011, 2024)

Dishwasher category	Electricity in %	Low pressure steam and hot water in %	Natural gas in %
No 1 Undercounter water-change	100	-	-
No 2 Undercounter one-tank	100	-	-
No 3 Pass through ('hood type')	100	-	-
No 4 Utensil / Pot dishwashers	98-100 (90-95)	0-2 (5-10)	-
No 5 One-tank conveyor-type	90-100 (~80)	0-10 (20)	0 (0-1)
No 6 Multi-tank conveyor-type	85-90 (~70)	10-15 (30)	0 (0-1)

Source: Stakeholder feedback from the 2024 survey; text in red: updated data compared to 2011 values

5.6.3. Telecom

A number of professional dishwashers are now equipped with features that allow them to be connected and 'smart'. This allows the user to know when the machine is on, whether it is under- or oversized, control the cycle time, operator waiting time and total working time, and consumption values. It also allows remote diagnosis in the event of fault or breakdown.

5.6.4. Installation / Physical environment

There is no specific information available on the availability and level of knowledge or training of installers. At least the larger dishwashers in categories 2 to 6 need to be installed by trained personnel.

Unlike professional washing machines and tumble dryers, which can be used in shared laundries, there appear to be no shared solutions for professional dishwashers.

5.7. Open questions to stakeholders

Please check the following aspects of Task 3 on user behaviour, as there have been significant changes since the 2011 preparatory study:

- Typical usage intensity of the different dishwasher categories, i.e. time in active mode, annual number of dishes per year (Table 5-4). There may also be a discrepancy when comparing data on total time in active mode and time in 'ready to use' mode (Table 5-12).
- Detergent consumption: Stakeholder feedback suggested that there are no other consumables besides detergents and rinse aids; however, standards IEC 63136 and DIN EN 17735 further define ‘chemical treating agents’; please specify if there are additional consumables and if so, their consumption in grams per litre for the different dishwasher categories.
- Increased consumption due to partial workload in categories 2-6 (Table 5-8), as the suggested values from the 2024 stakeholder consultation are significantly higher than the 2011 data.
- Use of other programmes (Table 5-9): Should further programmes be included in the calculation of actual use? In particular, the very long running programmes for hygiene purposes seem to have an additional impact that is not yet sufficiently captured; please specify the share of use and the additional consumption of energy, water and detergents for this type of programme.
- Initial tank filling: the 2011 preparatory study indicated 2 shifts per day, but only 1 shift was included in the additional impact calculations. Please confirm the typical number of initial fills per day for each of the categories (Table 5-10)
- Water supply / water connection (Tables 5-21 / 5-22): 2011 data still accurate?
- Further best practice in sustainable use measures (see section 5.4.6) which would not be covered by design options (BAT) under section 6.2.4

6. MEErP Task 4 – Technologies

6.1. Objectives of MEErP Task 4

MEErP Task 4 treats the technical analysis of the current professional dishwashers on the EU market with the aim to provide general inputs for the definition of the base case(s) (MEErP Task 5) as well as the identification of the improvement potential (MEErP Task 6). For this purpose, this task will also look for information on BAT (Best Available Technology) / BNAT (Best Not Yet Available Technology). The technologies will be analysed with regard to the material inventory in the dishwashers by collecting data on the respective Bill of Materials (BOM) in order to define the relevant Base Cases in MEErP Task 5.

6.2. Technical product description in the use-phase

As part of the technical product description in the use-phase, particular attention was paid to the analysis of the energy and water consumption of professional dishwashers and the use of detergents to fulfil their intended purpose, namely the cleaning of dishes and crockery in a B2B context. In close relation to the market analysis of MEErP Task 2, the current products on the market were thoroughly analysed and described regarding their technical specifications, different technologies (e.g. for heat supply) and functioning in the use phase. The analysis of the technical parameters was adapted to the parameters for testing the functional performance of dishwashers as specified in the standard (see MEErP Task 1.2 and section 3.3.1, respectively).

6.2.1. Main operating principles of professional dishwashers

The following table gives an overview of the six categories defined in Task 1 and their main properties. A more detailed description on the classification of professional dishwashers can be found in Task 1 (see section 3.2.3.7).

Table 6-1: Categorisation of professional dishwashers

<table>
<tr><th>Category-Number</th><th>Water supply</th><th>Number of tanks</th><th>Operating principle</th><th>Type of loading</th><th>Type of washware</th></tr>
<tr><td>Category 1
Undercounter water-change</td><td>Water-change operation</td><td>0</td><td rowspan="3">Program automats</td><td rowspan="2">Front loaders</td><td rowspan="2">Mainly dishes, glasses, cups, cutlery.</td></tr>
<tr><td>Category 2
Undercounter one-tank</td><td rowspan="4">Tank operation</td><td rowspan="2">1</td></tr>
<tr><td>Category 3
Hood-type</td><td>Pass-through</td></tr>
<tr><td>Category 4
Utensil/pot</td><td>Front loaders and pass-through</td><td>Black cookware and large utensils.</td></tr>
<tr><td>Category 5
Conveyor-type one-tank</td><td rowspan="2">Conveyor-type</td><td>n.a.</td><td rowspan="2">Mainly dishes, glasses, cutlery, also tablets, black cookware.</td></tr>
<tr><td>Category 6
Conveyor-type multi-tank</td><td>2 and more</td><td>n.a.</td></tr>
</table>

n.a. = not applicable
(Source: Task 4 report of 2011 preparatory study on professional dishwashers, adapted)

There are differences between each of the six categories; however some of the categories can be grouped together: e.g. all dishwashers of categories 2 to 6 work with a tank system, where the detergent solution is circulated within the machine and not fully changed between the dishwashing cycles. On the contrary, dishwashers of category 1 use fresh water for each cycle. Similar groups of certain properties apply for other aspects, like operating principle, type of loading, etc.

Regaring the technology there is no essential difference between the dishwasher categories under consideration. Most important components of all categories are:

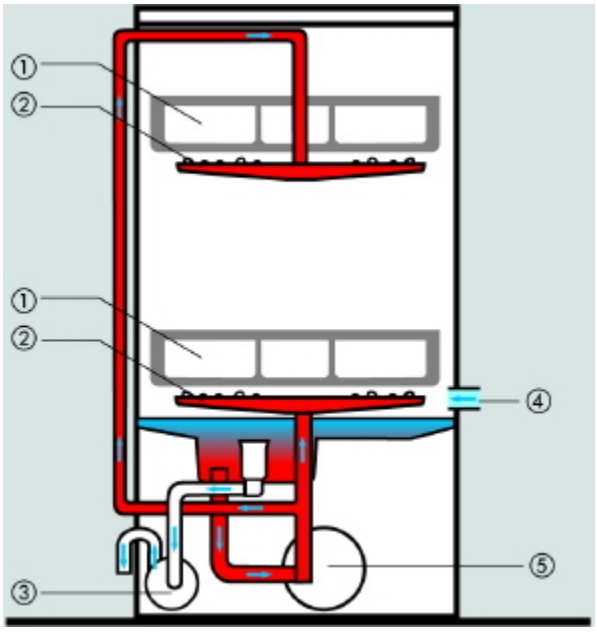
- containment and support structure;
- tanks and / or boilers;
- heating elements;
- motor and pumps;
- spray arms;
- filter system;
- control and display, electronics and sensors, electrics, and
- where applicable, heat exchangers or heat pumps.

Many parts of a dishwasher, such as the external panelling, the tank, the washing and rinsing water circuits, the piping, the jets, the filters and the support structure are made of stainless steel. Because these parts have to withstand harsh environments and constant use, all manufacturers use this material for their machines. As shown in section 6.3.1, the stainless steel share of all dishwasher categories is therefore higher than 50% for category 1 and even higher than 70% for categories 2 to 6 (measured as weight percent of net weight, without packaging materials).

In the following sections, the principal function of dishwashers with water-change operation (section 6.2.1.1) and tank operation (section 6.2.1.2) is described. Dishwashers with tank operation can further be subdivided into programme automats and conveyor-type dishwashers. Section 6.2.1.3 summarises the differences between water-change and tank operated dishwashers.

6.2.1.1. Water-change operation

The following illustration provides an overview of the construction and principal function of dishwashers with water-change operation.



Legend

1 Basket / rack
2 Spray arm cleaning and rinsing
3 Drain pump
4 Fresh water inlet
5 Circulating pump

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-1: Construction of an undercounter water-change dishwasher (Category 1)

The following steps can be distinguished in the dishwashing cycle:

- Pre-wash period: rinsing with cold water (optional);
- Wash period: spraying with warm/hot leach;
- Final rinse period: rinsing with hot water and rinse aid;
- Drying period: drying by use of fresh air or by the residual heat of the final rinse period.

In general dishwashers work with the mechanical force of water jets. The water jets spray against every spot on the dish surface, separate the food-soil from the dish and wash it away. The water is circulated and again sprayed onto the dishes.

Dishwashers of this category work with one set of rotating spray arms for both cleaning and rinsing (2). Sideward-pointing nozzles are placed on the spray arms to create an inclined plane of water jets to clean the dishes and rotate the spray arms through the backlash of the water.

The water is drawn from the fresh water inlet (4) and heated in the wash chamber by means of heating coils. It is then pumped into the spray arms by a circulating pump (5). The drained detergent solution is collected and large dirt and food particles are removed through a filter to avoid damage or blockage of the narrow jet nozzles. The filtered detergent solution is then pumped into the spray arms (2) again. After the wash period the detergent solution is drained by a drain pump (3). For the final rinse, fresh water is used that has to be heated using heating coils.

6.2.1.2. Tank operation

Professional dishwashers with tank operation can be subdivided into programme automats with one-tank (categories 2-4) and conveyor-type dishwashers (categories 5 and 6), either one- or multi-tank. Programme automats need much less space than the spacious conveyor-type dishwashers. However, the latter allow continuous dishwashing of large amounts of dishes in a short time.

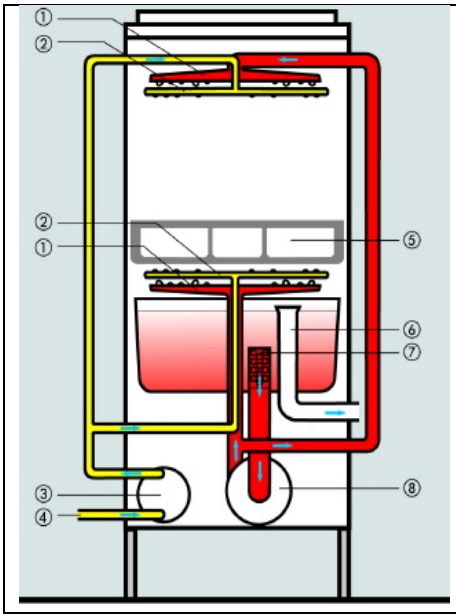
Programme automats (one-tank)

The following steps can be distinguished in a dishwashing process of one-tank programme automats:

- Wash period: spraying with warm/hot leach (usually between 55°C and 65°C);
- Final rinse period: rinsing with hot water and rinse aid (usually between 80 and 85°C; in case of special glasswashers also lower temperatures between 60 and 65°C possible);
- Drying period: drying by use of fresh air or by the residual heat of the final rinse period; this period often takes place outside the machine.

The pre-cleaning is usually performed manually before the items are put into the dishwasher.

The following illustration provides an overview of the construction and principal function of tank operated dishwashers.



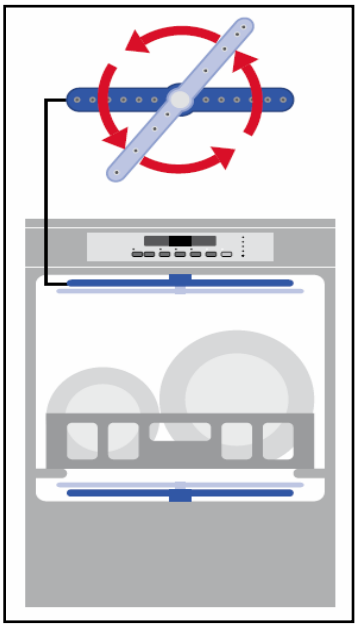
Legend

1 Spray arm cleaning
2 Spray arm rinsing
3 Boiler for rinsing solution
4 Fresh water inlet
5 Basket / rack
6 Overflow pipe
7 Intake filter
8 Circulating pump

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-2: Construction of a one-tank programme automat (categories 2 to 4)

Tank operated programme automats work with the mechanical force of water jets. However, they use two separate water cycles and therefore usually work with two sets of rotating spray arms (principle: see Figure 6-3 below) that are each placed on the top and the bottom of the tub (see Figure 6-2 above): one set for cleaning (1, red), and one set for rinsing (2, yellow).



(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

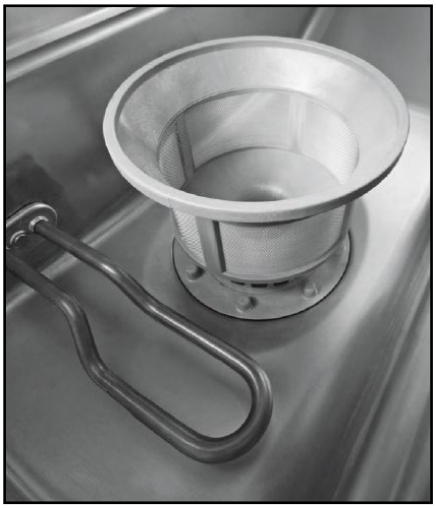
Figure 6-3: Circular movement of the spray arms in tank operated programme automats (categories 2 to 4)

At the beginning of the day the wash tanks of tank operated dishwashers have to be filled with detergent solution and heated to operating temperature (usually between 55 and 65°C). During the day, standby energy consumption occurs because the tank temperature has to be kept on the defined temperature level by the tank heating system (‘ready to use’ mode).

During the dishwashing process, the stored detergent solution is continuously pumped into the spray arms for cleaning (1) by the circulating pump (8). The drained detergent solution is collected and large dirt and food particles are removed through a filter (7) (usually a set of different filters) to avoid damage or blockage of the narrow jet nozzles (see also Figure 6-4). The filtered detergent solution is then pumped into the spray arms for cleaning (1) again. The detergent solution is not changed between two programme cycles, but only partly replaced by hot fresh water from the final rinse process (so-called regeneration of detergent solution).

For the rinse process, hot fresh water heated in a separate boiler (3) is sprayed onto the dishes through a different set of spray arms (2). The excess detergent solution (through additional water from final rinse process) is drained through the overflow pipe (6). Once a day or after each working shift the detergent solution in the wash tank is fully changed.

The following figure shows the filter and heating system of a one-tank programme automat.



(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-4: Filter and heating system of an undercounter one-tank dishwasher (category 2)

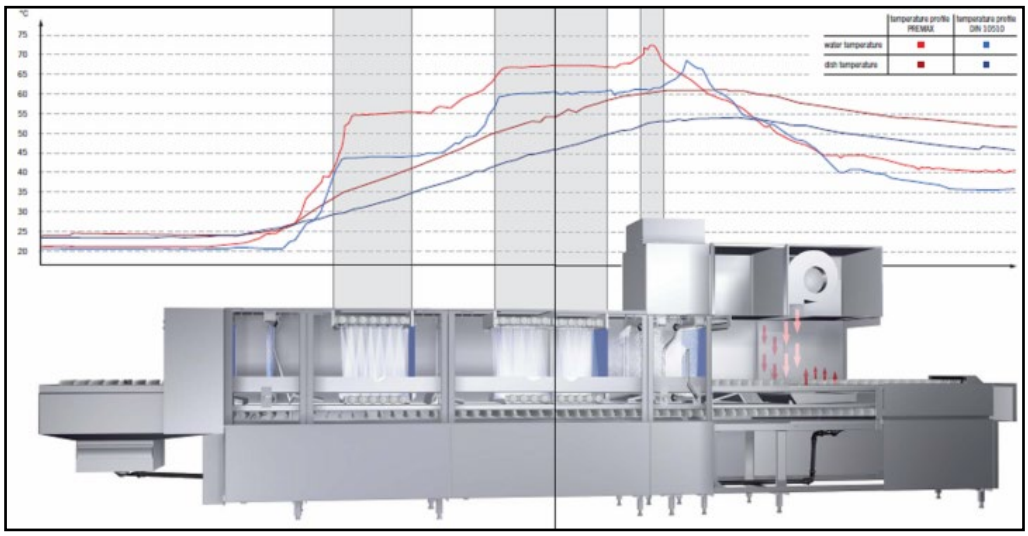
Conveyor-type (one-tank / multi-tank)

In principle, the dishwashing process of a conveyor-type dishwasher is the same compared to tank operated programme automats. The following steps can be distinguished in a dishwashing process.

- Pre-wash period: rinsing with cold water;
- Wash period: spraying with warm/hot leach (usually between 55 and 65°C);
- Intermediate-rinse period: removal of leach with warm water;
- Final rinse period: rinsing with hot water and rinse aid (usually between 80 and 85°C);
- Drying period: drying by use of fresh air or by the residual heat of the final rinse period, might take place outside the machine.

The main difference to programme automats is that with conveyor-type dishwashers the different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the wash ware is transported through these zones. Depending on the type of dishes, the degree of soiling and the available space, conveyor-type dishwashers are provided with one or several wash tanks.

In the following figure, a multi-tank belt conveyor with one pre-wash zone and one cleaning zone is shown. The red lines in the graph show the temperature of the water (light red) and the dishes (dark red) in the different zones.



(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

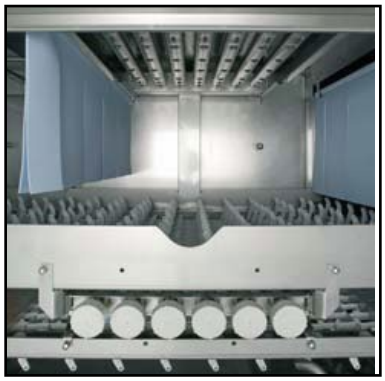
Figure 6-5: Example of a multi-tank conveyer-type dishwasher (category 6)

As with one-tank programme automats the wash tank(s) of conveyor-type dishwashers have to be filled with detergent solution and heated to operating temperature (around 40°C for the pre-wash period and between 55 and 65°C for the wash period) at the beginning of the day/shift. During the day, standby consumption occurs because the tank temperature has to be kept on the defined temperature level (‘ready to use’ mode).

The different steps of the dishwashing programme work in principle as in programme automats:

For the pre-washing and for the cleaning process, detergent solution is stored in the wash tanks from where it is continuously pumped into the spray arms by a circulating pump. The drained detergent solution is collected and large dirt and food particles are removed through filters to avoid damage or blockage of the jet nozzles. The filtered detergent solution is then pumped into the spray arms again. The detergent solution is not changed between two programme cycles, but only partly regenerated. For the rinse process, hot fresh water heated in a separate boiler is sprayed onto the dishes through another set of spray arms. The excess detergent solution (through additional water from final rinse process) is drained through an overflow pipe at the first of the wash tanks (counter flow principle: the fresh water is used for rinsing, replacing water in the last wash tank. Excess water from this tank flows into the previous wash tank and so on). At the end of the dishwasher there might also be a drying zone, where the dishes are dried by hot air (see red arrows in Figure 6-5 above). Once a day or after each working shift the detergent solution in the wash tank is fully changed.

In contrast to programme automats, the spray arms in conveyor-type dishwashers do not rotate but are usually fixed tubes on top and bottom of the dishwashing channel. In some machines, the spray arms are also installed at the sides to achieve uniform wetting.



(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-6: Arrangement of wash arms and nozzles

Two different conveyor systems are available:

- *Basket conveyor dishwashers* (Figure 6-7, left): the wash ware is put into baskets which are manually put into the machine and then automatically transported through the dishwasher.
- *Belt conveyor dishwashers* (Figure 6-7, right): the wash ware is put directly on a conveyor belt which continuously moves through the dishwasher.

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-7: Principle of a basket conveyor dishwasher (left) and a belt conveyor dishwasher (right)

Based on rather different capacity requirements and the economic consequences, conveyor-type dishwashing machines are equipped with quite different technological features. In Task 6 (Best available technologies) the differences and their impact on energy and water consumption are described in detail, while the following table only provides a short overview.[94]

[94] Note: Example by one manufacturer; other manufacturers might have different sets of optional configurations.

Table 6-2: Different configuration of a multi-tank conveyor-type dishwasher (category 6)

	Model A Series	Model B Series
Energy Management	n. a.	x
Heat recovery exhaust air	optional	x
Insulation	optional	x
Heat pump	n. a.	optional
Optimised final rinse	n. a.	x
Water consumption management	n. a.	x
Data documentation	optional	x

n. a. = not available for the model; x = technology is part of the series or option

6.2.1.3. Differences between water-change and tank operated dishwashers

A fundamental difference exists between water-change (category 1) and tank operated dishwashers (categories 2–6): While dishwashers in category 1 use fresh water for each step of the programme, all other machines work with a tank system of one (categories 2–5) or more tanks (category 6).

The advantage of tank operation compared to water-change dishwashers is that the detergent solution in the wash tank is kept at a constant temperature thus enabling much shorter cleaning cycles and a high throughput per hour as the detergent solution does not have to be heated each time before a dishwashing cycle. Higher water temperatures and higher pressure additionally shorten the cleaning process itself. Depending on the connected load (230 or 400 Volt), cycle times and thus the capacity of the same dishwasher vary to a certain extent. Because the detergent solution is only regenerated and not fully replaced they also use less water per dishwashing cycle, resulting in lower energy and detergent consumption.

The following table gives a summary of the differences between water-change and tank operated dishwashers.

Table 6-3: Comparison of freshwater and tank system

Aspect	Water-change (freshwater) system	Tank system
Principal function	Fresh water for every washing and rinsing step	Fresh water only for rinsing
Filtration	Water filtration necessary	Intensive water filtration necessary
Programme duration	Medium to long, as the heating of water needs some time.	Very short duration possible, as hot water is stored in wash tanks.
Output per hour	Medium to low	High
Capacity	Two racks possible	Usually only one rack / conveyor belt
Water and energy consumption	Higher, as fresh water is used for each cycle which has to be heated.	Lower, as water is recycled and used for several cycles / racks.
Standby losses	0.01 kW	0.25 kW – 2 kW

6.2.2. Existing products

For each of the categories defined in Task 1 (see section 3.2.3.7), the technical description of existing products on the market is given below.

6.2.2.1. Category 1: Undercounter water-change dishwashers

The following figure shows a typical undercounter water-change dishwasher.

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-8: Undercounter front loader with water-change operation (category 1)

The following table gives an overview of the characteristics of a typical appliance of this category.

Table 6-4: Main characteristics of a typical undercounter water-change dishwasher (category 1)

Main characteristics	Data from 2011 preparatory study, Task 4 report	Data from 2nd stakeholder consultation
Programme		
Number of dishwashing programmes	10 (dishwashing process can be adjusted to task)	10-13 (dishwashing process can be adjusted to task)
Washing capacity, ideal	2–20 racks/h (depending on programme)	2–24 racks/h (depending on programme, 2 racks per cycle)
Cycle time	6–27 minutes (depending on programme)	5-60 minutes (depending on programme)
Programme temperature	Depending on programme (between 20–60°C, rinsing temperature up to 93°C)	Depending on programme (between 20–60°C, rinsing temperature up to 93°C)
Construction details		
Height/width/depth	820/600/600 mm	820/600/600 mm
Weight (without packaging)	ca. 50 kg	ca. 50 kg
Tank volume	not applicable	not applicable (rinsing system without a tank)
Electricity and water connection		
Voltage	Normal (230 V) or high-load connection (400 Volt) possible	Normal (230 V) or high-load connection (400 Volt) possible
Total load	9 kW	9 kW
Power of pump	0.4 kW	0.4 kW

(Source: Task 4 report of 2011 preparatory study on professional dishwashers; updated with data from 2nd stakeholder consultation highlighted in red colour)

6.2.2.2. Category 2: Undercounter one-tank dishwashers

The following figure shows a typical undercounter one-tank dishwasher.

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-9: Manually loaded undercounter front loader with one-tank (Category 2)

In case of undercounter one-tank dishwashers, usually only one basket can be placed into the dishwasher (loading and unloading from the front side), as the tank needs space as well. Undercounter dishwashers can be constructed as 'generalists' for different items (dishes, glasses, and cutlery) or as specialised versions, i.e. only for dishes, for glasses or for cutlery respectively. As the temperature and mechanical action vary for different adjustments, the related energy and water consumption varies to a certain extent. For example, glasswashers are also available in smaller dimensions (undercounter models that are only 415 to 475 mm wide). These models are often used in bar areas. The basic mode of operation is the same as in the 600 mm wide models; however, they usually work with lower temperatures to avoid damage of the sensitive washware.

The following table gives an overview of the characteristics of a typical category 2 undercounter one-tank dishwasher.

Table 6-5: Main characteristics of a typical undercounter water-change dishwasher (category 2)

Main characteristics	Data from 2011 preparatory study, Task 4 report	Data from 2nd stakeholder consultation
Programme		
Number of dishwashing programmes	3	1-10
Washing capacity, ideal	40 racks/h (with 400 Voltage) 25 racks/h (with 230 Voltage)	Theoretical maximum capacity: 40 racks/h, the capacity is not related to the input voltage Taking into account loading and unloading, in real life a maximum of 20 racks/h is possible

Main characteristics	Data from 2011 preparatory study, Task 4 report	Data from 2nd stakeholder consultation
Cycle time	60-360 sec (with 400 Voltage) 140 / 180 / 360 sec (with 230 Voltage)	60-240 sec. (with 400 Voltage) 90-140 / 120-180 / 240-360 sec. (with 230 Voltage) Hygiene-focused-programmes may have duration up to 10 minutes
Tank temperature	usually between 55°C and 65°C	usually between 55°C and 65°C
Boiler temperature	usually between 80°C and 85°C (glasswashers: also 60-65°C possible)	usually between 80°C and 85°C (glasswashers: also 60-65°C possible)
Construction details		
Height/width/depth	820/600/650 mm (glasswashers: 415-475 mm width)	820/600/600-650 mm (glasswashers: 725 mm height, 415-475 mm width)
Weight (without packaging)	ca. 70 kg (glasswashers: ~ 50 kg)	ca. 55-95 kg (glasswashers: ~ 50 kg), depending on model, variants an choosen options
Tank volume	7-20 litres, average 15 litres	8-25 liters, average 15 litres
Electricity and water connection		
Voltage	230 Volt or 400 Volt	220-230 Volt or 380-415 Volt
Total load	With 400 Voltage: 7.7 kW With 230 Voltage: 3.6 kW	With 400 Voltage: 6.0-11 kW With 230 Voltage: 1.8-4.1 kW
Power of pump	0.2-0.8 kW, typical 0.6 kW	0.2-0.8 kW, typical 0.5-0.75 kW

(Source: Task 4 of 2011 preparatory study on professional dishwashers; updated with data from 2nd stakeholder consultation highlighted in red colour)

6.2.2.3. Category 3: Hood-type dishwashers

The following figure shows a typical hood-type (pass-through) dishwasher.

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-10: One-tank pass-through (hood-type) dishwasher (category 3)

In case of hood-type dishwashers the baskets are put into the dishwasher from one side and are taken out of the dishwasher from the other side. As in case of other tank dishwashers, only one basket can be cleaned at one level, as the tank also needs space. There are appliances, however, where two baskets can be cleaned next to each other, integrated in one housing at the same time. Such appliances are like a double or twin appliance.

Hood-type dishwashers are ergonomically easier to operate than undercounter dishwashers, because the filled baskets stay at working level and can easily be moved into and out of the dishwasher. Additionally, the separation of a dirty and a clean area is possible when using the pass-through type. They are usually constructed as 'generalists' for different items, such as dishes, glasses, cutlery, etc.

The following table gives an overview of the main characteristics of this category.

Table 6-6: Main characteristics of a typical undercounter water-change dishwasher (category 3)

Main characteristics	Data from 2011 preparatory study, Task 4 report	Data from 2nd stakeholder consultation
Programme		
Number of dishwashing programmes	3	3-9
Washing capacity, ideal	60 racks/h	Theoretical maximum capacity: 60-80 racks/h Taking into account loading and unloading, in real life a maximum of 40 racks/h is possible
Cycle time	60-180 sec	45-180 sec hygiene-focused-programmes may have duration up to 10 minutes
Tank temperature	usually between 55°C and 65°C	usually between 55°C and 65°C
Boiler temperature	usually between 80°C and 85°C	usually between 80°C and 85°C (glasswashers also 60-65°C possible)
Construction details		
Height/width/depth (with open door)	2 000/760/820 mm	1,550-2,000/746-760/755-820 mm different dimensions possible depending on choosen model and options
Weight (without packaging)	ca. 120 kg	100-200 kg, depending on choosen model and options
Tank volume	16-60 litres, average 40 litres	14-60 litres, average 40 litres
Electricity and water connection		
Voltage	400 Volt	400 Volt, also 230 V and multiple supply is available
Total load	7 kW	7-14 kW
Power of pump	0.75-1.5 kW, typical 0.9 kW	0.75-1.5 kW, typical 0.9 kW

(Source: Task 4 of 2011 preparatory study on professional dishwashers; updated with data from 2nd stakeholder consultation highlighted in red colour)

6.2.2.4. Category 4: Utensil / pot dishwashers

The following figure shows a typical utensil / pot dishwasher.

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-11: Example of an utensil / pot dishwasher (category 4)

The main difference to one-tank undercounter and pass-through dishwashers is that utensil / pot dishwashers are especially constructed for the cleaning of items other than dishes, glasses and cutlery, i.e. black cookware, pots, pans, containers, trays or other mostly large utensils. Therefore, the dimensions are often larger than those of undercounter front loaders or pass-through dishwashers for dishes, glasses and cutlery as the items to be cleaned are also bulkier. Further, the cleaning performance is usually higher, e.g. by means of higher scavenging pressure or other stronger mechanical and chemical treatment in order to dissolve incrustations. Due to their high scavenging pressure, they cannot be loaded with glass or ordinary crockery.

Two construction types can be distinguished:

- Front loading dishwashers;
- Pass-through dishwashers.

The pass-through dishwashers are usually loaded manually, however, some manufacturers offer special roller containers that can be filled outside the machine and then pushed into the dishwasher.

The following table gives an overview of the main characteristics of this category.

Table 6-7: Main characteristics of a typical undercounter water-change dishwasher (category 4)

Main characteristics	Data from 2011 preparatory study, Task 4 report	Data from 2nd stakeholder consultation
Programme		
Number of dishwashing programmes	3	3-4
Washing capacity, ideal	20 racks/h	20-40 racks/h
Cycle time	90–540 sec	90–540 sec, longer cycle times are possible
Tank temperature	usually between 55°C and 65°C	usually between 55°C and 65°C
Boiler temperature	usually between 80°C and 85°C	usually between 80°C and 85°C
Construction details		
Height/width/depth (with open door)	2 000/876/900 mm	1,991-2,000/876/900 mm for small models, larger dimensions are possible
Weight (without packaging)	ca. 200 kg	200-280 kg
Tank volume	60-130 litres, average 100 litres	60-130 litres, average 100 litres
Electricity and water connection		
Voltage	400 Volt	400 Volt
Total load	13.0 kW	13.0-18.0 kW
Power of pump	typical 1.6 kW	typical 2.2-2.5 kW, 2 x 2.5 kW is possible

(Source: Task 4 of 2011 preparatory study on professional dishwashers; updated with data from 2nd stakeholder consultation highlighted in red colour)

A special type of pot dishwasher is the so called granulate dishwasher. With these dishwashers (both front loaders and pass-through) the mechanical cleaning is intensified through scouring of the wash ware (mainly black cookware) with plastic granules of different size. A granule collector catches the plastic pellets during the granule washing programme.

The following figure shows the working principle of granulates.

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-12: Granulates to foster the cleaning process

The granules can subsequently be cleaned out in a sink with a pipe-mounted sprayer. The special advantage of this process is that less water and energy is needed to clean the pots and other black cookware. Pre-rinsing is not necessary. Granulates are reused in the machine. After about 2,500 cycles they are worn out and have to be replaced.

The following table shows the main characteristics of an exemplary granulate dishwasher. As this type of dishwasher was not covered by the 2nd stakeholder consultation, values from the 2011 preparatory study on professional dishwashers, Task 4 report, are presented, updated with current product data sheets from manufacturers.

Table 6-8: Main characteristics of an exemplary pot dishwasher with granulate

Main characteristics	Data from 2011 preparatory study, Task 4 report	Data updated with current data sheets
Programme		
Number of dishwashing programmes	3	3-6
Cycle time	120–310 sec	30-45 cycles
Tank temperature	usually between 55°C and 65°C	usually between 55°C and 65°C
Boiler temperature	usually between 80°C and 85°C	usually between 80°C and 85°C
Construction details		
Loading volume	190 litres	190 litres
Height/width/depth (with open door)	2,400/850/900 mm	1,700-2 400/850-950/900-1,160 mm
Weight (without packaging)	413 kg	350-413 kg
Tank volume	83 litres	83-90 litres
Electricity and water connection		
Voltage	400 Volt	400 Volt
Total load	15 kW	15 kW
Power of pump	2.6 kW	2.2-2.6 kW

(Source: Task 4 of 2011 preparatory study on professional dishwashers; updated with data from 2nd stakeholder consultation highlighted in red colour)

These values need to be verified in the stakeholder meeting.

6.2.2.5. Category 5: One-tank conveyor-type dishwashers

The following figure shows a typical one-tank conveyor-type dishwasher.

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-13: One-tank basket conveyer dishwasher (Category 5)

One-tank conveyor-type dishwashers use one wash tank for cleaning and fresh water for the final rinsing. Pre-cleaning is normally performed manually (i.e. outside the dishwasher). The detergent and rinse aid are automatically dosed from a reservoir. The dishwashers can be used for different wash ware: dishes, glasses, cutlery, more seldom also for black cookware (pots and pans) and utensils.

The following table gives an overview of the main characteristics of this category.

Table 6-9: Main characteristics of a typical undercounter water-change dishwasher (category 5)

Main criteria	Data from 2011 preparatory study, Task 4 report	Data from 2nd stakeholder consultation
Programme		
Number of dishwashing programmes	2–3	1–5
Washing capacity, ideal	70–110 racks/h	70–110 racks/h
Cycle time -> Programme time	90–180 sec.	40–180 sec.
Tank temperature	usually between 55°C and 65°C	usually between 55°C and 65°C
Boiler temperature	usually between 80°C and 85°C	usually between 80°C and 85°C
Construction details		
Width/depth/height	1,300/800/1,420 mm (without preparing zone)	1,120-1,300/800-920/1,420-1,785 mm (without preparing zone)
Depth/height of passage height	500/460 mm	500-720/450-490 mm
Weight (without packaging)	ca. 900 kg	200-900 kg
Tank volume	110-130 litres, average (120 litres)	70-130 litres, average (120 litres)
Electricity and water connection		
Voltage	400 V	400 V
Power of pump	typical 1.5 kW	typical 1.2-1.7 kW

(Source: Task 4 of 2011 preparatory study on professional dishwashers; updated with data from 2nd stakeholder consultation highlighted in red colour)

According to information provided by stakeholders, the cycle time is not a valid metric for Category 5. Instead, the programme time (in sec) or the transport speed (in m/min) would be more suitable metrics. For the transport speed, values in the range from 0.6-1.2 m/min can be found in current data sheets of manufacturers.

6.2.2.6. Category 6: Multi-tank conveyor-type dishwashers

The following figure shows a typical multi-tank conveyor-type dishwasher.

(Source: Task 4 report of 2011 preparatory study on professional dishwashers)

Figure 6-14: Multi-tank basket conveyer dishwasher (category 6)

Category 6 dishwashers comprise at least one pre-wash zone using a wash tank, one cleaning zone using a wash tank and a final rinse zone using fresh water. These dishwashers can be used for different wash ware: dishes, glasses, cutlery, and more seldom black cookware (pots and pans) and utensils.

Multi-tank dishwashers are usually a combination of different modules for pre-washing and cleaning. These modules can be quite different in size and determine the washing capacity of the machine (plates/hour). Also the passage width and height can be different.

The following table gives an overview of the main characteristics of this category.

Table 6-10: Main characteristics of a typical undercounter water-change dishwasher (category 6)

Main criteria	Data from 2011 preparatory study, Task 4 report	Data from 2nd stakeholder consultation
Programme		
Number of dishwashing programmes	3	3-10
Washing capacity	1,700–6,000 dishes/h	1,700–6,000 dishes/h
Cycle time -> Programme time	90–180 sec.	18–180 sec.
Tank temperature	usually between 55°C and 65°C	usually between 55°C and 65°C
Boiler temperature	usually between 80°C and 85°C	usually between 80°C and 85°C
Construction details		
Width (without packaging)	4,700–7,400 mm (without preparing zone)	3,500–7,400 mm (without preparing zone), the dimensions can also be beyond that range since the variety of options is very high
Depth/height of passage height	Different modules available	530-720/450-490 mm, different modules available
Weight	ca. 1,300 kg	660-1,300 kg
Tank volume	130-750 litres, average 230 litres	130-750 litres, average 100-400 litres per single tank, a machine can have multiple tanks
Electricity and water connection		
Voltage	400 Volt	230-400 Volt
Total load	39–51 kW	33–51 kW, depending on models and options
Power of pump	no data available	0.3-3.0 kW, a machine can have multiple pumps

(Source: Task 4 of 2011 preparatory study on professional dishwashers; updated with data from 2nd stakeholder consultation highlighted in red colour)

According to information provided by stakeholders, the cycle time is not a valid metric also for category 6. Instead, the programme time (in sec.) or the transport speed (in m/min) would be more suitable metrics. For the transport speed, values in the range from 0.8-1.6 m/min can be found in current data sheets of manufacturers.

6.2.3. Products with standard improvement (design) options

The manufacturers and suppliers of professional dishwashers offer their products, if at all, in categories 1 to 4 as a sort of standard solution, whereas in the case of products in categories 5 and 6, there are often several product lines of appliances with additional options that can be ordered. These additional options are used to address customer-specific operating conditions and/or local infrastructure conditions. Against this background, it is not possible to make a systematic and clear distinction between equipment features that are standard design options and features that can be clearly assigned to a BAT. In this respect, the classifications made here should be considered as preliminary. They will need to be reviewed and, if necessary, revised during the further stakeholder consultation process.

Heat exchanger

According to the manufacturers, heat exchangers are used in the majority of the appliances (see chapter 4.4.3), so that an allocation to standard improvement (design) options is obvious for this option.

However, from a technical point of view, ‘heat exchanger’ is a generic term because there are significantly different types of heat exchangers used in professional dishwashers. Without claiming to be exhaustive, heat exchangers can be used as follows:

- Heating of the cleaning and rinsing water in cases where the appliance is supplied with thermal energy in the form of low pressure steam and hot water. However, this is only the case for a small percentage of the appliances in categories 4 to 6 (see Table 5-23 in Section 5.6.2) and the relevance is consistently rated as declining by the manufacturers.
- Recovery of waste heat from the wastewater flow.
- Recovery of waste heat from the moisture-laden air inside the appliance (vapours).

In addition, heat exchangers are technically divided into recuperators (where the two media are passed through separate spaces) and regenerators (where the hot and cold media pass alternately through the heat-storing body), as in the case of Zeolite(R) technology. Finally, heat exchangers vary in their design (from simple plate heat exchangers to so-called water-pocket heat exchangers to complex tube bundle heat exchangers) and in the way the media are directed (counterflow versus co-current flow versus cross-flow).

In the further course of the study, it must therefore be clarified with the manufacturers what types of heat exchangers are actually used in each category of professional dishwashers and the extent to which energy savings can be achieved with them.

Improved thermal insulation

Improving the insulation of the equipment also appears to be a standard improvement option. Insulation generally has two effects: it can improve the energy efficiency of the equipment by reducing heat loss, and it can improve working conditions in the dishwashing area (scullery).

Clarification is needed for the further processing of the study with regard to whether improved thermal insulation is used in all appliance categories, what specific savings can be achieved and whether recycling is hampered by, for example, composite materials that are difficult to separate.

Additional warm/hot water connection, steam-operated heating and gas-operated heating

The option of heating the operating fluids for cleaning and rinsing in professional dishwashing machines using gas, steam or hot water is a standard improvement option. However, the data in Table 5-23, Section 5.6.2 indicate that electric heating is at a high level and continues to increase. Depending on the efficiency of the local supply of steam or hot water, the question arises as to whether the use of these energy sources actually has advantages from an energy point of view. This question should be clarified with stakeholders in the further course of the study.

6.2.4. Best Available Technology (BAT)

6.2.4.1. Heat Recovery (Wastewater and vapours)

Generally speaking, systems for utilising waste heat are not yet among the standard options for improvement; they are usually additional options or system components for professional dishwashers that can be selected. From a technical point of view, there are two heat sources that can be used for recovery: firstly, waste heat from wastewater and, secondly, waste heat from vapours, i.e. the warm, moisture-laden air inside the appliance. In the case of appliances in categories 5 and 6, the wastewater is already being used due to the design, as the water flow is directed against the direction of the dishes. Manufacturers apparently use different concepts for heat recovery. Specifically, systems are offered with and without heat pumps. According to the manufacturers, the controlled air flow within the appliances is of particular importance for the question of how heat recovery can be achieved.

To our knowledge, specific and comparable data on effectiveness (i.e. what proportion of the waste heat is used) and efficiency (i.e. how high are the costs of heat recovery in relation to the benefits) are not yet available and will need to be clarified with the relevant manufacturers in the further course of the study. In addition, it is necessary to investigate which systems can be used in which categories of appliances.

In addition, heat storage systems such as zeolite technology should be further investigated. These can be considered as a BAT for domestic dishwashers and an application of this technology for professional category 1 appliances is conceivable.

6.2.4.2. Automatic adaptation of programme to load and to soiling level of dishes / utensils

Several manufacturers offer automatic detection of empty spaces on the conveyor belts or unfilled racks as an additional option for category 5 and 6 machines. The devices can reduce rinsing to the areas where the dishes are actually located. This should result in significant savings of fresh water and rinse aid.

In general, further clarification is needed with stakeholders as to which automatic adjustment options in line with BAT are available for which appliance categories and what energy, water and detergent savings could be achieved as a result.

6.2.4.3. Water treatment (demineralisation and reverse osmosis)

Several manufacturers of professional dishwashers offer integrated or additional water treatment systems. Two different processes are offered:

- the so-called demineralisation (here, all minerals are removed from the water and replaced with ions that do not form any residues on the washed items) and
- reverse osmosis systems (here, water is passed under high pressure through a membrane that retains almost all substances).

In the further course of the study, it must be clarified with the manufacturers which environmental advantages and disadvantages are associated with the different systems and - more generally - which further effects are associated with water treatment.

6.2.4.4. Cleaning with lower temperature

Another way to reduce the specific energy requirement is to clean at lower temperatures, as the lower temperature gradient compared to the environment reduces heat loss. The 2011 preparatory study showed that in Europe, the hygienic requirements of the dishwashing process are met by thermal means. This means that no special disinfectants are required in the cleaning or rinsing agents.

Most manufacturers do not consider the option of developing chemical sanitising instead of thermal sanitising to be important. However, one manufacturer has classified the development towards lower temperatures firstly as very relevant and secondly as increasingly important. In view of this, this technology development option must be clarified in the further course of this study.

6.2.5. Best Not yet Available Technology (BNAT)

A patent research has been carried out to identify technologies or technological features that are currently under research and development or in the early stages of commercialisation. These Best Not yet Available Technologies (BNAT) are currently not widely used, but have the potential to enable significant advances in environmental performance. The research resulted in the following innovations:

6.2.5.1. Supercritical carbon dioxide cleaning

- Patent number: CN105686777A
- Origin: China
- Year of publication: 2016
- This technology for dishwashers utilises supercritical carbon dioxide as a cleaning medium, offering high cleanliness and environmental benefits. The design includes a cleaning seal chamber, ultrasonic transducers and a separation kettle for efficient cleaning.
- Reference: https://patents.google.com/patent/CN105686777A/en

6.2.5.2. Combined ultrasonic and spray cleaning

- Patent number: KR20230085690A
- Origin: South Korea
- Year of publication: 2023
- This dishwasher technology integrates ultrasonic cleaning with traditional spray methods, aiming to enhance cleaning efficiency and reduce water and energy consumption.
- Reference: https://patents.google.com/patent/KR20230085690A/en

6.2.5.3. Closed loop heat pump drying

- Patent number: EP3542114B1
- Origin: Europe
- Year of publication: 2020
- The core of this technology is a drying system that incorporates a heat pump assembly operating with a primary fluid, connected to multiple heat sources and sinks to improve the energy efficiency of drying processes.
- Reference: https://patents.google.com/patent/EP3542114B1/en

6.2.5.4. Enzyme cleaning agents

- Patent number: EP3542114B1
- Origin: Germany
- Year of publication: 2014
- This invention relates to a detergent for dishwashers comprising enzymes, phosphorus-free complexing agents, non-ionic surfactants, propylene glycol and other components. The formulation is claimed to increase the cleaning efficiency while being environmentally friendly.
- Reference: https://patents.google.com/patent/DE102012107728A1/en

6.3. Production, distribution, end-of-life

This section covers the following aspects:

- Product weight and Bills-of-Materials;
- Energy use of manufacturing;
- Primary scrap/waste produced during manufacturing;
- Volume and weight of the packaged product;
- Means of transport employed;
- Technical product life (time-to-failure of critical parts);
- Material flows and collection effort at end-of-life (secondary waste), to landfill/ incineration/ recycling/ re-use.

6.3.1. Product weight and Bills-of-Materials

In the following, the Bill-of-Materials (BOM) for each of the professional dishwasher categories is presented, as defined in Task 1 (see section 3.2.3.7).

6.3.1.1. Category 1: Undercounter water-change dishwashers

According to stakeholder input, the material composition is equivalent to that of a household dishwasher as described in the preparatory study on washing machines and dishwashers (Lot 14). Therefore, the BOM has been taken from the 2011 preparatory study on professional dishwashers, see Task 4 report (2011 values).

Table 6-11: Material composition of an undercounter water-change dishwasher (category 1) - 2011 values

Material / component	weight in g	weight in ratio %	Material category
Stainless Steel	24,560	51.0	3-Ferro
Steel Sheet galvanized	403	0.8	3-Ferro
Cast Iron	2,303	4.8	3-Ferro
Polypropylen (PP)	4,980	10.3	1-BlkPlastics
Polyamid (PA)	399	0.8	2-TecPlastics
Polymethylmetacrylate (PMMA)	6	0.0	2-TecPlastics
Acrylonitrile Butadiene Styrene (ABS)	751	1.6	1-BlkPlastics
Plystyrene (PS)	512	1.1	1-BlkPlastics
Styropor expandable polystyrene (EPS)	40	0.1	1-BlkPlastics
Polybutylene Terephthalate (PBT)	35	0.1	1-BlkPlastics
Polyvinylchlorid (PVC)	403	0.8	1-BlkPlastics
EPDM-rubber	524	1.1	1-BlkPlastics
POM	230	0.5	1-BlkPlastics
PE	187	0.4	1-BlkPlastics

Material / component	weight in g	weight in ratio %	Material category
Plastics others	268	0.6	1-BlkPlastics
Aluminium	273	0.6	4-Non-ferro
Cu wire	1,006	2.1	4-Non-ferro
CuZn38 cast	23	0.0	4-Non-ferro
Chrom	71	0.1	4-Non-ferro
Bitumen	6,089	12.6	7-Misc.
Concrete	1,263	2.6	7-Misc.
Cotton	452	0.9	7-Misc.
Epoxy	609	1.3	2-TecPlastics
Wood	2,034	4.2	7-Misc.
others (paper)	285	0.6	7-Misc.
Electronics (control)	448	0.9	6-Electronics
Total net	**48,154**	**100.0**	

According to the input received during the 2nd stakeholder consultation in 2024, bitumen, concrete and cotton are not used in category 1 dishwashers. Furthermore, wood and others (paper) are considered to be part of the packaging. Therefore, these materials have been removed from the BOM and the weight ratio has been updated accordingly.

Table 6-12: Material composition of an undercounter water-change dishwasher (Category 1) - 2024 values

Material / component	weight in g	weight in ratio %	Material category
Stainless Steel	24,560	64.6	3-Ferro
Steel Sheet galvanized	403	1.1	3-Ferro
Cast Iron	2,303	6.1	3-Ferro
Polypropylen (PP)	4,980	13.1	1-BlkPlastics
Polyamid (PA)	399	1.0	2-TecPlastics
Polymethylmetacrylate (PMMA)	6	0.0	2-TecPlastics
Acrylonitrile Butadiene Styrene (ABS)	751	2.0	1-BlkPlastics
Plystyrene (PS)	512	1.3	1-BlkPlastics
Styropor expandable polystyrene (EPS)	40	0.1	1-BlkPlastics
Polybutylene Terephthalate (PBT)	35	0.1	1-BlkPlastics
Polyvinylchlorid (PVC)	403	1.1	1-BlkPlastics
EPDM-rubber	524	1.4	1-BlkPlastics
POM	230	0.6	1-BlkPlastics
PE	187	0.5	1-BlkPlastics
Plastics others	268	0.7	1-BlkPlastics
Aluminium	273	0.7	4-Non-ferro
Cu wire	1,006	2.6	4-Non-ferro
CuZn38 cast	23	0.1	4-Non-ferro
Chrom	71	0.2	4-Non-ferro
Epoxy	609	1.6	2-TecPlastics
Electronics (control)	448	1.2	6-Electronics
Total net	**38,031**	**100.0**	

6.3.1.2. Category 2: Undercounter one-tank dishwashers

The following table shows the parts list of a typical category 2 dishwasher. The shares of the different materials and the category to which the materials are assigned are presented. The dataset is again taken from the Lot 14 Task 4 report.

Table 6-13: Material composition of an undercounter one-tank dishwasher (category 2)

Material / component	Weight in g	Fraction in %	Material category according to MEEuP
Stainless steel	49,760	71.2	3-Ferrous
Polypropylene (PP)	4,565	6.5	1-BlkPlastics
Polyamide (PA)	500	0.7	2-TecPlastics
Epoxy	1,000	1.4	2-TecPlastics
Acrylonitrile Butadiene Styrene (ABS)	70	0.1	1-BlkPlastics
Pumps (copper)	2,500	3.6	4-Non-ferrous
Pumps (stack of sheets)	2,500	3.6	3-Ferrous
Pumps (stainless steel wave)	2,250	3.2	3-Ferrous
Pumps (Al)	2,250	3.2	4-Non-ferrous
Cable (copper)	1,100	1.6	4-Non-ferrous
Cable sheath (PVC)	600	0.9	1-BlkPlastics
Cable sheath (silicone, EDPM)	300	0.4	1-BlkPlastics
Electronics (control)	500	0.7	6-Electronics
Gaskets (EDPM)	2,040	2.9	1-BlkPlastics
Total net	**69,935**	**100.0**	

In general, the data from the Lot 14 Task 4 report was confirmed by stakeholders. Nevertheless, it was noted that the proportion of stainless steel has increased (up to 80%). However, it was not specified which materials are used to a lesser extent in return. Therefore, the values from the Lot 24 Task 4 report were provisionally left unchanged. The adjustment of the proportional composition needs to be clarified during the stakeholder meeting (see corresponding question in section 6.5). The same is applicable to the stakeholder information that epoxy would already be included in the electronics (control). But this is contradicted by the fact that the electronics, weighing only 500 g, have a much lower mass than the 1,000 g of epoxy and therefore cannot contain it.

Moreover, one manufacturer provided a BOM for a category 2 dishwasher with a lower weight and a different material composition (less stainless steel, more polymers in return). As it is still subject to review whether this material composition reflects an existing market trend for category 2, the BOM is currently not presented here.

6.3.1.3. Category 3: Hood-type dishwashers

The following table shows the BOM of a typical dishwasher of category 3, the shares of the different materials and the category to which the materials are assigned. Also this dataset is taken from the 2011 preparatory study on professional dishwashers, Task 4 report.

Table 6-14: Material composition of a hood-type dishwasher (category 3)

Material / component	Weight in g	Weight in ratio %	Material category
Stainless steel	93,090	79.1	3-Ferrous
Polypropylene (PP)	4,310	3.7	1-BlkPlastics
Polyamide (PA)	1,000	0.8	2-TecPlastics
Epoxy	800	0.7	2-TecPlastics
Acrylonitrile Butadiene Styrene (ABS)	70	0.1	1-BlkPlastics
Pumps (copper)	3,000	2.5	4-Non-ferrous
Pumps (stack of sheets)	3,000	2.5	3-Ferrous
Pumps (stainless steel wave)	2,500	2.1	3-Ferrous
Pumps (Al)	3,000	2.5	4-Non-ferrous
Cable (copper)	1,700	1.4	4-Non-ferrous
Cable sheath (PVC)	1,000	0.8	1-BlkPlastics
Cable sheath (silicone, EDPM)	500	0.4	1-BlkPlastics
Electronics (control)	600	0.5	6-Electronics
Gaskets (EDPM)	3,085	2.6	1-BlkPlastics
Total net	**117,655**	**100.0**	

Similar to category 2, stakeholders generally confirmed also category 3 data from the 2011 preparatory study, Task 4 report. Again, it was noted that the proportion of stainless steel has increased (up to 80%). However, it was not specified which materials are used to a lesser extent in return. Therefore, the values from the Lot 24 Task 4 report were provisionally left unchanged. The adjustment of the proportional composition needs to be clarified during the stakeholder meeting (see corresponding question in section 6.5). The same is applicable to the stakeholder information that epoxy would already be included in the electronics (control). But this is contradicted by the fact that the electronics, weighing only 600 g, have a much lower mass than the 800 g of epoxy and therefore cannot contain it.

Besides this, one manufacturer provided a BOM for a category 3 dishwasher with a significantly higher weight and a different material composition. As it is still subject to review whether this material composition reflects an existing market trend for category 3, the BOM is currently not presented here.

6.3.1.4. Category 4: Utensil / pot dishwashers

The following table shows the BOM of a typical dishwasher of category 4 (without granulates[95]), the shares of the different materials and the category to which the materials are assigned. The dataset is again taken from the 2011 preparatory study on professional dishwashers, Task 4 report.

[95] Granulate dishwashers are not seen as typical for category 4 but rather as special case. The material composition is thus based on a pot dishwasher without granulates. Granulate dishwashers will be further analysed in Task 6.

Table 6-15: Material composition of a utensil / pot dishwasher (category 4)

Material / component	Weight in g	Weight in ratio %	Material category
Stainless steel	165,000	80.1	3-Ferrous
Polypropylene (PP)	3,000	1.5	1-BlkPlastics
Polyamide (PA)	4,000	1.9	2-TecPlastics
Epoxy	0	0.0	2-TecPlastics
Ethylene Propylene Dien M-class rubber (EPDM)	4,000	1.9	1-BlkPlastics
Acrylonitrile Butadiene Styrene (ABS)	0	0.0	1-BlkPlastics
Pumps (copper)	5,000	2.4	4-Non-ferrous
Pumps (stack of sheets)	4,000	1.9	3-Ferrous
Pumps (stainless steel wave)	3,000	1.5	3-Ferrous
Pumps (Al)	5,000	2.4	4-Non-ferrous
Cable (copper)	2,400	1.2	4-Non-ferrous
Cable sheath (PVC)	1,400	0.7	1-BlkPlastics
Cable sheath (silicone, EDPM)	1,100	0.5	1-BlkPlastics
Electronics (control)	2,100	1.0	6-Electronics
Gaskets, etc. (EDPM)	6,000	2.9	1-BlkPlastics
Total net	**206,000**	**100.0**	

Similar to the previous categories, stakeholders generally confirmed also category 4 data from the 2011 preparatory study on professional dishwashers, Task 4 report. Again, it was noted that the proportion of stainless steel has increased (up to 85%). However, it was not specified which materials are used to a lesser extent in return. Therefore, the values from the 2011 preparatory study were provisionally left unchanged. The adjustment of the proportional composition needs to be clarified during the stakeholder meeting (see corresponding question in section 6.5).

6.3.1.5. Category 5: One-tank conveyor-type dishwashers

The following table shows the BOM of a typical dishwasher of category 5, the shares of the different materials and the category to which the materials are assigned. The dataset is again taken from the 2011 preparatory study on professional dishwashers, Task 4 report.

Table 6-16: Material composition of a one-tank conveyor-type dishwasher (category 5)

Material / component	Weight in g	Weight in ratio %	Material category
Stainless steel	642,250	72.06	3-Ferrous
Polypropylene (PP)	55,500	6.23	1-BlkPlastics
Polyamide (PA)	6,140	0.69	2-TecPlastics
Polyvinyl chloride (PVC)	4,600	0.52	1-BlkPlastics
Polystyrene (PS)	4,430	0.50	1-BlkPlastics
Acrylonitrile Butadiene Styrene (ABS)	5,000	0.56	1-BlkPlastics
Pumps (copper)	16,825	1.89	4-Non-ferrous
Pumps (stack of sheets)	15,625	1.75	3-Ferrous
Pumps (stainless steel wave)	12,335	1.38	3-Ferrous
Pumps (Al)	17,470	1.96	4-Non-ferrous
Condenser (AL)	4,720	0.53	4-Non-ferrous
Condenser (Cu)	7,080	0.79	4-Non-ferrous
Ventilator, fan (AL)	17,440	1.96	4-Non-ferrous
Ventilator, fan (Cu)	10,160	1.14	4-Non-ferrous
Drive motor (AL)	4,000	0.45	4-Non-ferrous
Drive motor (Cu)	5,000	0.56	4-Non-ferrous
Cable (copper)	16,300	1.83	4-Non-ferrous
Cable sheath (PVC)	8,640	0.97	1-BlkPlastics
Cable sheath (silicone, EDPM)	5,170	0.58	1-BlkPlastics
Electric contactor (copper)	10,000	1.12	4-Non-ferrous
Electronics (control)	9,800	1.10	6-Electronics
Gaskets (EDPM)	12,800	1.44	1-BlkPlastics
Total net	**891,285**	**100.00**	

Category 5 (one-tank) conveyor-type dishwashers are also available with a steam heating system. In this case the additional material input for the heating system is estimated to be 150 kg (mainly stainless steel).

Similar to the previous categories, stakeholders generally confirmed also category 5 data from the 2011 preparatory study on professional dishwashers, Task 4 report. Again, it was noted that the proportion of stainless steel has increased (up to 85%). However, it was not specified which materials are used to a lesser extent in return. Therefore, the values from the 2011 study were provisionally left unchanged. The adjustment of the proportional composition needs to be clarified during the stakeholder meeting (see corresponding question in section 6.50).

6.3.1.6. Category 6: Multi-tank conveyor-type dishwashers

The following table shows the BOM of a typical dishwasher of category 6, the shares of the different materials and the category to which the materials are assigned. The dataset is again taken from the 2011 preparatory study on professional dishwashers, Task 4 report (2011 values).

Table 6-17: Material composition of a multi-tank conveyor-type dishwasher (category 6) – 2011 values

Material / component	Weight in g	Weight in ratio %	Material category
Stainless steel	980,000	76.3	3-Ferrous
Polypropylene (PP)	58,000	4.5	1-BlkPlastics
Polyamide (PA)	18,660	1.5	2-TecPlastics
Epoxy	0	0.0	2-TecPlastics
Ethylene Propylene Dien M-class rubber (EPDM)	12,000	0.9	1-BlkPlastics
Acrylonitrile Butadiene Styrene (ABS)	0	0.0	1-BlkPlastics
Pumps (copper)	39,020	3.0	4-Non-ferrous
Pumps (stack of sheets)	37,070	2.9	3-Ferrous
Pumps (stainless steel wave)	25,370	2.0	3-Ferrous
Pumps (Al)	44,880	3.5	4-Non-ferrous
Cable (copper)	19,800	1.5	4-Non-ferrous
Cable sheath (PVC)	11,440	0.9	1-BlkPlastics
Cable sheath (silicone, EDPM)	8,360	0.7	1-BlkPlastics
Electronics (control)	15,400	1.2	6-Electronics
Gaskets, etc. (EDPM)	15,000	1.2	1-BlkPlastics
Total net	**1,285,000**	**100.0**	

Category 6 (multi-tank) conveyor-type dishwashers are also available with a steam heating system. In this case the additional material input for the heating system is estimated to be 200 kg (mainly stainless steel).

As for the previous categories, stakeholders noted that the share of stainless steel has increased. The proportion is considered to be much higher than indicated above, up to 95%. However, it was not specified which materials are used to a lesser extent in return. Therefore, the values from the 2011 preparatory study on professional dishwashers, Task 4 report, were provisionally left unchanged. The adjustment of the proportional composition needs to be clarified during the stakeholder meeting (see corresponding question in section 6.5).

It was also noted that category 6 dishwashers are generally equipped with heat recovery. Therefore, the corresponding lines from category 5 (see Table 6-17) have been added to the BOM of category 6, see updated table below (2024 values).

Table 6-18: Material composition of a multi-tank conveyor-type dishwasher (category 6) – 2024 values

Material / component	Weight in g	Weight in ratio %	Material category
Stainless steel	980,000	72.9	3-Ferrous
Polypropylene (PP)	58,000	4.3	1-BlkPlastics
Polyamide (PA)	18,660	1.4	2-TecPlastics
Epoxy	0	0.0	2-TecPlastics
Ethylene Propylene Dien M-class rubber (EPDM)	12,000	0.9	1-BlkPlastics
Acrylonitrile Butadiene Styrene (ABS)	0	0.0	1-BlkPlastics
Pumps (copper)	39,020	2.9	4-Non-ferrous
Pumps (stack of sheets)	37,070	2.8	3-Ferrous
Pumps (stainless steel wave)	25,370	1.9	3-Ferrous
Pumps (Al)	44,880	3.3	4-Non-ferrous
Condenser (AL)	4,720	0.4	4-Non-ferrous
Condenser (Cu)	7,080	0.5	4-Non-ferrous
Ventilator, fan (AL)	17,440	1.3	4-Non-ferrous
Ventilator, fan (Cu)	10,160	0.8	4-Non-ferrous
Drive motor (AL)	4,000	0.3	4-Non-ferrous
Drive motor (Cu)	5,000	0.4	4-Non-ferrous
Cable (copper)	19,800	1.5	4-Non-ferrous
Cable sheath (PVC)	11,440	0.9	1-BlkPlastics
Cable sheath (silicone, EDPM)	8,360	0.6	1-BlkPlastics
Electric contactor (copper)	10,000	0.7	4-Non-ferrous
Electronics (control)	15,400	1.1	6-Electronics
Gaskets, etc. (EDPM)	15,000	1.1	1-BlkPlastics
Total net	**1,343,400**	**100.0**	

6.3.1.7. Overview of all dishwasher categories

An overview of the material input in the different categories of professional dishwashers is shown in the following tables (both absolute values and shares of material categories according to MEErP, including packaging material).

Table 6-19: Material input for the different categories of professional dishwashers (material categories according to MEErP, including packaging)

Materials-category	Unit	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Cat. 5	Cat. 6
Bulk Plastics	g	8,826	8,075	9,465	16,000	99,080	110,090
TecPlastics	g	1,014	1,500	1,800	4,000	6,140	18,660
Ferrous	g	27,266	54,510	98,590	172,000	670,210	1,042,440
Non-ferrous	g	1,373	5,850	7,700	12,400	108,995	103,700
Coating	g	0	0	0	0	0	0
Electronics	g	448	500	600	2,100	9,800	15,400
Misc.	g	11,769	8,750	17,000	19,500	79,000	174,710
Total weight	g	50,696	79,185	135,155	226,000	973,225	1,465,000

For classification details see the legend to the following table.

Table 6-20: Share of material categories (according to MEEuP) for the different categories of professional dishwashers (including packaging)

Materials-category	Unit	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Cat. 5	Cat. 6
Bulk Plastics	g	17.4%	10.2%	7.0%	7.1%	10.2%	7.5%
Tec Plastics	g	2.0%	1.9%	1.3%	1.8%	0.6%	1.3%
Ferrous	g	53.8%	68.8%	72.9%	76.1%	68.9%	71.2%
Non-ferrous	g	2.7%	7.4%	5.7%	5.5%	11.2%	7.1%
Coating	g	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Electronics	g	0.9%	0.6%	0.4%	0.9%	1.0%	1.1%
Misc.	g	23.2%	11.1%	12.6%	8.6%	8.1%	11.9%
Total weight	**g**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Cat. 1 Undercounter front loaders with water-change operation

Cat. 2 Undercounter front loaders with one-tank

Cat. 3 Hood-type dishwashers

Cat. 4 Utensil / pot dishwashers

Cat. 5 One-tank conveyor-type dishwashers

Cat. 6 Multi-tank conveyor-type dishwashers

In all categories, the share of ferrous metal (mainly stainless steel) is with approximately 55% to 75% (including packaging) predominant. According to the input received during the second stakeholder consultation in 2024, the share of stainless steel is estimated to be even higher (80-95%, see sections 6.3.1.2 - 6.3.1.6).

International standards like ASTM or NSF/ANSI as well as standards in Europe (for example DIN 10510) require the use of corrosion resistant material for surfaces exposed to wash and rinse water according to the intended use environment (cf. Task 1).

6.3.2. Assessment of the energy use of manufacturing

Concerning the energy used for the production of professional dishwashers, only one stakeholder provided data for categories 2 to 6. The values are shown in the table below.

Table 6-21: Energy use of manufacturing for the different categories of professional dishwashers

Professional dishwasher category	energy use of manufacturing (kWh / unit)
Category 1: Undercounter water-change dishwashers	no data available
Category 2: Undercounter one-tank dishwashers	30
Category 3: Hood-type dishwashers	36
Category 4: Utensil/pot dishwashers	40
Category 5: One-tank conveyor-type dishwashers (belt/basket)	250
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	300

Unfortunately, there is no publicly available data on this aspect. Hence, it will be necessary to verify during the stakeholder meeting whether this data set is representative for all manufacturers of professional dishwashers.

6.3.3. Assessment of the primary scrap production during sheet metal manufacturing

As shown in section 6.3.1, the Bill of Material of professional dishwashers contains a high proportion of metals, in particular stainless steel. Against this background, the primary scrap generated during sheet metal production is considered to be a relevant parameter for the overall environmental performance of professional dishwashers.

In this respect, the EcoReport Tool dataset for steel sheet stamping and bending stamping and bending single route, assumes a default value of 5% loss. It will be necessary to verify with stakeholders whether this assumption applies to the manufacturing process for all categories of professional dishwashers.

6.3.4. Packaging materials

In the 2011 preparatory study on professional dishwashers, Task 4 report, packaging materials were included in the BOM of the different dishwasher categories. For the purpose of the present report, these 2011 values have been summarised in a separate overview (see following table).

Table 6-22: Average type and weight of the packaging in the different categories of professional dishwashers - 2011 values

Professional dishwasher category	EPS (weight in g)	PE-Foil (weight in g)	Polystyrene (weight in g)	Wood (weight in g)	Cardboard (weight in g)
Category 1: Undercounter water-change dishwashers	724	172	-	1,011	635
Category 2: Undercounter one-tank dishwashers	-	-	500	6,000	2,750
Category 3: Hood-type dishwashers	-	-	500	12,250	4,750
Category 4: Utensil/pot dishwashers	-	-	500	16,000	3,500
Category 5: One-tank conveyor-type dishwashers (belt/basket)	-	-	2,940	63,500	15,500
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	-	-	5,290	141,180	33,530

(Source: Based on final conclusions as presented in Tables 5, 7, 9, 12, 14, and 16 of the Task 4 report of the 2011 preparatory study on professional dishwashers)

The partially wide range of individual packaging materials reflects the differences between dishwashers from different manufacturers.

Table 6-23: Average type and weight of the packaging in the different categories of professional dishwashers - 2024 values

Professional dishwasher category	EPS (weight in g)	PE-Foil (weight in g)	Polystyrene (weight in g)	Wood (weight in g)	Cardboard (weight in g)	Other materials (weight in g)
Category 1: Undercounter water-change	724	172	-	1,011	635 – 19,000	
Category 2: Undercounter one-tank	-	250	500 - 600	3,000 – 6,000	2,750 – 13,500	500 – 1,000 (PP plastic strip)
Category 3: Hood-type	-	-	500 - 600	12,250	4,750 – 13,500	500 – 1,000 (PP plastic strip)
Category 4: Utensil/pot	-	-	500 - 600	13,500 - 16,000	3,500 – 10,500	500 – 1,000 (PP plastic strip)
Category 5: One-tank conveyor-type dishwashers	-	90 – 6,000	2,940	63,500 – 98,000	0 – 15,500	11,000 (iron)
Category 6: Multi-tank conveyor-type dishwashers	-	150 – 8,000	5,290	125,000 - 270,000	0 – 33,530	15,000 (iron)

(Source: Based on final conclusions as presented in Tables 5, 7, 9, 12, 14, and 16 of Task 4 report of the 2011 Preparatory Study on Professional dishwashers; updated according to feedback from the 2nd stakeholder consultation)

Several stakeholders stressed that the exact weights depend heavily on the individual models and options, the country of destination and the means of transport required (e.g. ocean freight). In addition, for category 6, the quantities vary greatly depending on the number of parts into which the appliance is split for shipping, while the number of parts depends on the length of the appliance.

6.3.5. Volume and weight of the packaged product

The following table shows an overview of the average volume and weight of the final packaged product. These values are used to calculate the environmental impacts resulting from distribution. The dataset is again taken from the 2011 Preparatory Study on Professional dishwashers, Task 4 report (2011 values).

Table 6-24: Average volume and weight of the final packaged product in the different categories of professional dishwashers

Professional dishwasher category	Average volume of the final packaged product 2011 values	Average volume of the final packaged product 2024 values	Average weight of the final packaged product 2011 values	Average weight of the final packaged product 2024 values
Category 1: Undercounter water-change dishwashers	0.40 m^3	0.40 m^3	ca. 50 kg	ca. 50 kg
Category 2: Undercounter one-tank dishwashers	0.48 m^3	0.47 - 0.60 m^3	ca. 80 kg	50 - 110 kg, depending on model, variants and choosen options
Category 3: Hood-type dishwashers	1.03 m^3	1.03 – 2.4 m^3	ca. 135 kg	135 - 255 kg, depending on model, variants and choosen options
Category 4: Utensil/pot dishwashers	4.95 m^3	1.6 – 4 m^3	ca. 225 kg	320-420 kg, depending on model, variants and choosen options
Category 5: One-tank conveyor-type dishwashers (belt/basket)	12.25 m^3	2 - 12.25 m^3	ca. 975 kg	ca. 975 kg other values possible depending on model, variants and choosen options
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	16.58 m^3	16.58 - 22 m^3	ca. 1,465 kg	ca. 1,465 kg other values possible depending on model, variants and choosen options

(Source: Task 4 report of 2011 Preparatory Study on Professional dishwashers; updated with data from 2nd stakeholder consultation 2024 highlighted in red colour)

Several stakeholders provided feedback on this dataset, resulting in an updated dataset (2024 values) that once more mirrors a wide range of differences between dishwashers from various manufacturers.

6.3.6. Actual means of transport employed in shipment of components, sub-assemblies and finished products

Depending on data availability, the means of transport employed in shipment of components, sub-assemblies and finished products as well as corresponding distances have to be modelled according to the PEF guidance[96]. For example, for the transport of the finished product it needs to be clarified, which transport scenarios apply to the distribution of professional dishwashers (see following figure).

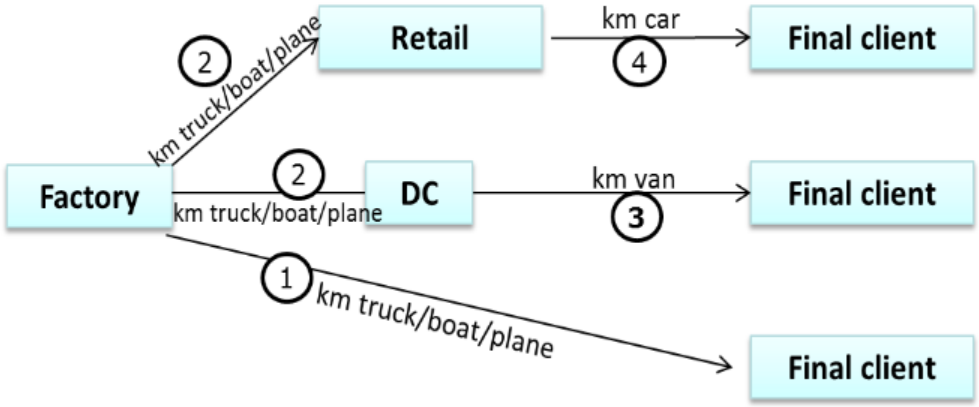


Figure 6-15: Default transport scenario according to PEFCR[97]

It is assumed that only direct delivery to the final client and delivery via a distribution center (DC, see figure above) are applicable for professional dishwashers.

In case of direct delivery to the final client, the following modelling parameters apply:

- In case of a local supply chain: 1,200 km by truck (>32 t, EURO 4);
- In case of a intracontinental supply chain: 3,500 km by truck (>32 t, EURO 4);
- In case of international supply chain: 1,000 km by truck (>32 t, EURO 4) and 18,000 km by ship (transoceanic container).

The immediate next step in the analysis is therefore to clarify the distribution structure for professional dishwashers and the shares of the individual supply chain scenarios (local / intracontinental international).

96 https://eplca.jrc.ec.europa.eu/permalink/PEFCR_guidance_v6.3-2.pdf

97 https://eplca.jrc.ec.europa.eu/permalink/PEFCR_guidance_v6.3-2.pdf

6.3.7. Technical product life

The product life of professional dishwashers as well as the most important priority parts in terms of necessary repairs / spare parts have already been covered in sections 5.5.1 and 5.5.2. The next step of the analysis will be the assessment / estimation of the time-to-failure of the parts mentioned in section 5.5.2 (see Table 5-19).

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

This section provides considerations regarding the end-of-life material flows of the professional dishwashers for handling as pure waste (landfill, pyrolytic incineration), heat recovery (non-hazardous incineration optimised for energy recovery), recycling and/or re-use.

At the end of their life time (for details, cf. Task 3), almost no professional dishwasher will end at a landfill, as materials are too valuable. For this reason, most products will either be refurbished or recycled for scrap parts or materials. We assumed that only 5% by weight of the products are not recovered (i.e. go to landfill) during the end-of-life phase. Indeed, in principle, almost all materials in the dishwashers' composition are recovered (assumption: 95% in post-WEEE conditions according to MEErP) and follow one of the following options:

- Metals are recycled;
- Paper, cardboard, and plastics are incinerated (thermal recycling with possible benefits of energy recovery) or mechanically recycled. Plastics may also be directly reused;
- Other types of waste (concrete, bitumen) go to landfill. Hazardous waste consists only of electronic components, which are considered easy to disassemble and are in limited quantity (around 1% of the total weight).

The plastic share of professional dishwashers is mostly less than 10% related to its overall weight (see Table 6-20). Regarding the recovered plastic fraction, the following end-of-life management options were estimated for all categories, based on stakeholders' feedback:

- Thermal recycling: 70 %.
- Material (or mechanical) recycling: 29 %
- Re-use, closed loop recycling: 1 %

Printed wiring boards (PWB) are used in dishwashing machines of all categories. According to stakeholder information, these parts are easy to dismantle and are completely recycled by certified scrap dealers.

If a dishwasher with an installed heat pump is dismantled, specialised technicians will extract the refrigerant from the heat pump. In this process, only a technically unavoidable, small amount of refrigerant will escape.

6.4. Aspects beyond MEErP

Beyond the aspects foreseen under the current methodology for energy-related products, the study team will also consider further specific aspects with relevance to the new regulatory scheme under ESPR, especially Article 5 on ecodesign requirements and on Article 8ff. on a Digital Product Passport (DPP).

6.4.1. Analysis of critical raw materials and substances of concern

This relates in particular to the presence of critical raw materials (CRM) and the analysis of potential substances of concern (SoC). Within this context, the following substances were covered by the desk research and the 2nd stakeholder consultation in 2024.

6.4.1.1. Refrigerants

Dishwashers of categories 5 and 6 can be equipped with a heat pump containing refrigerants. The refrigerants used are R-134a (tetrafluorodichlorethene), R-407C (a hydrofluorocarbon blend of R-32, R-125, and R-134a), R-513a and others with an average filling of approx. 1.5 kg. According to stakeholder feedback, refrigerants are not used in the other dishwasher categories 1 to 4. As the use of heat pumps is considered as BAT (Best Available Technology), this aspect will be further elaborated in Task 6.

6.4.1.2. Mercury

According to stakeholders, the dishwashers of all six categories do not contain mercury. All materials used within the products comply with the restrictions set out in the RoHS Directive (cf. section 3.4.1.4).

6.4.1.3. Silver ions

According to stakeholders, the dishwashers of all six categories do not contain silver ions. There is no need of silver ions in dishwashers, because there are other possibilities (temperature, chemistry, steam) to guarantee hygienic standards.

6.4.1.4. Permanent magnets (containing neodymium)

According to input received during the 2nd stakeholder consultation in 2024, permanent magnets containing neodymium are used in drive and fan motors, microswitches (reed contact), sensors for detecting fill levels, spray arm speeds, position detection of sieves, flaps, floats, flow meters, etc. Ferrite-based permanent magnets are also used in cutlery lifting magnets, electric pumps as well as sensors.

With regard to the corresponding quantities, stakeholders reported for motors 6 magnets of 11.5 g each or 4 magnets of 3.4 g each (NdFeB), for reed magnets approx. 100 g, for door locks 1.5 g (NdFeB). Drain pumps contain 38.5 g (ferrite), sensors contain various ferrite magnets of approx. 1 g each, cutlery lifting magnet approx. 5-10 kg (ferrite).

Regarding the advantages of permanent magnets (containing neodymium), stakeholders mentioned their effectiveness, reliability and affordability. Alternatives for motors are considered to be inferior in terms of efficiency, performance and energy consumption. For many applications, contactless signal or force transmission using permanent magnetism is seen as a solution with no known alternatives. Where mechanically activated door switches are used, the risk of malfunction due to dirt / vapour / chemicals and mechanical influences is considered to be high. In the case of reed switches, magnet-based components reduce the failure rate by operating in harsh and dirty conditions. Disadvantages of neodymium-based permanent magnets are corrosion problems. This is not the case with ferrite-based permanent magnets.

6.4.1.5. Other critical raw materials

Stakeholders mentioned copper, which is used in wires, as well as several other critical raw materials used in electronic boards and circuits.

6.4.1.6. Other substances of concern

According to stakeholder input, lead is contained in copper and brass alloys as well as in heating elements. Furthermore, boric acid, PTFE and PVDF were mentioned. This information is applicable to all dishwashing categories.

6.4.2. Analysis of circular economy aspects

Beyond these aspects foreseen under the current methodology for energy-related products, the study team will also consider further specific aspects within the context of circular economy with relevance to the new regulatory scheme under ESPR, especially Article 5 on ecodesign requirements and on Article 8ff. on a Digital Product Passport, which are the following:

- Special focus on existing design approaches for circular economy (durability, reliability, reparability, maintenance, refurbishment) and resource efficiency, as well as current materials, components or technologies potentially impeding a circular approach, such as integrated components like electronics;
- Existing application of recycled materials;
- Remanufacturing and recycling technologies;
- Application of novel production technologies like 3D-printing, relevant in terms of environmental impacts or availability of spare parts for professional dishwashers;
- Existing approaches of the professional dishwasher's sector to develop Digital Product Passports[98].

In terms of repairability, the importance of spare parts is obvious. For the possibility to estimate the impact of maintenance and repair, the MEErP methodology foresees taking a present percentage of the impacts of the materials as inputs to the Bill of Materials. In the 2011 preparatory study, a default value = 1% was taken as percentage for all categories of professional dishwashers. This estimate was confirmed by the feedback from the 2nd stakeholder consultation in 2024.

The other aspects mentioned above are the subject of ongoing research and will be included in the final version of this report.

[98] Currently the JRC is developing a methodology for the preparation of a DPP. When available and if still possible, this method will be used within this study for the analysis and proposal of DPP requirements and design.

6.4.3. Analysis and consideration of DPP-induced requirements

6.4.3.1. DPP-requirements and options to decide for existing EPREL system or new DPP system

The ESPR outlines several requirements for the Digital Product Passport (DPP) in Chapter III, Articles 9 to 15:

- Article 9 Digital product passport
- Article 10 Requirements for the digital product passport
- Article 11 Technical design and operation of the digital product passport
- Article 12 Unique identifiers
- Article 13 Digital product passport registry
- Article 14 Web portal for data in the digital product passport
- Article 15 Customs controls relating to the digital product passport

Two exceptions are specified in the ESPR 2024/1781, Article 9, paragraph 4, regarding cases when a DPP is not required:

- '4. When setting the requirements related to the digital product passport, the Commission may exempt product groups from the requirement to have a digital product passport where:
    - technical specifications of the digital product passport are not available in relation to the essential requirements included in Articles 10 and 11; or
    - other Union law includes a system for the digital provision of information related to a product group which the Commission considers achieves the objectives referred to in paragraph 3, points (a) and (b).'

Regarding Article 9, paragraph 4, the EPREL database serves as a system under Union law for the digital provision of information. Currently, professional dishwashers are not included in the EPREL system. However, there is potential for using the EPREL system, as the product group is similar to household dishwashers, especially considering that the revised MEErP methodology is not yet available. The EPREL system operates on a centralised database, with information accessible via a website and a QR code linking to the website's information. EPREL focuses on energy-related information, meaning that other ecodesign-related information is currently not included. Therefore, EPREL may not be sufficient for all product groups with new system or information requirements.

There are three main options to meet DPP and information requirements, exemplified in the following table and described below:

Table 6-25 Different options to meet DPP system and information requirements

	System			Information		
	EPREL system	EPREL system extended	DPP System	EPREL	EPREL extended	DPP
Industrial and professional laundry appliances		x	x		x	x
Household washing machines and household washer-dryers	x			x	x	
Household dishwashers	x			x	x	
Professional dishwashers		x	x		x	x

- The product group already exists within the EPREL system, meaning the exemption from DPP requirements according to ESPR 2024/1781, Article 9, paragraph 4(b) applies. In this case, the EPREL system can be used, but there may be new information that is relevant. While the EPREL system is sufficient, the information it contains needs to be expanded.
- The product group is not yet included in EPREL, but the EPREL system and/or information might still be sufficient. In this case, the EPREL system can be extended by adding a new product category with similar information and system features (e.g., QR code).
- The product group is not present in EPREL, and there are requirements that EPREL cannot meet. In this situation, the requirements must be evaluated, and the DPP system and information design specified. For example, a QR code may not be sufficient, and an RFID chip that can be read during recycling might be necessary.

The approach for analysing DPP and information requirements was not yet available within the revised MEErP methodology at the time of the analysis of Tasks 1-4.

For the next steps this study will follow, to the extent possible, the envisaged JRC approach, based on the JRC ‘Call for Tender EC-JRC/SVQ/2024/MVP/1837 - Technical Assistance in Defining Requirements for the Inclusion of Data and Information in the Digital Product Passport (DPP)’. The call foresees the use of so-called ‘use cases’ to define the necessary DPP information and system. DPP use cases are specific objectives that can be achieved with the DPP for (environmental or economic) benefit. The following table shows the use case developed in the Battery Pass and CIRPASS projects for the electronics sector. There is also a qualitative assessment (rating) by experts.

Table 6-26 Exemplary DPP use cases at certain stages and their relevance

DPP use case	Stage	Rating
Reliable communication of ESG data	Business	High
Informed purchasing decisions	Consumer	High
Eased servicing	Business / Repair	Medium
Precise risk assessment for transport	Transport	None
More efficient recycling processes	Recycling / Reuse	Low
Simplified residual value determination	Reuse	Medium
Streamlined trade of waste	Recycling	Medium
Efficient data exchange and reporting	Business	Low
Increased end-of-life collection	Consumer	Low
Industry benchmarking	Business	High
Accurate market overview	Business	Low
Informed policy design	Business	High

This use case oriented approach will make it possible to determine whether specific use cases, such as 'more efficient recycling processes' are relevant. For example, relevance may arise when waste products contain several hazardous substances or valuable materials, such as CRMs. Providing this information to recyclers is critical to effectively sorting products within the waste stream. It is therefore important to ensure that the necessary data is included in the Digital Product Passport (DPP), or another system for the digital provision of information which the Commission considers achieves the DPP objectives. The use case also includes considerations for the DPP system.

For the DPP system, the type of data carrier is particularly important. A QR code may be suitable for larger products that are unlikely to be exposed to dirt or wear and tear, as it ensures that the code remains readable throughout the life cycle of the product. For smaller products, where a QR code may not be practical, an RFID chip may be required.

The logic for deriving use case based DPP information and DPP system aspects will need to be defined by the JRC as part of a harmonised methodology under the revised MEErP. Following this logic, use cases and associated DPP requirements will be provided in Task 5 of this Preparatory Study. The use case approach takes into account, among other factors, the relevance of the CRM content and information required for specific stakeholders, the data carrier (QR code or RFID chip) and the DPP registry. It is important to note that the harmonised approach to the analysis of DPP requirements will be introduced with the revision of the MEErP. Therefore, this analysis is qualitative and addresses DPP essentials, but will not include the full quantitative analysis of stakeholder-specific DPP requirements.

The design measures developed under Task 6 of the Preparatory Study will include the information to be included into the DPP, or another system for the digital provision of information which the Commission considers achieves the DPP objectives.

6.5. Open questions to stakeholders

6.5.1. Main characteristics of existing products

Category 1

The weight (without packaging) for a typical category 1 dishwasher of approx. 50 kg was judged to be up to date by stakeholders. However, in current product sheets for this category, up to 75 kg could be found. What is the average weight of a typical category 1 dishwasher?

Category 2

According to stakeholder input, the maximum capacity 40 racks/h is only theroretical. When taking into account loading and unloading, in real life only a maximum of 20 racks/h is possible. Can this value be confirmed by all stakeholders?

Category 3

According to stakeholder input, the maximum capacity 60-80 racks/h is only theroretical. When taking into account loading and unloading, in real life only a maximum of 40 racks/h is possible. Can this value be confirmed by all stakeholders?

According to stakeholder input, a relatively wide range concerning weight (100-200 kg) has been reported, depending on choosen model and options. What is a typical / average value in this respect to dishwashers in this category?

Category 4

Since the main characteristics of an dishwasher with granulate have not been covered in the 2nd stakeholder consultation, values from the 2011 preparatory study, Task 4 report, are presented that have been updated with current product data sheets of manufacturers: Can the current data set be confirmed by stakeholders?

All categories

According to stakeholder input, number of programmes has increased in recent years, especially in the high-end segment. Can this trend of diversification of programmes be confirmed by all stakeholders?

All categories

Has the washing capacity reported by stakeholder been measured according to EN 17735?

6.5.2. Product weight and Bills-of-Materials

Categories 2-6

It was noted by stakeholders that the proportion of stainless steel has increased (up to 80% - 95%, depending on dishwasher category). Can this trend be confirmed by all stakeholders? Which materials are used to a lesser extent in return?

According to stakeholder input, epoxy is considered to be already included in the electronics (control). But this is contradicted by the fact that the electronics have a much lower mass than that of epoxy and therefore cannot contain it. Can this assessment be confirmed by all stakeholders?

Category 2

One manufacturer provided a BOM for a category 2 dishwasher with a lower weight and a different material composition (less stainless steel, more polymers in return). Does this material composition reflect an existing market trend for category 2?

Category 3

One manufacturer provided a BOM for a category 3 dishwasher with a significantly higher weight (approx. 180 kg instead of approx. 120 kg) and a different material composition (less stainless steel, more polymers in return). It needs to be reviewed whether this material composition reflects an existing market trend for category 3. Does this material composition reflect an existing market trend for category 2

6.5.3. Assessment of the energy use of manufacturing

Can the existing data set for manufacturing energy use be confirmed by stakeholders? Is it representative for all professional dishwashers? Can the data gap for category 1 be filled?

6.5.4. Products with standard improvement (design) options

Can you verify the device features mentioned in section 6.2.3 that are assigned to standard improvement (design) options?

Would the use of local supply with steam or hot water provide advantages over electric heating of operating fluids for cleaning and rinsing from a holistic energy point of view?

6.5.5. Best Available Technology (BAT)

According to the desk research and stakeholder input, the following technological features have the potential to be considered as BAT:

- Heat recovery (wastewater and steam);

- Automatic adaptation of the programme to the load and degree of soiling of the dishes / utensils;
- Water treatment (demineralisation and reverse osmosis);
- Low temperature cleaning.

Can you confirm that this is BAT and provide further information on the technological features mentioned?

What automatic adjustments to load and soiling level of dishes / utensils are available for each dishwasher category and how much energy, water and detergent can be saved?

Do you see lower temperature dishwashing and related technological developments seen as a sensible direction of development, and how do you view the use of chemicals for chemical sanitisation assessed in this context?

Are you aware of any other relevant innovation that should be classified as BAT?

6.5.6. Best Not yet Available Technology (BNAT)

Can you confirm that the technologies or technological features outlined in section 6.2.5 have a relevant potential for significant improvements in environmental performance but are currently not used in existing products on the market?

Are you aware of further relevant innovation that should be classified as BNAT?

7. References

Australian Government (Hg.) (2024): Energy Rating. Dishwashers. Online verfügbar unter https://www.energyrating.gov.au/industry-information/products/dishwashers/old-dishwashers, zuletzt geprüft am 14.11.2024.

Blauer Engel (Hg.) (2022): Maschinengeschirrspülmittel DE-UZ 201. Vergabekriterien. Version 3. Online verfügbar unter https://produktinfo.blauer-engel.de/uploads/criteriafile/de/DE-UZ%20201-202201-de-Kriterien-V3.pdf, zuletzt geprüft am 30.10.2024.

Caldas, M. G.; Spiliotopoulos, Christoforos; Alfieri, Felice; Umberto Eynard, Luca Zampori, Gian Andrea Blengini, Lucia Mancini, Fabrice Mathieux, Fulvio Ardente (2022): Review of the MEErP - Methodology for Ecodesign of Energy-related Products. Joint Research Centre (JRC). Online verfügbar unter https://susproc.jrc.ec.europa.eu/product-bureau//sites/default/files/2021-09/MEErP_revision_draft_report_Task_1-2_24-06-2021.pdf.

EC (Hg.) (o. J.): EU Ecolabel Product Groups and Criteria. European Commission (EC). Online verfügbar unter https://environment.ec.europa.eu/topics/circular-economy/eu-ecolabel/product-groups-and-criteria_en#discover-the-full-range-of-eu-ecolabel-product-groups, zuletzt geprüft am 16.08.2024.

EC (1994): European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, vom 31.12.1994. In: Official Journal (L 365/10). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31994L0062, zuletzt geprüft am 16.08.2024.

EC (2004): Regulation (EC) No 648/2004 of the European Parliament and of the Council of 31 March 2004 on detergents (Text with EEA relevance). In: Official Journal (L 104/1). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02004R0648-20150601#E0004, zuletzt geprüft am 08.11.2024.

EC (2006a): Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast). Machine Directive, vom 09.06.2006. In: Official Journal (L 157/24). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006L0042, zuletzt geprüft am 19.04.2024.

EC (2006b): 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), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC. REACH. In: Official Journal (L 396/1). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R1907, zuletzt geprüft am 14.11.2024.

EC (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), vom 18.12.2008. In: Official Journal 51 (L 339), S. 45–52. Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R1275, zuletzt geprüft am 12.08.2024.

energieschweiz (Hg.) (2023): Anforderungen für gewerbliche Geschirrspüler. Faktenblatt Mai 2023. Ittigen. Online verfügbar unter https://www.bfe.admin.ch/bfe/en/home/efficiency/energy-labels-and-efficiency-requirements/commercial-appliances/requirements-for-commercial-dishwashers.html, zuletzt geprüft am 14.11.2024.

EU (2011): 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, vom 01.07.2011. In: Official Journal (L 174/88). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011L0065, zuletzt geprüft am 19.04.2024.

EU (2012a): Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast). WEEE, vom 24.07.2012. In: Official Journal (L 197/38). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0019, zuletzt geprüft am 26.07.2024.

EU (2012b): Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products Text with EEA relevance. Biocide, vom 27.06.2012. In: Official Journal (L 167/1). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0528, zuletzt geprüft am 19.04.2024.

EU (2014a): Directive 2014/30/EU of the European Parliament and of the Council of 26.2.2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility. EMC, vom 29.03.2014. In: Official Journal (L 96/79). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0030, zuletzt geprüft am 19.04.2024.

EU (2014b): 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), vom 22.05.2014. In: Official Journal (L153/62). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0053, zuletzt geprüft am 15.08.2024.

EU (2014c): 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, vom 20.05.2014. In: Official Journal (L 150/195). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0517, zuletzt geprüft am 16.08.2024.

EU (2016a): 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), vom 20.04.2016. In: Official Journal (L 104/27). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016D0611, zuletzt geprüft am 22.04.2024.

EU (2016b): 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), vom 31.03.2016. In: Official Journal (L 81/99). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0426, zuletzt geprüft am 16.08.2024.

EU (2020): Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. WFD. In: Official Journal (L 327), S. 1–73. Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32000L0060, zuletzt geprüft am 14.11.2024.

EU (2023a): 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, vom 04.07.2023. In: Official Journal (L 169/35). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R1230R(01), zuletzt geprüft am 07.08.2024.

EU (2023b): 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, vom 04.07.2023. In: Official Journal (L 169/35). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R1230R(01), zuletzt geprüft am 07.08.2024.

EU (2023c): 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), vom 29.06.2023. In: Official Journal (L 165/1). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R1230, zuletzt geprüft am 16.08.2024.

EU (2023d): 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), vom 29.06.2023. In: Official Journal (L 165/1). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R1230, zuletzt geprüft am 16.08.2024.

EU (2024): Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858,

(EU) 2018/1724 and (EU) 2019/1020 (Text with EEA relevance). CRM Act, vom 03.05.2024. In: Official Journal (L series). Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401252, zuletzt geprüft am 30.07.2024.

EU Ecolabel (Hg.) (2024): EU Ecolabel for detergents and cleaning products. User manual. Version 1.5. Online verfügbar unter https://environment.ec.europa.eu/document/download/4985a329-5418-4f12-92db-f28225cbc4ec_en?filename=DETERGENTS_User_Manual_V1.4_October_%202022_3.pdf, zuletzt geprüft am 30.10.2024.

EUR-Lex (2024): Packaging and packaging waste. Summary of: Directive 94/62/EC on packaging and packaging waste. Hg. v. European Union. Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM:l21207, zuletzt aktualisiert am 19.09.2024.

European Commission (EC) (Hg.) (2012): RoHS 2 FAQ. DG ENV. Online verfügbar unter https://environment.ec.europa.eu/document/download/051e7e21-a0cc-4cb0-a3aa-ae6cb7f13488_en?filename=FAQ%20key%20guidance%20document%20-%20RoHS.pdf, zuletzt geprüft am 02.08.2024.

European Commission (EC) (Hg.) (2014): Frequently Asked Questions on Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE). DG ENV. Online verfügbar unter https://circabc.europa.eu/ui/group/636f928d-2669-41d3-83db-093e90ca93a2/library/c4bd6fd7-910c-4196-b0c2-1a792089e5cc/details?download=true, zuletzt geprüft am 06.08.2024.

European Commission (EC) (Hg.) (2018): Supplementary Guidance on the LVD/EMCD/RED. DG Internal Market, Industry, Entrepreneurship and SMEs. Online verfügbar unter https://ec.europa.eu/docsroom/documents/29121, zuletzt geprüft am 15.08.2024.

European Commission (EC) (Hg.) (2024a): Guidances relating to the Regulation (EU) 2016/426. Online verfügbar unter https://ec.europa.eu/docsroom/documents/60254, zuletzt geprüft am 07.08.2024.

European Commission (EC) (Hg.) (2024b): Guide to application of the Machinery Directive 2006/42/EC. Edition 2.3 – April 2024 (Update of 2nd Edition). DG GROW. Online verfügbar unter https://ec.europa.eu/docsroom/documents/60145, zuletzt geprüft am 07.08.2024.

European Commission (EC) (Hg.) (2024c): Guide to application of the Machinery Directive 2006/42/EC. Edition 2.3 – April 2024 (Update of 2nd Edition). DG GROW. Online verfügbar unter https://ec.europa.eu/docsroom/documents/60145, zuletzt geprüft am 07.08.2024.

Kemna, René (2011): Methodology for Ecodesign of Energy-related Products MEErP 2011. Methodology Report, Part 1: Methods. Hg. v. European Commission. Brussels. Online verfügbar unter https://op.europa.eu/en/publication-detail/-/publication/b7650397-32f1-436c-82c4-df39aef297a3.

Ministère de la Transition écologique et de la Cohésion des territoires (Hg.) (2024): Indice de durabilité. Online verfügbar unter https://www.ecologie.gouv.fr/politiques-publiques/indice-durabilite#:~:text=L%27indice%20de%20durabilit%C3%A9%20est,%3A%20T%C3%A9l%C3%A9viseur%20et%20lave%2Dlinge, zuletzt aktualisiert am 18.07.2024, zuletzt geprüft am 16.08.2024.

Ministère de l'économie des finances et de la souveraineté industrielle et numérique (Hg.) (2024): Tout savoir sur l'indice de réparabilité. Online verfügbar unter https://www.economie.gouv.fr/particuliers/tout-savoir-indice-reparabilite, zuletzt geprüft am 16.08.2024.

Ministère de l'Économie, des Finances er de l'Industrie et Ministère chargé du Budget et des Comptes publics (Hg.) (2021): Les pièces détachées : l'information sur leur disponibilité. Online verfügbar unter https://www.economie.gouv.fr/dgccrf/Publications/Vie-pratique/Fiches-pratiques/les-pieces-detachees, zuletzt aktualisiert am 13.01.2021, zuletzt geprüft am 22.10.2024.

Nordic Swan (Hg.) (n. d.): Dishwasher detergents for professional use 080. Online verfügbar unter https://www.nordic-swan-ecolabel.org/criteria/dishwasher-detergents-for-professional-use-080/, zuletzt geprüft am 30.10.2024.

Nordic Swan (Hg.) (2024): Nordic Ecolabelling for Dishwasher detergents for professional use. Version 3.8. 25 November 2021 - 31 December 2027. Online verfügbar unter https://www.nordic-swan-ecolabel.org/498b38/contentassets/4fbf7d89969d452097042cd798bfd3d7/criteria-document-for-product-group-080_080_dishwasher-detergents-for-professional-use-080_english.pdf, zuletzt geprüft am 30.10.2024.

Sustainable Energy Authority of Ireland (seai) (Hg.) (o. J.): Accelerated Capital Allowance. Online verfügbar unter https://www.seai.ie/grants/business-grants/accelerated-capital-allowance/, zuletzt geprüft am 16.08.2024.

Sustainable Energy Authority of Ireland (seai) (Hg.) (n. d.): Accelerated Capital Allowances Eligibility Criteria - Category: Catering & Hospitality Equipment - Technology: Commercial Dishwashers. Ref. No.: CDI-C1.0. Online verfügbar unter https://www.seai.ie/sites/default/files/publications/Commercial_dishwashers.pdf, zuletzt geprüft am 30.10.2024.

Swiss Federal Office of Energy (Hg.) (2023): Requirements for commercial dishwashers. Online verfügbar unter https://www.bfe.admin.ch/bfe/en/home/efficiency/energy-labels-and-efficiency-requirements/commercial-appliances/requirements-for-commercial-dishwashers.html, zuletzt aktualisiert am 15.08.2023, zuletzt geprüft am 14.11.2024.

US DOE (2022): Standards and Test Procedures. Clothes Washers. Online verfügbar unter https://www.energy.gov/eere/buildings/standards-and-test-procedures, zuletzt aktualisiert am 16.09.2024.

US EPA/DOE (Hg.) (2021): ENERGY STAR® Program Requirements. Product Specification for Commercial Dishwashers - Eligibility Criteria. Version 3.0. U.S. Environmental Protection Agency (US EPA); U.S. Department of Energy (US DOE). Online verfügbar unter https://www.energystar.gov/sites/default/files/2024-

08/Commercial%20Dishwashers%20Version%203.0%20Specification%20Rev.%20-%20September%202021.pdf, zuletzt geprüft am 31.10.2024.

Appendix 1 – Online questionnaire of 1st stakeholder consultation

ESPR Preparatory Study and Impact Assessment support study on Professional Dishwashers

Consultation on product scope, definitions, standards and legislation

This study focuses on professional dishwashing appliances. They are used to clean, rinse, and dry wash ware that is connected to the preparation, cooking, arrangement or serving of food (including drinks) in commercial and industrial market segments. The heating of the water or air can be realised by electricity or by other energy sources like steam or gas.

The following consultation has been developed to request information relevant for Task 1 of the preparatory study. MEErP Task 1 aims to define the product category and system boundaries of the ‘playing field’ for ecodesign in relation to professional dishwashing machines. This is important for a realistic definition of design options and improvement potential and is also relevant in the context of technically defining any implementing legislation or voluntary measures (if any).

Information collected through this consultation shall be taken into consideration in the definition of the scope of professional dishwashing machines to be considered in potential future regulation for this sector. Such information is also important in order to allow the definition of base cases for establishing the performance of relevant equipment to be looked at in the following tasks. Therefore, after the scope is established, a further consultation shall be launched regarding the information needed for completion of MEErP Tasks 2, 3 and 4 (markets, users, and technologies).

The 2011 preparatory study specified the following definitions in relation to the product group at hand:

‘Professional dishwasher’ means a machine which cleans, rinses, and dries wash ware like dishware, glassware, cutlery, and other utensils connected to the preparation, cooking, arrangement or serving of food (including drinks) by chemical, mechanical, and thermal means; which is connected to electric mains and which is designed to be used principally for commercial and industrial purposes as stated by the manufacturer in the Declaration of Conformity (DoC).

The delimitation of professional dishwashers from household dishwashers was determined on the basis of the 'intended use' ('domestic' or 'commercial/industrial') as declared by the manufacturer in the product information or the Declaration of Conformity.

On this basis, the scope of the 2011 preparatory study on professional dishwashers was defined and categorised as follows:

– Category 1: Undercounter water-change dishwashers (semi-professional)

– Category 2: Undercounter one-tank dishwashers

– Category 3: Hood-type dishwashers

- Category 4: Utensil/pot dishwashers
- Category 5: One-tank conveyor-type dishwashers (belt/basket)
- Category 6: Multi-tank conveyor-type dishwashers (belt/basket)

At this stage of the study, either confirmation or a revision and refinement of the scope and definitions proposed in the past is a key focus.

We kindly ask you to answer the following questions by 31 August 2024 at the latest.

The information and data that you provide to the survey shall be used only by the study partners in the preparation of the "Preparatory Study and Impact Assessment support study on professional dishwashers". 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-commdishwashers@oeko.de).

By responding to this consultation, you are agreeing to the conditions specified in our privacy policy (see here**) and confirming that your contact details (e.g. name, email) may be shared with the partners conducting the study and used for future contact in relation to this study. Your contact details shall only be used for the purpose of this study.**

This survey contains 11 questions.

There are 18 questions in this survey.

Responding person

Please choose **only one** of the following:

- ◯ Mrs
- ◯ Mr
- ◯ Non-binary

First name *

Please write your answer here:

Last name *

Please write your answer here:

Organisation *

Please write your answer here:

Position *

Please write your answer here:

Email address *

Please write your answer here:

Product definition

The definition mentioned in the introduction differs slightly from the definition of commercial dishwashers given in EN IEC 63136:2019 or ENERGY STAR.
In this context, which definition do you consider to be the most appropriate for a possible future product regulation?

*

Please write your answer here:

Delimitation to household dishwashers

Would the term "non-household" be a feasible way of unambiguously delimiting professional/commercial/industrial from household dishwashers which are covered by Commission Regulations (EU) 2019/2022 and (EU) 2019/2017 on Ecodesign and Energy labelling for household dishwashers?

*

Please write your answer here:

Delimitation to household dishwashers

How can an external party (e.g. consumers, market surveillance) clearly recognise whether a dishwasher is a household or non-household appliance (e.g. based on a specific regulation to be met or a specific technical parameter/feature)?

*

Please write your answer here:

Delimitation to household dishwashers

Are there any technical parameters that could be used for the delimitation between professional and household use of dishwashing machines? For each of the following parameters, please explain why it would be suitable for this purpose or why not:

*

	Field for explanation
Type of materials and/or components used (in terms of robustness)	
Planned lifetime (e.g., in number of cycles)	
Detergent dosage (e.g. automatic detergent dosage in case of professional dishwashers)	
Connected load (e.g., three phase connection (400V) in case of professional dishwashers)	
Level of programmability	
Aspects of the warranty to the user	
Further aspects	

Categorisation of product group

Do you agree that the current categorisation (see below) is fit for purpose?
If not, please explain why and indicate alternative categorisation parameters that in your opinion should be considered in a potential future regulation of professional dishwashers.

– Category 1: Undercounter water-change dishwashers (semi-professional)
– Category 2: Undercounter one-tank dishwashers
– Category 3: Hood-type dishwashers
– Category 4: Utensil/pot dishwashers
– Category 5: One-tank conveyor-type dishwashers (belt/basket)
– Category 6: Multi-tank conveyor-type dishwashers (belt/basket)
*

Please write your answer here:

Categorisation of product group

The following table specifies qualitative functional and performance parameters for dishwashers in the different categories, as concluded in the 2011 preparatory study report.
Do you consider this data to be up-to-date with the machines currently available on the market?

Please use the comment boxes below for each category if you have any additional information.

Note: n.a. = not applicable

	Category 1: Undercounter water-change dishwashers	**Category 2: Undercounter one-tank dishwashers**	**Category 3: Hood-type dishwashers**	**Category 4: Utensil/pot dishwashers**	**Category 5: One-tank conveyor-type dishwashers**	**Category 6: Multi-tank conveyor-type dishwashers**
Main properties						
Water supply	water-change operation	tank system/one-tank	tank system/ one-tank	tank system/ one-tank	tank system/one-tank	tank system/multi-tank
Operating principle of dishwashing machine	program automat	program automat	program automat	program automat	conveyor-type dishwasher	conveyor-type dishwasher
Type of loading	front loading	front loading	pass through	front loading or pass through	n.a.	n.a.
Means of transport	n.a.	n.a.	n.a.	n.a.	basket transport or conveyor belt	basket transport or conveyor belt
Number of baskets to be cleaned at the same time	two of three (on two or three levels)	one (on one level)	one or two (on one level)	one (on one level)	n.a.	n.a.
Size/format	uncercounter	uncercounter	cupboard size	undercounter or cupboard size	large conveyor-type dishwashers	large conveyor-type dishwashers
Way of utilisation	stationary	stationary or mobile	stationary or mobile	stationary	stationary	stationary
Heat sources	electricity	electricity	electricity	electricity low pressure steam or hot water	electricity low pressure steam or hot water, (natural gas)	electricity low pressure steam or hot water, (natural gas)
Variants	freestanding, built-under, integrated and fully integrated models	freestanding and built-under models		granulate dishwasher for black cookware		dishwasher for cleaning of reusable boxes and containers

*

	Category 1: Undercounter water-change dishwashers	Category 2: Undercounter one-tank dishwashers	Category 3: Hood-type dishwashers	Category 4: Utensil/pot dishwashers	Category 5: One-tank conveyor-type dishwashers	Category 6: Multi-tank conveyor-type dishwashers
Water supply						
Operating principle of dishwashing machine						
Type of loading						
Means of transport						
Number of baskets to be cleaned at the same time						
Size/format						
Way of utilisation						
Heat sources						
Variants						

Categorisation of product group

Would it be more suitable to introduce other/further categories in light of their effect on performance (e.g. differentiating between categories based on the energy source used for heating of water/air)?

*

Please write your answer here:

Scope of a possible future product regulation

Are there any types of professional dishwashers that in your opinion should be excluded from the scope of a possible future product regulation?
If so, please explain which ones and why.

*

Please write your answer here:

Standards for professional dishwashers

At the time of the previous preparatory study in 2011, standards were lacking that addressed the definition of different categories of professional dishwashers as well as methods for the testing of their performance (e.g., consumption of energy, water and detergents). Since then, existing standards (e.g. ENERGY STAR and NSF/ANSI 3) have been updated and new standards (e.g. EN IEC 63136:2019) have been developed.
Please indicate whether there are still any gaps or shortcomings and, if so, for which professional dishwashing categories and in what sense.

*

Please write your answer here:

Legislation on professional dishwashers

Are you aware of any legislation particularly relevant for professional dishwashers that has been introduced at EU, Member State or third country level since 2011?

*

Please write your answer here:

Additional comments

If you have any additional comments on the scope, definitions, standards and legislation, please do not hesitate to provide them.

Please write your answer here:

Completion of the survey

You have dealt with all the questions and are about to complete the survey.

Clicking 'Submit' will close the survey and you will not be able to add or change anything afterwards.

Alternatively, you can save the current status and continue later by clicking "Resume later" (top right).

You have now completed the survey.

Thank you for your participation!

Your contributions will be analysed by the project team to provide input for the
"Preparatory Study and Impact Assessment support study on Professional Dishwashers".

09-16-2024 – 16:12
Submit your survey.
Thank you for completing this survey.

Appendix 2 – Online questionnaire of 2nd stakeholder consultation

ESPR Preparatory Study and Impact Assessment support study on professional dishwashers

Stakeholder consultation on markets, users and technologies (MEErP Tasks 2, 3, and 4)

This study focuses on potential regulatory Ecodesign for Sustainable Products measures for professional dishwashing appliances. They are used to clean, rinse, and dry wash ware that is connected to the preparation, cooking, arrangement or serving of food (including drinks) in commercial and industrial market segments.

Based on the results of the 2011 preparatory study, professional dishwashers can be categorised as follows:

– Category 1: Undercounter water-change dishwashers (semi-professional)
– Category 2: Undercounter one-tank dishwashers
– Category 3: Hood-type dishwashers
– Category 4: Utensil/pot dishwashers
– Category 5: One-tank conveyor-type dishwashers (belt/basket)
– Category 6: Multi-tank conveyor-type dishwashers (belt/basket)

This stakeholder consultation has been prepared to request information relevant for MEErP Tasks 2, 3 and 4 of the preparatory study which is related to markets, users, and technologies of professional dishwashers.

Please note: The consultation consists of two parts! Questions are mainly to be answered through the online survey tool. For some more detailed questions, we provide you in addition a separate Excel file for download. We kindly ask you to contribute to the online survey and the separate Excel-based questionnaire (either as upload or via email to ecodesign-commdishwashers@oeko.de) by 15 October 2024 at the latest.

Information collected through this consultation will be of great importance to quantify the impacts of any implementing legislation or voluntary measures on professional dishwashers (if any). 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 professional dishwashers”. Please note that your comments and suggestions may be made public in the study reports or on the study website.

By filling out the online survey and/or returning the additional Excel-based questionnaire you are agreeing to the conditions specified in our privacy policy which can be viewed through the following link. Your contact details shall only be used for the purpose of this study.

In case of any questions please contact us through the project specific email: **ecodesign-commdishwashers@oeko.de**

There are 53 questions in this survey.

General data on your company and responding person

Please specify the **category of stakeholders** that you represent. *

Please choose **only one** of the following:

- ◯ Manufacturer or importer of professional dishwashers
- ◯ Industry association representing manufacturs of professional dishwashers
- ◯ Customers / User of professional dishwashers
- ◯ Industry association representing customers using professional dishwashers
- ◯ Company providing maintenance, repair or refurbishing of professional dishwashers
- ◯ End of Life service provider for professional dishwashers
- ◯ Other

Please select one option among the following

Responding person *

Please write your answer(s) here:

Mr / Mrs / non-binary	
First name	
Last name	
Organisation	
Position	
Email address	

Please fill in your contact details.

[MEErP Task 2 Markets] General questions related to markets of professional dishwashers

Background for the consultation on 'markets' (MEErPTask 2)

The following questions have been developed to request information relevant for MEErP Task 2 of the preparatory study on professional dishwashers. It aims to identify the key aspects of the market for the products in scope, as regards:
(1) the numbers of units being sold per year and the number of units in use (the stock) in each segment;
(2) the past and forecast evolutions of these numbers;
(3) the technical evolution of products;
(4) the economic, social and environmental costs and benefits associated with the production, the purchase, the operation and the disposal of the products.

Please note:
For additional, more detailed questions on MEErP Tasks 2, 3 and 4, the consulation consists of a **separate Excel file for download under this** LINK.

Please fill out the Excel-Tables in addition to this online survey and send them back either as upload via this online survey or via email to *ecodesign-commdishwashers@oeko.de*.

Kindly attach the aforementioned documents along with the survey

Please specify the number of employees (Full-Time Equivalent - FTE) of your company

Please write your answer here:

Please provide a numerical answer (in FTE)

Please specify the **total turnover** (in million euros - MEUR) of your company in 2023 in the business units related to professional dishwashers.

Please write your answer here:

Please provide a numerical answer (in MEUR)

Please specify the **turnover for each category of dishwashers** (in million Euros - MEUR) of your company in 2023 in the business units related to professional dishwashers.

	Please indicate the turnover in MEUR	Comments on individual rows
Category 1: Undercounter water-change dishwashers (semi-professional)		
Category 2: Undercounter one-tank dishwashers		
Category 3: Hood-type dishwashers		
Category 4: Utensil/pot dishwashers		
Category 5: One-tank conveyor-type		
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)		

To your knowledge, which **organisations** are active **in the field of repair / refurbishment / recycling** of professional dishwashers?

Please write your answer(s) here:

Organisations in the field of repairs of professional dishwashers:	
Organisations in the field of refurbishment of professional dishwashers:	
Organisations in the field of recycling of professional dishwashers:	

Please provide the names of organisations

[MEErP Task 2 Markets] Questions specific to manufacturers, importers and industry associations of professional dishwashers

Please provide the share of the sales of your company in the field of professional dishwashers that is exported, i.e. manufactured in the EU and sold outside of the EU.

Please write your answer here:

Please provide your answer in % of your turnover bearing on professional dishwashers

What are the top 5 countries, outside the EU, to which **your company exports** professional dishwashers?

Please write your answer(s) here:

Destination country 1 (= largest export market)

Destination country 2

Destination country 3

Destination country 4

Destination country 5 (= smallest export market)

Please include your answers in each of the boxes below, starting from the largest to the smallest export market.

Estimate the share (in market prices) of the EU internal market demand of professional dishwashers that are **covered by imports**, i.e. manufactured outside of the EU and sold in the EU.

Please write your answer here:

Please provide your answer in % of the total EU demand for professional dishwashers

To your knowledge, do subsidiaries of non-EU companies manufacture professional dishwashers in the EU?

Please choose **only one** of the following:

- ◯ Yes
- ◯ No

If answered "yes" to the former question, what are these companies, what are their countries of origin and where are their establishments of manufacturing sites in the EU located?

Please write your answer here:

Please include your answer in the box below

What is the approximate share of your company's turnover made from direct or indirect **sales to public clients (public procurement)** in the field of professional dishwashers over the past 5 years?

Please write your answer here:

Please include your answer in the box below in %.

Please provide an estimation of the current **efficiency ratio STOCK:NEW** in use phase.
This is a rough indicator of the ratio between the energy consumption of the average new product and the energy consumption of the average product installed, i.e. in stock). Usually it is <1, i.e., the stock efficiency (products sold about half a product lifetime ago) is worse than efficiency of new products.

Please write your answer(s) here:

Category 1: Undercounter water-change dishwashers	
Category 2: Undercounter one-tank dishwashers	
Category 3: Hood-type dishwashers	
Category 4: Utensil/pot dishwashers	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	

Can you specify a value for the **Weibull shape parameter** (beta) of your products (manufacturers usually determine this parameter to understand and predict how and when products are likely to fail).

Please write your answer here:

Can you specify a **value for the price elasticity of your products**, i.e., how responsive the quantity demanded of a product is to a change in the price assuming the following correlation between price (P) and variable costs of producing the products (CV):

$$\varepsilon = -\frac{P}{P - CV}$$

Please write your answer here:

Please select from the list below the technical features that apply to the professional dishwashers manufactured by your company and by all companies in the EU market, respectively.

*

Please choose the appropriate response for each item:

	Features applied in professional dishwashers manufactured by your company	Features applied in (probably) all professional dishwashers on the EU market
Heat exchanger	◯	◯
Heat Pump	◯	◯
Additional warm/hot water connection	◯	◯
Gas-operated heating	◯	◯
Steam-operated heating	◯	◯
Wash process with lower temperature	◯	◯
Recovering of wash water	◯	◯
Waste water heat recovery	◯	◯
Electronic stop controls (disconnect the machine from the mains supply a programme ending or after last user activity)	◯	◯

	Features applied in professional dishwashers manufactured by your company	Features applied in (probably) all professional dishwashers on the EU market
Improved rinsing systems	◯	◯
Automatic weigthing system/ automatic load control	◯	◯
Automatic dosing of detergents	◯	◯
Automatic adaptation of programme to load and to soiling level of dishes / utensils	◯	◯
Improved thermal insulation	◯	◯
Improved maintainability / repairability / capacity to be upgraded or refurbished (ease of dis-assembly and re-assembly, ease of access to servicing area, modular design)	◯	◯
Improved recyclability (avoidance or clear marking of substances of concern, separability of parts made of different materials)	◯	◯
Use of recycled plastics	◯	◯
Use of recycled metals	◯	◯
Reduced wear and stress imposed on dishes / utensils	◯	◯

	Features applied in professional dishwashers manufactured by your company	Features applied in (probably) all professional dishwashers on the EU market
Improved ergonomics of operation (load carrying, temperature, humidity, noise)	◯	◯

[MEErP Task 2 Markets] Questions specific to customers/users/user associations in the segment of professional dishwashers

Please specify the professional dishwashers that you typically operate:

Please choose **all** that apply:

- ☐ Category 1: Undercounter water-change dishwashers (semi-professional)
- ☐ Category 2: Undercounter one-tank dishwashers
- ☐ Category 3: Hood-type dishwashers
- ☐ Category 4: Utensil/pot dishwashers
- ☐ Category 5: One-tank conveyor-type dishwashers (belt/basket)
- ☐ Category 6: Multi-tank conveyor-type dishwashers (belt/basket)

Please specify the **total capacity in number of plates for each of the categories** of professional dishwashers that you operate.

Please write your answer here:

Please include your answers in the box below.

Please specify the **average number of cycles per year per machine for each of the categories** of the professional dishwashers that you operate.

Please write your answer here:

Please include your answers in the box below.

Please specify the **category of dishes / utensils being processed** by the professional dishwasher(s) that you operate.

Please choose all that apply and provide a comment:

☐ cutlery	
☐ plates and saucers	
☐ glasses	
☐ cups, bowls	
☐ saucepans	
☐ frying pans	
☐ oven dishes	
☐ other	

Choose from the list below (multiples answers possible)

In your assessment of Life-Cycle Costs (if any), **over what duration** do you perform your calculation?
Please specify for each dishwasher category, if necessary.

Please write your answer here:

Please include your answers (in years) in the box below.

In your assessment of Life-Cycle Costs (if any), what **discount rate** (interest minus inflation) do you use?

Please write your answer here:

Please include your answer (in % per year) in the box below.

Please provide an estimation of the **escalation rate** (project annual growth of running costs) related to professional dishwashers.

Please write your answer here:

Please include your answer (in % per year) in the box below.

Please provide an estimate of each of the following **sources of cost for your company in the use of the professional dishwasher(s)** that you use (if operating different categories of professional dishwashers, please specify for each dishwasher category).

Please write your answer(s) here:

upfront purchase	
installation/ commissioning	
energy costs per year	
water costs per year	
detergent costs per year	
operating labour costs per year	
maintenance / repair / upgrade costs per year	
downtime costs per year	
dis-installation / de-commissioning	
disposal of waste equipment	

Please include your answers in the boxes below (in EUR, excl. VAT)

[MEErP Task 2 Markets] Questions specific to companies providing maintenance, repair or refurbishing services, and/or to End-of-Life service providers

To your knowledge, does a **second-hand market for spare parts** of professional dishwashers exist in the EU?

Please choose **only one** of the following:

- ◯ Yes
- ◯ No

If answered yes to the former question, **at which scale does the second-hand market for spare parts** of professional dishwashers operate?

Please choose **only one** of the following:

- ◯ sub-Member State
- ◯ Member State
- ◯ the EU

To your estimation, what is the **share of the total demand for professional dishwashers** that is met by each of the categories below **of second-hand professional dishwashers**?

Please write your answer(s) here:

Professional dishwashers that can be directly re-used	
Professional dishwashers that can be re-used after refurbishment / upgrade	

Please include your answers in % in each of the boxes below.

What is the (predominant) nature of your current contractual relationship to the manufacturer(s) of professional dishwashers?

Please choose **only one** of the following:

- ◯ Exclusive right to repair, maintain or re-furbish over geographic zone
- ◯ Exclusive right to repair, maintain or re-furbish over range of products
- ◯ Non-exclusive right to repair, maintain or re-furbish over geographic zone
- ◯ Non-exclusive right to repair, maintain or re-furbish over range of products
- ◯ No contractual relationship
- ◯ Other

[MEErP Task 3 Users] Questions on usage of professional dishwashers

Background for the consultation on 'users' (MEErPTask 3)

MEErP Task 3 of the preparatory study aims to identify the influence of user behaviour (e.g. intensity of use, application temperature, programme selection, real load size) on the consumption of consumables (energy, water, detergent). The correlation between user behaviour and the specific energy consumption due to technical reasons is also to be clarified and quantified. Moreover, the end-of-life behaviour and the environmental impacts depend on the respective local infrastructure, which is also covered by this section. Besides the most used programme in professional dishwashing appliances, other common programmes are selectable which mainly differ by their duration, temperature and the respective cleaning performance, thus also resulting in different consumption values.

Please note:
For additional, more detailed questions on MEErP Tasks 2, 3 and 4, the consulation consists of a **separate Excel file for download under this** LINK.

Please fill out the Excel-Tables in addition to this online survey and send them back either as upload via this online survey or via email to *ecodesign-commdishwashers@oeko.de*.

Kindly attach the aforementioned documents along with the survey

The following **concentration values for detergents and rinse aids** were assumed as averages for calculations performed for all professional dishwashers in the 2011 preparatory study. Should new data not suggest otherwise, they will also be used in the current study as averages and for calculations.

- **Concentration of detergent**: **3.00 g/litre** (range of data: 2-4 g/litre)
- **Concentration of rinse aid**: **0.35 g/litre**.

Please write your answer here:

Do you have any comments on these values and/or data to support alterations?

If there is **consumption of additional consumables besides detergents / rinse aids** which needs to be taken into consideration, please specify them (and their values in respect of different professional dishwashing categories) below.

Please write your answer here:

According to the previous preparatory study from 2011, **off-mode consumption** is not relevant for this product category (annual off-mode consumption below <1 kWh/year).

Please choose **only one** of the following:

◯ Annual off-mode consumption of professional dishwashers has no relevance.

◯ Annual off-mode consumption of dishwashers is of relevance. Please consider off-mode consumption values for respective sub-categories provided in the comment.

Make a comment on your choice here:

Maloperation of professional dishwashers can influence the energy, water and detergent / rinsing aid consumption. Maloperation is usually a result of choosing the wrong programme or wrong dosage of detergent and rinsing aids (too little/too much). For the purposes of the study and further calculations the following values assumed in the 2011 preparatory study will be assumed if no other data is available as to the **average influence of maloperation on the ideal consumption of energy, water and detergents**:

- Professional dishwasher categories 1 to 4 (commercial dishwashers): **+10%**
- Professional dishwasher categories 5 to 6 (industrial dishwashers): **+5%**

Please choose **only one** of the following:

◯ I agree to these values

◯ I do not agree to these values

Make a comment on your choice here:

Do you agree with these values? If not, please explain your view and provide an alternative.

[MEErP Task 3 Users] Questions on maintenance, upgrades/repairs and end-of-life of professional dishwashers

Please provide an estimation of **average expected initial lifetime (years)** per dishwasher category (do not consider extension of lifetime through refurbishment in your answers).

Please write your answer(s) here:

Category 1: Undercounter water-change dishwashers	
Category 2: Undercounter one-tank dishwashers	
Category 3: Hood-type dishwashers	
Category 4: Utensil/pot dishwashers	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	

Please provide an estimation of **average frequency of maintenance action(s) (numbers per year)** per dishwasher category.

Please write your answer(s) here:

Category 1: Undercounter water-change dishwashers	
Category 2: Undercounter one-tank dishwashers	
Category 3: Hood-type dishwashers	
Category 4: Utensil/pot dishwashers	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	

Please provide an estimation of **average frequency of repair action(s) (numbers during lifetime)** per dishwasher category.

Please write your answer(s) here:

Category 1: Undercounter water-change dishwashers	
Category 2: Undercounter one-tank dishwashers	
Category 3: Hood-type dishwashers	
Category 4: Utensil/pot dishwashers	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	

Please specifiy most relevant **priority parts in terms of necessary repairs / spare parts** per dishwasher category.

Please write your answer(s) here:

Category 1: Undercounter water-change dishwashers	
Category 2: Undercounter one-tank dishwashers	
Category 3: Hood-type dishwashers	
Category 4: Utensil/pot dishwashers	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	

Please estimate the **average rate of labour for upgrade and/or repair activities** (Euro/hour) related to professional dishwashers.

Please write your answer here:

Please describe the **typical treatment at the end of the first service life** of professional dishwashers and/or their most relevant parts.

Please write your answer here:

Is **refurbishment** practiced for professional dishwashers?

If so, please specify for each professional dishwashing category by how much (years) this can extend the planned lifetime of an appliance (if relevant, specify whether there are multiple refurbishment cycles).

Please write your answer here:

[MEErP Task 4 Technologies] Questions on technologies / composition / materials of professional dishwashers

Background for the consultation on 'technologies' (MEErPTask 4)

MEErP Task 4 comprises a general technical analysis of the current products on the EU market. As part of it, the Bill of Materials and the whole life cycle analysis of the different product categories is to be identified. It is to provide first results regarding the annual energy, water and detergent consumptions of professional dishwashers over their lifetime. Furthermore, this task serves as a basis for the subsequent Tasks, especially MEErP Task 5 (definition of base cases) and for the identification of the improvement potential of professional dishwashers (MEErP Task 6).

The technical analysis of the production phase is to specify the product weight and Bill-of-Materials (BOM), distinguishing the weight of different materials fractions and electronic components at the level requested by the EcoReport Unit Indicators as proposed in the MEErP report. This includes manufacturing and packaging.

Please note:
For additional, more detailed questions on MEErP Tasks 2, 3 and 4, the consulation consists of a **separate Excel file for download under this** LINK.

Please fill out the Excel-Tables in addition to this online survey and send them back either as upload via this online survey or via email to *ecodesign-commdishwashers@oeko.de*.

Kindly attach the aforementioned documents along with the survey

Please provide an estimation of the **energy use of manufacturing/assembly (kWh)** of an appliance per dishwasher category.

Please write your answer(s) here:

Category 1: Undercounter water-change dishwashers	
Category 2: Undercounter one-tank dishwashers	
Category 3: Hood-type dishwashers	
Category 4: Utensil/pot dishwashers	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	

Refrigerants: In the 2011 preparatory study, it was concluded that professional dishwashers of categories 5 and 6 might be equipped with a heat pump containing refrigerant. The refrigerants used are R-134a (tetrafluorodichlorethene), R-407C (a hydrofluorocarbon blend of R-32, R-125, and R-134a) and others with an average filling of 3 to 4.5 kg.

*

Please choose **only one** of the following:

◯ Yes, refrigerants are used in professional dishwashers. Please specify in which dishwasher categories, in which components, which type of refrigerant(s) and the average (kg).

◯ No, refrigerants are not used in professional dishwashers

◯ I do not know

Make a comment on your choice here:

Do you agree that refrigerants are currently in use in professional dishwashers on the EU market?

Mercury: In the 2011 preparatory study, based on stakeholder input, it was concluded that mercury is not contained in any of the components of professional dishwashers. Such appliances were explained to conform to the Directive 2011/65/EU (RoHS), albeit without making use of any of the RoHS Annex III exemptions still valid for the use of mercury.

*

Please choose **only one** of the following:

- ◯ Yes, mercury is not used in professional dishwashers
- ◯ No, mercury is used in lamps of professional dishwashers
- ◯ No, mercury is used in other components of professional dishwashers - please specify which
- ◯ I do not know

Make a comment on your choice here:

Do you agree that mercury is currently not in use in professional dishwashers on the EU market?

Silver is used in various applications to promote the release of silver ions under moisture conditions. These have an antibacterial activity that is useful in certain areas, e.g., water treatment, medical applications, etc.
In the 2011 preparatory study, based on stakeholder input, it was concluded that silver was not applied anymore in professional dishwashers.

*

Please choose **only one** of the following:

- ◯ Yes, silver is currently not used in professional dishwashers
- ◯ No, silver is used in certain components of professional dishwashers - please specify which
- ◯ I do not know

Make a comment on your choice here:

Do you agree that silver is currently not in use in professional dishwashers on the EU market?

Permanent magnets / Critical Raw Materials: The proposal for a Critical Raw Material Act (see COM(2023) 160 final; 2023/0079(COD)) states that permanent magnets are incorporated in a wide variety of products, referring among others to "heat pumps, electric motors, industrial electric pumps, etc.".

The permanent magnets commonly used in permanent magnet motors include sintered magnets and bonded magnets with the main types being aluminium-nickel-cobalt, ferrite, samarium cobalt, neodymium iron boron. Some of these contain materials which have been identified by the European Commission as critical raw materials.

*

Please choose **only one** of the following:

- ◯ Yes, permanent magnets are used in professional dishwashers - please detail in which components or auxiliary equipment
- ◯ No, permanent magnets are not used in professional dishwashers
- ◯ I do not know

Make a comment on your choice here:

Are permanent magnets currently used in professional dishwashers?

Permanent magnets: If you answered "Yes" to the previous question, please specify the **composition and typical weight** of the permanent magnets applied in professional dishwashers. Please refer in your answer to the various dishwashing categories and specify if and which type of magnets are typically used in each category.

Please write your answer here:

Permanent magnets: Does the use of these magnet-based components have an **advantage over alternative components**? Please detail such aspects.

Are there any **design alternatives to the magnet-based components** and what would be their advantages and/or disadvantages, e.g. in terms of performance and/or environmental impacts?

*

Please write your answer(s) here:

Advantages of magnet-based components over alternative components	
Alternative design solutions to magnet-based components and their advantages and/or disadvantages	

Critical Raw Materials: Beyond the questions on permanent magnets, are there other Critical Raw Materials in professional dishwashers (e.g., in small batteries or other electronics)?

Please write your answer here:

Please specify the components containing CRM, the type of CRM and - if known - the typical weight of CRM contained in professional dishwashers.

Substances of Concern (SoC): Do the components or materials of professional dishwashers contain regulated or restricted substances (REACH SVHC, REACH Annex XVII substances or other regulatory programmes)? If so, which?

Please write your answer(s) here:

Category 1: Undercounter water-change dishwashers	
Category 2: Undercounter one-tank dishwashers	
Category 3: Hood-type dishwashers	
Category 4: Utensil/pot dishwashers	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	

Spare parts: For the possibility to estimate the impact of maintenance and repair, the methodology foresees taking a present percentage of the impacts of the materials as inputs to the Bill of Materials (BoM). In the 2011 preparatory study, a **default value = 1%** was taken as percentage for all categories of professional dishwashers.

*

Please choose **only one** of the following:

- ◯ Yes, I agree to the default value of 1% of spare parts for all dishwasher categories.
- ◯ No, I do not agree to the default value of 1% of spare parts for all dishwasher categories. Please consider more specific data in the comment.
- ◯ I do not know

Make a comment on your choice here:

Do you agree with the default value of 1% of the total Bill of Materials for the impacts of spare parts for all dishwasher categories?

Limescale: Hard water leads to limescale build-up on the heating element of dishwashers as well as on drums, pipes and hoses. Over time, as the limescale build up increases, this can cause heating element failure and subsequently reduces the lifetime of the dishwasher. What measures are taken in professional dishwashers to prevent limescale build up and its subsequent impacts on appliance and wash ware. How common is the use of such measures in the design of appliances and/or by their consumers?

Please write your answer(s) here:

Measures of product design to prevent limescale in professional dishwashers	
Measures of maintenance to prevent limescale in professional dishwashers	
Other measures to prevent limescale in professional dishwashers	

You have now completed the survey.

Thank you for your participation!

Your contributions will be analysed by the project team to provide input for the
"Preparatory Study and Impact Assessment support study on Professional Dishwashers".

10-23-2024 – 11:38
Submit your survey.
Thank you for completing this survey.

Appendix 3 – Excel questionnaire of 2nd stakeholder consultation

ESPR Preparatory Study and Impact Assessment support study on professional dishwashers

Stakeholder consultation on markets, users and technologies (MEErP Tasks 2, 3, and 4) - Introduction & Guidance

This study focuses on professional dishwashing appliances. They are used to clean, rinse, and dry wash ware that is connected to the preparation, cooking, arrangement or serving of food (including drinks) in commercial and industrial market segments.

Based on the results of the 2011 preparatory study, professional dishwashers can be categorised as follows:
– Category 1: Undercounter water-change dishwashers (semi-professional)
– Category 2: Undercounter one-tank dishwashers
– Category 3: Hood-type dishwashers
– Category 4: Utensil/pot dishwashers
– Category 5: One-tank conveyor-type dishwashers (belt/basket)
– Category 6: Multi-tank conveyor-type dishwashers (belt/basket)

This stakeholder consultation has been prepared to request information relevant for MEErP Tasks 2, 3 and 4 of the preparatory study related to markets, users, and technologies of professional dishwashers.

Please note: The consultation consists of two parts! Questions are mainly to be answered through the online survey tool. For some more detailed questions, we provide you in addition this separate Excel file. We kindly ask you to contribute to the online survey and the separate Excel-based questionnaire (either as upload to the online survey or via email to ecodesign-commdishwashers@oeko.de) by 15 October 2024 at the latest.

Information collected through this consultation will be of great importance to quantify the impacts of any implementing legislation or voluntary measures on professional dishwashers (if any). 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 professional dishwashers". Please note that your comments and suggestions may be made public in the study reports or on the study website.

By filling out the online survey and/or returning the additional Excel-based questionnaire you are agreeing to the conditions specified in our privacy policy which can be viewed through the following link. Your contact details shall only be used for the purpose of this study.

In case of any questions please contact us through the project specific email:
ecodesign-commdishwashers@oeko.de

Link to Privacy Policy

Provision of answers to the questions in this file to the email ecodesign-commdishwashers@oeko.de will be considered as agreement to the privacy policy and confirmation that your contact details (e.g., name, email) can be shared with the partners performing the study and used for future contact in relation to this study.

Responding person: Please fill in your contact details

Mr / Mrs / non-binary	
First name	
Last name	
Organisation	
Position	
Email address	

Please put a cross to the category of stakeholders that you represent

	Manufacturer or importer of professional dishwashers
	Industry association representing manufacturs of professional dishwashers
	Customers / User of professional dishwashers
	Industry association representing customers using professional dishwashers
	Company providing maintenance, repair or refurbishing of professional dishwashers
	End of Life service provider for professional dishwashers
	Other:

Link to online survey for further questions and/or upload of this Excel-file:
https://secure.oeko.de/surveys/index.php/592367?lang=en

ESPR Preparatory Study and Impact Assessment support study on professional dishwashers

Background for MEErP Task 2

The following questionnaire has been developed to request information relevant for Task 2 of the preparatory study.
MEErP Task 2 aims to identify the key aspects of the market for the products in scope, as regards:
(1) the numbers of units being sold per year and the number of units in use (the stock) in each segment;
(2) the past and forecast evolutions of these numbers;
(3) the technical evolution of products;
(4) the economic, social and environmental costs and benefits associated with the production, the purchase, the operation and the disposal of the products.

Tables for MEErP Task 2 questions on features important for customers from manufacturers' point of view

Q2-1: (For manufacturers and importers) Please complete the following tables on number of annual sales over past 30 years (Table 2-1a and Table 2-1b).

Table 2-1a: Annual number of sales over past 30 years **of your company** for each category of dishwashers you operate

	Category 1: Undercounter water-change dishwashers (semi-professional)	Category 2: Undercounter one-tank dishwashers	Category 3: Hood-type dishwashers	Category 4: Utensil/pot dishwashers	Category 5: One-tank conveyor-type dishwashers (belt/basket)	Category 6: Multi-tank conveyor-type dishwashers (belt/basket)
2023						
2022						
2021						
2020						
2019						
2018						
2017						
2016						
2015						
2014						
2013						
2012						
2011						
2010						
2009						
2008						
2007						
2006						
2005						
2004						
2003						
2002						
2001						
2000						
1999						
1998						
1997						
1996						
1995						
1994						

Table 2-1b: Annual number of sales over past 30 years **on whole EU market** for each category of dishwashers you operate

	Category 1: Undercounter water-change dishwashers (semi-professional)	Category 2: Undercounter one-tank dishwashers	Category 3: Hood-type dishwashers	Category 4: Utensil/pot dishwashers	Category 5: One-tank conveyor-type dishwashers (belt/basket)	Category 6: Multi-tank conveyor-type dishwashers (belt/basket)
2023						
2022						
2021						
2020						
2019						
2018						
2017						
2016						
2015						
2014						
2013						
2012						
2011						
2010						
2009						
2008						
2007						
2006						
2005						
2004						
2003						
2002						
2001						
2000						
1999						
1998						
1997						
1996						
1995						
1994						

Tables for MEErP Task 2 questions on features important for customers from manufacturers' point of view

Q2-2: (For manufacturers & importers) For each category of professional dishwashers, please provide your perception regarding the importance for your customers of each of the features in Table 2-2.

Table 2-2: Features for customers per category of dishwasher

Dishwasher category	upfront purchasing price		lifetime duration (after which a new appliance needs to be paid again)		reliability (which reduces the downtime of the appliance)		energy costs		water costs		detergent costs		operating labour costs		maintenance / repair / upgrade costs		full life-cycle costs (including all the above)		Comments on individual rows
	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	
Category 1: Undercounter water-change dishwashers (semi-professional)																			
Category 2: Undercounter one-tank dishwashers																			
Category 3: Hood-type dishwashers																			
Category 4: Utensil/pot dishwashers																			
Category 5: One-tank conveyor-type dishwashers (belt/basket)																			
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)																			

Tables for MEErP Task 2 questions on technical features important for customers from manufacturers' point of view

Q2-3: (For manufacturers & importers) For each category of professional dishwashers, please provide your perception regarding the importance for your customers of each of the technical features presented in Table 2-3.

Table 2-3: Importance of technical features for customers per category of dishwasher

Dishwasher category	Heat exchanger		Heat Pump		Additional warm/hot water connection		Gas-operated heating		Steam-operated heating		Wash process with lower temperature		Recovering of wash water		Waste water heat recovery		Electronic stop controls (disconnect the machine from the mains supply a programme ending or after the last user activity)		Improved rinsing systems		Automatic weighting system / automatic load control		Automatic dosing of detergent		Automatic adaptation of programme to load and to soiling level of dishes / utensils		Improved thermal insulation		Improved maintainability / repairability / capacity to be upgraded or refurbished (ease of dis-assembly and re-assembly, ease of access to		Improved recyclability (avoidance or clear marking of substances of concern, separability of parts made of different materials)		Use of recycled materials		Reduced wear and stress imposed on dishes / utensils		Improved ergonomics of operation (load carrying, temperature, humidity, noise)		Comments on individual rows
	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	Degree of importance	Trend in importance	
Category 1: Undercounter water-change dishwashers (semi-professional)																																									
Category 2: Undercounter one-tank dishwashers																																									
Category 3: Hood-type																																									
Category 4: Utensil/pot dishwashers																																									
Category 5: One-tank conveyor-type dishwashers																																									
Category 6: Multi tank conveyor-type dishwashers																																									

Tables for MEErP Task 2 questions on prices

Q2-4: (For manufacturers & importers) For each category of professional dishwashers, please specify the lower bound and upper bound selling price (in EUR, excl. VAT) of your products on the EU market to the end customer of new and re-furbished products, respectively (Table 2-4).

Table 2-4: Price to end customer, per category of dishwasher, in EUR, excl. VAT

Dishwasher category	New products		Re-furbished products		Comments on individual rows
	Lower-bound price (EUR, excl. VAT)	Upper-bound price (EUR, excl. VAT)	Lower-bound price (EUR, excl. VAT)	Upper-bound price (EUR, excl. VAT)	
Category 1: Undercounter water-change dishwashers (semi-professional)					
Category 2: Undercounter one-tank dishwashers					
Category 3: Hood-type dishwashers					
Category 4: Utensil/pot dishwashers					
Category 5: One-tank conveyor-type dishwashers (belt/basket)					
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)					

Tables for MEErP Task 2 questions on work distribution

Q2-5: (For manufacturers & importers) For each of the following operations beyond manufacturing, how is the work shared (in %) among your company, independent suppliers under contract with your company and independent suppliers with no contractual relationship to your company distributed?

Table 2-5: Distribution of work beyond manufacturing

Operations beyond manufacturing	Your company (%)	Independent suppliers under contract with your company (%)	Independent suppliers with no contractual relationship to your company (%)	Total	Comments on individual rows
sales				0,00%	
installation and commissioning				0,00%	
maintenance and repair				0,00%	
re-furbishing or upgrade of installed equipment				0,00%	
de-commissioning, dis-assembly				0,00%	
preparation of parts for re-use or for recycling				0,00%	
recycling				0,00%	

Tables for MEErP Task 2 questions on features important for end users from their own point of view

Q2-6: (For customers/users/user associations) How important is for your company each of the following non-technical and technical features, in their purchasing decision of a professional dishwasher?

Table 2-6: Technical and non-technical features for end-users of professional dishwashers

Features		Degree of importance	Trend in importance	Comments on individual rows
non-technical features	upfront purchasing price			
	lifetime duration (after which a new appliance needs to be paid again)			
	reliability (which reduces the downtime of the appliance)			
	energy costs			
	water costs			
	detergent costs			
	operating labour costs			
	maintenance / repair / upgrade costs			
	full life-cycle costs (including all the above)			
technical features	Heat exchanger			
	Heat Pump			
	Additional warm/hot water connection			
	Gas-operated heating			
	Steam-operated heating			
	Wash process with lower temperature			
	Recovering of wash water			
	Waste water heat recovery			
	Electronic stop controls (disconnect the machine from the mains supply a programme ending or after the last user activity)			
	Improved rinsing systems			
	Automatic weighting system / automatic load control			
	Automatic dosing of detergent			
	Automatic adaptation of programme to load and to soiling level of dishes / utensils			
	Improved thermal insulation			
	Improved maintainability / repairability / capacity to be upgraded or refurbished (ease of dis-assembly and re-assembly, ease of access to servicing area, modular design)			
	Improved recyclability (avoidance or clear marking of substances of concern, separability of parts made of different materials)			
	Use of recycled materials			
	Reduced wear and stress imposed on dishes / utensils			
	Improved ergonomics of operation (load carrying, temperature, humidity, noise)			

ESPR Preparatory Study and Impact Assessment support study on professional dishwashers

Background for MEErP Task 3

MEErP Task 3 of the preparatory study aims to identify the influence of user behaviour (e.g. intensity of use, application temperature, programme selection, real load size) on the consumption of consumables (energy, water, detergent). The correlation between user behaviour and the specific energy consumption due to technical reasons is also to be clarified and quantified. Moreover, the end-of-life behaviour and the environmental impacts depend on the respective local infrastructure, which is also covered by this section.

Besides the most used programme in professional dishwashing appliances, other common programmes are selectable which mainly differ by their duration, temperature and the respective cleaning performance, thus also resulting in different consumption values.

Tables for MEErP Task 3 question on capacity ranges

Q3-1: The capacity ranges of the different professional dishwasher categories from the previous preparatory study of 2011 provide a first indication of a possible use intensity and the resulting consumption of energy, water and detergents. Do you agree with the assumptions made for capacity ranges of the different professional dishwasher categories in Table 3-1a below? Please specify your comments in the right-hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters, please use the empty Table 3-1b on the right, allowing a comparison of your data to the initial assumptions.

Table 3-1a: Assumptions on professional dishwasher intensity of use

Professional dishwasher category	Capacity range [dishes/hour] (in brackets: typical capacity)	Comments on individual rows
Category 1: Undercounter water-change dishwashers	80-300 (200)	
Category 2: Undercounter one-tank dishwashers	300-800 (550)	
Category 3: Hood-type dishwashers	500-1 300 (860)	
Category 4: Utensil/pot dishwashers	10-30 cycles/ hour [1] (20 cycles/ hour)	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	1 500 - 2 000 [2] (1 750)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	1 700 - 6 000 [3] (3 600)	

Source: Final conclusions as presented in Table 1 of Task 3 final report of 2011 Preparatory study

[1] The capacity of utensil/pot dishwashers is measured in cycles per hour as no dishes but large cooking utensils are cleaned that considerably vary in size.

[2] Some dishwashers of category 5 on the market use extreme high capacity of up to 5 000 dishes per hour. This is however not considered as “typical” capacity range.

[3] Some dishwashers of category 6 on the market use extreme high capacity of up to 14 000 dishes per hour. This is however not considered as “typical” capacity range.

Please use the below table for providing detailed input on individual parameters

Table 3-1b: Assumptions on professional dishwasher intensity of use

Professional dishwasher category	Capacity range [dishes/hour] (in brackets: typical capacity)
Category 1: Undercounter water-change dishwashers	
Category 2: Undercounter one-tank dishwashers	
Category 3: Hood-type dishwashers	
Category 4: Utensil/pot dishwashers	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	

Tables for MEErP Task 3 question on intensity of use

Q3-2: In the 2011 preparatory study, the annual numbers of dishes cleaned per professional dishwasher category were calculated serving as input for further assessments of energy, water and detergent consumption under ideal and real conditions. Do you agree with the assumptions made for the intensity of use of the different professional dishwasher categories in Table 3-2a below? Please specify your comments in the right-hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters, please use the empty Table 3-2b on the right, allowing a comparison of your data to the initial assumptions.

Table 3-2a: Assumptions on professional dishwasher intensity of use

Professional dishwasher category	Average capacity per cycle or per hour	Number of cycles per day	Time in active mode per day [1]	Working days per year	Typical work-load of basket/belt [2]	Number of dishes / cycles per year	Comments on individual rows
Category 1: Undercounter water-change dishwashers	30 dishes/cycle	5	1h 30	200	80%	24 000 dishes	
Category 2: Undercounter one-tank dishwashers	18 dishes/cycle	55	1h 50	300	80%	237 600 dishes	
Category 3: Hood-type dishwashers	18 dishes/cycle	80	2h 40	300	80%	345 600 dishes	
Category 4: Utensil/pot dishwashers	not applicable	30	2h 08	300	60%	9 000 cycles	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	1 750 dishes/hour	not applicable	3h 30	330	75%	1 515 900 dishes	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	3 600 dishes/hour	not applicable	4h 30	330	75%	4 009 500 dishes	

Source: Final conclusions as presented in Table 2 of Task 3 final report of 2011 Preparatory study

[1] Calculations based on stakeholder feedback with regard to distributed usage of different program durations.

[2] The typical workload is included in this table to calculate the typical number of dishes cleaned per year. Its influence on the specific consumption values will be considered in Table 3-4 (see Tab "T3_Q3-4_Partial_workload").

Answer Q3-2: (any additional comments)

Please use the below table for providing detailed input on individual parameters

Table 3-2b: Assumptions on professional dishwasher intensity of use

Professional dishwasher category	Average capacity per cycle or per hour	Number of cycles per day	Time in active mode per day [1]	Working days per year	Typical work-load of basket/belt [2]	Number of dishes / cycles per year
Category 1: Undercounter water-change dishwashers						
Category 2: Undercounter one-tank dishwashers						
Category 3: Hood-type dishwashers						
Category 4: Utensil/pot dishwashers						
Category 5: One-tank conveyor-type dishwashers (belt/basket)						
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)						

Tables for MEErP Task 3 question on ideal conditions of operation

Q3-3: Table 3-3a provides an overview of the specific average energy, water and detergent (incl. rinsing aid) consumption of the different professional dishwasher categories based on the 2011 preparatory study final report. The consumption range given in brackets reflects the different ranges of capacity sizes and heating options within each machine category. The table shows the consumption values of professional dishwashers with an average technology (not including BAT) being offered on the market at that time.
Should this consultation not prove that the values have changed they will be used for preliminary calculations of energy, water and detergent consumption during the use phase under ideal conditions in order to give an overview of the environmental relevance of the different professional dishwasher categories and to subsequently determine the influence of specific aspects of user behaviour which are not included under ideal conditions.
Do you agree with the assumptions made for professional dishwasher categories specified in Table 3-3a below? Please specify your comments in the right hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters, please use the empty Table 3-3b on the right, allowing a comparison of your data to the initial assumptions.

Table 3-3a: Specific energy, water and detergent consumption of an average current device of different professional dishwasher categories under ideal conditions

Professional dishwasher category	Energy consumption (range) kWh/100 dishes	Water consumption (range) litre/100 dishes	Detergent / rinse aid consumption g/100 dishes	Comments on individual rows
Category 1: Undercounter water-change dishwashers	4.3	80	268	
Category 2: Undercounter one-tank dishwashers	1.6 (1.2-2.0)	16 (equals 2.9 l per cycle)	54	
Category 3: Hood-type dishwashers	1.7 (1.5-2.0)	16	54	
Category 4: Utensil/pot dishwashers	0.5 kWh per cycle	5.2 litre per cycle	17 g per cycle	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	2.0 (1.8-2.3)	13 (11-15)	44	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	2.0 (1.6-2.3)	12 (11-13)	40	

Source: Final conclusions as presented in Table 3 of Task 3 final report of 2011 Preparatory study

Answer Q3-3: (any additional comments)

Please use the below table for providing detailed input on individual parameters

Table 3-3b: Specific energy, water and detergent consumption of an average current device of different professional dishwasher categories under ideal conditions

Professional dishwasher category	Energy consumption (range) kWh/100 dishes	Water consumption (range) litre/100 dishes	Detergent / rinse aid consumption g/100 dishes
Category 1: Undercounter water-change dishwashers			
Category 2: Undercounter one-tank dishwashers			
Category 3: Hood-type dishwashers			
Category 4: Utensil/pot dishwashers			
Category 5: One-tank conveyor-type dishwashers (belt/basket)			
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)			

Tables for MEErP Task 3 question on partial workload

Q3-4: In technical information sheets of professional dishwashers, the energy, water and detergent consumption is usually specified under optimal conditions and full load. In real life, however, the workload can be considerably lower. For the purposes of the study and further calculations the values (and ranges) assumed in the final report of the 2011 preparatory study shall be used to quantify the influence of real workload on the consumption of energy, water and detergent.
Do you agree with the assumptions made for professional dishwasher catgeories specified in Table 3-4a below? Please specify your comments in the right hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters, please use the empty Table 3-4b on the right, allowing a comparison of your data to the initial assumptions.

Table 3-4a: Increase of energy, water and detergent consumption of an average current device of different professional dishwasher categories due to partial workload

Professional dishwasher category	Average workload	Increase of … due to partial workload			Comments on individual rows
		specific energy consumption	specific water consumption	specific detergent / rinse aid consumption	
Category 1: Undercounter water-change dishwashers	80%	15%	25%	25%	
Category 2: Undercounter one-tank dishwashers	80%	7,5%	25%	25%	
Category 3: Hood-type dishwashers	80%	7,5%	25%	25%	
Category 4: Utensil/pot dishwashers	60%	7,5%	30%	30%	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	75%	10%	10%	10%	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	75%	10%	10%	10%	

Source: Final conclusions as presented in Table 5 of Task 3 final report of 2011 Preparatory study

Answer Q3-3: (any additional comments)

Please use the below table for providing detailed input on individual parameters

Table 3-4b: Increase of energy, water and detergent consumption of an average current device of different professional dishwasher categories due to partial workload

Professional dishwasher category	Average workload	Increase of … due to partial workload		
		specific energy consumption	specific water consumption	specific detergent / rinse aid consumption
Category 1: Undercounter water-change dishwashers				
Category 2: Undercounter one-tank dishwashers				
Category 3: Hood-type dishwashers				
Category 4: Utensil/pot dishwashers				
Category 5: One-tank conveyor-type dishwashers (belt/basket)				
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)				

Tables for MEErP Task 3 question on the use of other programmes

Q3-5: The selection of the dishwashing programme also influences the energy, water and detergent/rinse aid consumption. In addition to the basic setting, i.e. most used programme, the 2011 preparatory study also covered a short and long running cycle. For the purposes of the study and further calculations the corresponding values shall be used to quantify the influence of using other programmes on the consumption of energy, water and detergent.
Do you agree with the assumptions made for professional dishwasher catgeories specified in Table 3-5a below? Please specify your comments in the right hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters, please use the empty Table 3-5b on the right, allowing a comparison of your data to the initial assumptions.

Table 3-5a: Increase of energy, water and detergent consumption of an average current device of different professional dishwasher categories due to the use of other programmes

Type of programme	Duration of programme	Share of programme	Relative consumption of			Comments on individual rows
			Energy	Water	Detergent	
Category 1: Undercounter water-change dishwashers						
Basic Setting	16 min	80%	-	-	-	
Short running cycle	6 min	10%	-54%	-35%	0%	
Long running cycle	20 min	10%	16%	31%	0%	
Average consumption in comparison to standard consumption			96%	100%	100%	
Category 2: Undercounter one-tank dishwashers						
Basic Setting	120 sec	70%	-	-	-	
Short running cycle	60 sec	25%	-10%	0%	0%	
Long running cycle	180 sec	5%	10%	0%	0%	
Average consumption in comparison to standard consumption			98%	100%	100%	
Category 3: Hood-type dishwashers						
Basic Setting	120 sec	80%	-	-	-	
Short running cycle	60 sec	15%	-10%	0%	0%	
Long running cycle	180 sec	5%	10%	0%	0%	
Average consumption in comparison to standard consumption			99%	100%	100%	
Category 4: Utensil/pot dishwashers						
Basic Setting	150-360 sec	60%	-	-	-	
Short running cycle	90-180 sec	5%	-10%	0%	0%	
Long running cycle	300-540 sec	35%	10%	0%	0%	
Average consumption in comparison to standard consumption			103%	100%	100%	
Category 5: One-tank conveyor-type dishwashers (belt/basket)						
Basic Setting	120 sec [1]	90%	-	-	-	
Short running cycle	90 sec	10%	-25%	-25%	-25%	
Long running cycle	180 sec	0%	50%	50%	50%	
Average consumption in comparison to standard consumption			98%	98%	98%	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)						
Basic Setting	120 sec [1]	80%	-	-	-	
Short running cycle	90 sec	10%	-25%	-25%	-25%	
Long running cycle	180 sec	10%	50%	50%	50%	
Average consumption in comparison to standard consumption			103%	103%	103%	

Source: Final conclusions as presented in Table 6 of Task 3 final report of 2011 Preparatory study

[1] Contact time (plate in cleaning zone)

Answer Q3-6: (any additional comments)

Please use the below table for providing detailed input on individual parameters

Table 3-5b: Increase of energy, water and detergent consumption of an average current device of different professional dishwasher categories due to the use of other programmes

Type of programme	Duration of programme	Share of programme	Relative consumption of		
			Energy	Water	Detergent
Category 1: Undercounter water-change dishwashers					
Basic Setting					
Short running cycle					
Long running cycle					
Average consumption in comparison to standard consumption					
Category 2: Undercounter one-tank dishwashers					
Basic Setting					
Short running cycle					
Long running cycle					
Average consumption in comparison to standard consumption					
Category 3: Hood-type dishwashers					
Basic Setting					
Short running cycle					
Long running cycle					
Average consumption in comparison to standard consumption					
Category 4: Utensil/pot dishwashers					
Basic Setting					
Short running cycle					
Long running cycle					
Average consumption in comparison to standard consumption					
Category 5: One-tank conveyor-type dishwashers (belt/basket)					
Basic Setting					
Short running cycle					
Long running cycle					
Average consumption in comparison to standard consumption					
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)					
Basic Setting					
Short running cycle					
Long running cycle					
Average consumption in comparison to standard consumption					

Tables for MEErP Task 3 question on stand-by mode

Q3-6: Professional dishwashers are not always switched off directly after the end of the programme and therefore are left for a certain time in "stand-by mode". The following table shows the typical time and power consumption of professional dishwashers in low-power-modes. Do you agree with the assumptions made for the different professional dishwasher categories? Please specify your comments in the right hand column (per row) or in the answer box below the Table 3-6a (general comments). To provide detailed input on the various parameters, please use the empty Table 3-6b on the right, allowing a comparison of your data to the initial assumptions.

Table 3-6a: Typical time in low-power modes and standby consumption of professional dishwashers

Professional dishwasher category	Average usage time (switched on) in hours per day	Time in low power modes in hours per day		Calculated Standby consumption (in kWh/h)	Comments on individual rows
		Ready-to-use-mode	Left-on-mode		
Category 1: Undercounter water-change dishwashers	4,0	n.a.	2,6	0,01	
Category 2: Undercounter one-tank dishwashers	10,0	8,4	n.a.	0,25	
Category 3: Hood-type dishwashers	10,0	7,5	n.a.	0,35	
Category 4: Utensil/pot dishwashers	10,0	7,4	n.a.	1,00	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	10,0	6,5	n.a.	0,80	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	10,0	5,5	n.a.	2,00	

Source: Final conclusions as presented in Table 9 of Task 3 final report of 2011 Preparatory study

Answer Q3-6: (any additional comments)

Please use the below table for providing detailed input on individual parameters

Table 3-6b: Typical time in low-power modes and standby consumption of professional dishwashers

Professional dishwasher category	Average usage time (switched on) in hours per day	Time in low power modes in hours per day		Standby consumption (in kWh/h)	Off-mode consumption (in kWh/h)
		Ready-to-use-mode	Left-on-mode		
Category 1: Undercounter water-change dishwashers					
Category 2: Undercounter one-tank dishwashers					
Category 3: Hood-type dishwashers					
Category 4: Utensil/pot dishwashers					
Category 5: One-tank conveyor-type dishwashers (belt/basket)					
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)					

Tables for MEErP Task 3 question on energy infrastructure

Q3-7: Regarding the heating of the water inside professional dishwashers there are different options. The basic possibility is electric heating. For certain professional dishwasher categories, heating can additionally be done by low pressure steam or hot water or by direct gas heating. According to feedback given in the first stakeholder consultation of this study, direct gas heating is no longer applied. The following table shows the share of different energy carriers/sources used to heat up the water for professional dishwashers.
Do you agree with the assumptions made for the different professional dishwasher categories in Table 3-7a below? Please specify your comments in the right hand column (per row) or in the answer box below the Table 3-7a (general comments). To provide detailed input on the various parameters, please use the empty Table 3-7b on the right, allowing a comparison of your data to the initial assumptions.

Table 3-7a: Energy sources/carriers for water heating in professional dishwashers

Professional dishwasher category	Electricity in %	Low pressure steam and hot water in %	Natural gas in %	Comments on individual rows
Category 1: Undercounter water-change dishwashers	100	-	-	
Category 2: Undercounter one-tank dishwashers	100	-	-	
Category 3: Hood-type dishwashers	100	-	-	
Category 4: Utensil/pot dishwashers	90-95	5-10	0	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	ca. 80	20	0-1	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	ca. 70	30	0-1	

Source: Based on final conclusions as presented in Table 13 of Task 3 final report of 2011 Preparatory study

Answer Q3-7: (any additional comments)

Please use the below table for providing detailed input on individual parameters

Table 3-7b: Energy sources/carriers for water heating in professional dishwashers

Professional dishwasher category	Electricity in %	Low pressure steam and hot water in %	Natural gas in %
Category 1: Undercounter water-change dishwashers			
Category 2: Undercounter one-tank dishwashers			
Category 3: Hood-type dishwashers			
Category 4: Utensil/pot dishwashers			
Category 5: One-tank conveyor-type dishwashers (belt/basket)			
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)			

Tables for MEErP Task 3 question on upgrades and repairs

Q3-8: Regarding upgrades and repairs, please provide input on the typical kind of activities and the related time to carry them out and costs for the related spare parts.

Table 3-8: Typical upgrade and repair activities, time and costs related to professional dishwashers

Professional dishwasher category	Typical upgrade activity	Total time to carry out the typical upgrade activity (in hours)	Average cost of spare parts for upgrade (in Euro)	Typical repair activity	Total time to carry out the typical repair activity (in hours)	Average cost of spare parts for repair (in Euro)
Category 1: Undercounter water-change dishwashers						
Category 2: Undercounter one-tank dishwashers						
Category 3: Hood-type dishwashers						
Category 4: Utensil/pot dishwashers						
Category 5: One-tank conveyor-type dishwashers (belt/basket)						
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)						

Answer Q3-8: (any additional comments)

Tables for MEErP Task 3 question on End-of-life treatment

Q3-9: Regarding typical end-of-life treatment, please provide an estimation on the relative shares of refurbishment / remanufacturing for reuse, recycling, incineration or landfill treatments of professional dishwashers at the end of first service life.

Table 3-9: Typical upgrade and repair activities, time and costs related to professional dishwashers

Professional dishwasher category	Estimated market share of refurbishment / remanufacturing for reuse after end of first service-life (in percent of subcategory)	Estimated market share of recycling after end of first service-life (in percent of subcategory)	Estimated market share of incineration after end of first service-life (in percent of subcategory)	Estimated market share of landfill after end of first service-life (in percent of subcategory)	Total	Comments on individual rows
Category 1: Undercounter water-change dishwashers					0,00%	
Category 2: Undercounter one-tank dishwashers					0,00%	
Category 3: Hood-type dishwashers					0,00%	
Category 4: Utensil/pot dishwashers					0,00%	
Category 5: One-tank conveyor-type dishwashers (belt/basket)					0,00%	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)					0,00%	

Answer Q3-9: (any additional comments)

ESPR Preparatory Study and Impact Assessment support study on professional dishwashers

Background for MEErP Task 4

MEErP Task 4 comprises a general technical analysis of the current products on the EU market. As part of it, the Bill of Materials and the whole life cycle analysis of the different product categories is to be identified. It is to provide first results regarding the annual energy, water and detergent consumptions of professional dishwashers over their lifetime. Furthermore, this task serves as a basis for the subsequent Tasks, especially Task 5 (definition of base cases) and for the identification of the improvement potential of professional dishwashers.

The technical analysis of the production phase is to specify the product weight and Bill-of-Materials (BOM), distinguishing the weight of different materials fractions and electronic components at the level requested by the EcoReport Unit Indicators as proposed in the MEErP report. This includes manufacturing and packaging materials.

Tables for MEErP Task 3 question on appliance characteristics

Q4-1: The following Tables (4-1a through 4-6a) give an overview of the characteristics of typical appliances of each of the professional dishwashing categories. Do you agree with the data presented for each category? Please specify your comments in the right hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters, please use the empty tables on the right (4-1b through 4-6b), allowing a comparison of your data to the initial

Table 4-1a: Main characteristics of a typical undercounter water-change dishwasher (Category 1)

Main characteristics of Category 1	Data	Comments on individual rows
Programme		
Number of dishwashing programmes	10 (dishwashing process can be adjusted to task)	
Washing capacity, ideal	2-20 racks/h (depending on programme)	
Cycle time	6-27 minutes (depending on programme)	
Programme temperature	Depending on programme (between 20-60°C, rinsing temperature up to 93°C)	
Construction details		
Height/width/depth	820/600/600 mm	
Weight (without packaging)	ca. 50 kg	
Tank volume	not applicable	
Electricity and water consumption		
Voltage	normal (230 V) or high-load connection (400 Volt) possible	
Total load	9 kW	
Power of pump	0.4 kW	

Source: Final conclusions as presented in Table 4 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-1a (if any):

Please use the below table for providing detailed input on individual parameters

Table 4-1b: Main characteristics of a typical undercounter water-change dishwasher (Category 1)

Main characteristics of Category 1	Data
Number of dishwashing programmes	
Washing capacity, ideal	
Cycle time	
Programme temperature	
Height/width/depth	
Weight (without packaging)	
Tank volume	
Voltage	
Total load	
Power of pump	

Table 4-2a: Main characteristics of a typical undercounter one-tank dishwasher (Category 2)

Main characteristics of Category 2	Data	Comments on individual rows
Programme		
Number of dishwashing programmes	3	
Washing capacity, ideal	40 racks/h (with 400 Voltage) 25 racks/h (with 230 Voltage)	
Cycle time	60-360 sec (with 400 Voltage) 140 / 180 / 360 sec (with 230 Voltage)	
Tank temperature	usually between 55°C and 65°C	
Boiler temperature	usually between 80°C and 85°C (glasswashers also 60-65°C possible)	
Construction details		
Height/width/depth	820/600/650 (glasswashers: 415-475 mm width)	
Weight (without packaging)	ca. 70 kg (glasswashers ca. 50 kg)	
Tank volume	7-20 litres, average 15 litres	
Electricity and water connection		
Voltage	230 Volt or 400 Volt	
Total load	with 400 Voltage: 7.7 W with 230 Voltage: 3.6 W	
Power of pump	0.2-0.8 kW, typical 0.6 kW	

Source: Final conclusions as presented in Table 6 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-2a (if any):

Table 4-2b: Main characteristics of a typical undercounter one-tank dishwasher (Category 2)

Main characteristics of Category 2	Data
Programme	
Number of dishwashing programmes	
Washing capacity, ideal	
Cycle time	
Tank temperature	
Boiler temperature	
Construction details	
Height/width/depth	
Weight (without packaging)	
Tank volume	
Electricity and water connection	
Voltage	
Total load	
Power of pump	

Table 4-3a: Main characteristics of a typical hood-type dishwasher (Category 3)

Main characteristics of Category 3	Data	Comments on individual rows
Programme		
Number of dishwashing programmes	3	
Washing capacity, ideal	60 racks/h	
Cycle time	60-180 sec	
Tank temperature	usually between 55°C and 65°C	
Boiler temperature	usually between 80°C and 85°C	
Construction details		
Height/width/depth	2000/760/820 mm	
Weight (without packaging)	ca. 120 kg	
Tank volume	16-60 litres, average 40 litres	
Electricity and water connection		
Voltage	400 Volt	
Total load	7 kW	
Power of pump	0.75-1,5 kW, typical 0.9 kW	

Source: Final conclusions as presented in Table 8 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-3a (if any):

Table 4-3b: Main characteristics of a typical hood-type dishwasher (Category 3)

Main characteristics of Category 3	Data
Programme	
Number of dishwashing programmes	
Washing capacity, ideal	
Cycle time	
Tank temperature	
Boiler temperature	
Construction details	
Height/width/depth	
Weight (without packaging)	
Tank volume	
Electricity and water connection	
Voltage	
Total load	
Power of pump	

Table 4-4a: Main characteristics of a typical utensil / pot dishwasher (Category 4)

Main characteristics of Category 4	Data	Comments on individual rows
Programme		
Number of dishwashing programmes	3	
Washing capacity, ideal	20 racks/h	
Cycle time	90-540 sec	
Tank temperature	usually between 55°C and 65°C	
Boiler temperature	usually between 80°C and 85°C	
Construction details		
Height/width/depth	2000/876/900 mm	
Weight (without packaging)	ca. 200 kg	
Tank volume	60-130 litres, average 100 litres	
Electricity and water connection		
Voltage	400 Volt	
Total load	13.0 kW	
Power of pump	typical 1.6 kW	

Source: Final conclusions as presented in Table 10 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-4a (if any):

Table 4-4b: Main characteristics of a typical utensil / pot dishwasher (Category 4)

Main characteristics of category WM1	Data
Programme	
Number of dishwashing programmes	
Washing capacity, ideal	
Cycle time	
Tank temperature	
Boiler temperature	
Construction details	
Height/width/depth	
Weight (without packaging)	
Tank volume	
Electricity and water connection	
Voltage	
Total load	
Power of pump	

Table 4-5a: Main characteristics of a typical one-tank conveyor-type dishwasher (Category 5)

Main characteristics of Category 5	Data	Comments on individual rows
Programme		
Number of dishwashing programmes	2-3	
Washing capacity, ideal	70-110 racks/h	
Cycle time	90-180 sec	
Tank temperature	usually between 55°C and 65°C	
Boiler temperature	usually between 80°C and 85°C	
Construction details		
Height/width/depth	1300/800/1420 mm (without preparing zone)	
Depth/height of passage height	500/460 mm	
Weight (without packaging)	ca. 900 kg	
Tank volume	110-130 litres (average 120 litres)	
Electricity and water connection		
Voltage	400 V	
Power of pump	typical 1.5 kW	

Source: Based on final conclusions as presented in Table 13 of Task 4 final report of 2011 Preparatory study for WM4

Additional comments to Table 4-5a (if any):

Table 4-5b: Main characteristics of a typical one-tank conveyor-type dishwasher (Category 5)

Main characteristics of Category 5	Data
Programme	
Number of dishwashing programmes	
Washing capacity, ideal	
Cycle time	
Tank temperature	
Boiler temperature	
Construction details	
Height/width/depth	
Depth/height of passage height	
Weight (without packaging)	
Tank volume	
Electricity and water connection	
Voltage	
Power of pump	

Table 4-6a: Main characteristics of a typical multi-tank conveyor-type dishwasher (Category 6)

Main characteristics of Category 6	Data	Comments on individual rows
Programme		
Number of dishwashing programmes	3	
Washing capacity, ideal	1700-6000 dishes/h	
Cycle time	90-180 sec	
Tank temperature	usually between 55°C and 65°C	
Boiler temperature	usually between 80°C and 85°C	
Construction details		
Height/width/depth	4700-7400 mm (without preparing zone)	

Table 4-6b: Main characteristics of a typical multi-tank conveyor-type dishwasher (Category 6)

Main characteristics of Category 6	Data
Programme	
Number of dishwashing programmes	
Washing capacity, ideal	
Cycle time	
Tank temperature	
Boiler temperature	
Construction details	
Height/width/depth	

Depth/height of passage height	different modules available	
Weight (without packaging)	ca. 1300 kg	
Tank volume	130-750 litres, average 230 litres	
Electricity and water connection		
Voltage	400 Volt	
Total load	39-51 kW	
Power of pump	no data available	

Source: Final conclusions as presented in Table 15 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-6a (if any):

Depth/height of passage height	
Weight (without packaging)	
Tank volume	
Electricity and water connection	
Voltage	
Total load	
Power of pump	

Tables for MEErP Task 3 question on appliance Bill of Materials

Q4-2: The following Tables 4-7a through 4-12a give an overview of the Bill of Materials of typical appliances of each of the professional dishwashing categories. Do you agree with the data presented for each category? Please specify your comments in the right hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters, please use the empty tables on the right (Tables 4-7b to 4-12b), allowing a comparison of your data to the initial assumptions.

Table 4-7a: Bill of Materials of an undercounter water-change dishwasher (Category 1)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Stainless Steel	24 560	51.0	3-Ferro	
Steel Sheet galvanized	403	0.8	3-Ferro	
Cast Iron	2 303	4.8	3-Ferro	
Polypropylen (PP)	4 980	10.3	1-BlkPlastics	
Polyamid (PA)	399	0.8	2-TecPlastics	
Polymethylmetacrylate (PMMA)	6	0.0	2-TecPlastics	
Acrylonitrile Butadiene Styrene (ABS)	751	1.6	1-BlkPlastics	
Polystyrene (PS)	512	1.1	1-BlkPlastics	
Styropor expandable polystyrene (EPS)	40	0.1	1-BlkPlastics	
Polybutylene Terephthalate (PBT)	35	0.1	1-BlkPlastics	
Polyvinylchlorid (PVC)	403	0.8	1-BlkPlastics	
EPDM-rubber	534	1.1	1-BlkPlastics	
POM	230	0.5	1-BlkPlastics	
PE	187	0.4	1-BlkPlastics	
Plastics others	268	0.6	1-BlkPlastics	
Aluminium	273	0.6	4-Non-ferro	
Cu wire	1 006	2.1	4-Non-ferro	
CuZn38 cast	23	0.0	4-Non-ferro	
Chrom	71	0.1	4-Non-ferro	
Bitumen	6 089	12.6	7-Misc.	
Concrete	1 263	2.6	7-Misc.	
Cotton	452	0.9	7-Misc.	
Epoxy	609	1.3	2-TecPlastics	
Wood	2 034	4.2	7-Misc.	
others (Paper)	285	0.6	7-Misc.	
Electronics (control)	448	0.9	6-Electronics	
Total net	**48 154**	**100.0**		

Source: Final conclusions as presented in Table 5 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-7a, if any

Please use the below table for providing detailed input on individual parameters

Table 4-7b: Bill of Materials of an undercounter water-change dishwasher (Category 1)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material / component contain regulated or restricted substances (REACH SVHC, REACH Annex XVII substances or other regulatory programmes)? If so, which?
Stainless Steel					
Steel Sheet galvanized					
Cast Iron					
Polypropylen (PP)					
Polyamid (PA)					
Polymethylmetacrylate (PMMA)					
Acrylonitrile Butadiene Styrene (ABS)					
Polystyrene (PS)					
Styropor expandable polystyrene (EPS)					
Polybutylene Terephthalate (PBT)					
Polyvinylchlorid (PVC)					
EPDM-rubber					
POM					
PE					
Plastics others					
Aluminium					
Cu wire					
CuZn38 cast					
Chrom					
Bitumen					
Concrete					
Cotton					
Epoxy					
Wood					
others (Paper)					
Electronics (control)					
Total net					

Additional comments to Table 4-7b, if any

Table 4-8a: Bill of Materials of an undercounter one-tank dishwasher (Category 2)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Stainless steel	49 760	71.2	3-Ferrous	
Polypropylene (PP)	4 565	6.5	1-BlkPlastics	
Polyamide (PA)	509	0.7	2-TecPlastics	
Epoxy	1 000	1.4	2-TecPlastics	
Acrylonitrile Butadiene Styrene (ABS)	70	0.1	1-BlkPlastics	
Pumps (copper)	2 500	3.6	4-Non-ferrous	
Pumps (stack of sheets)	2 500	3.6	3-Ferrous	
Pumps (stainless steel wave)	2 250	3.2	3-Ferrous	
Pumps (Al)	2 250	3.2	4-Non-ferrous	
Cable (copper)	1 100	1.6	4-Non-ferrous	
Cable sheath (PVC)	600	0.9	1-BlkPlastics	
Cable sheath (silicone, EDPM)	300	0.4	1-BlkPlastics	
Electronics (control)	500	0.7	6-Electronics	
Gaskets (EDPM)	2 040	2.9	1-BlkPlastics	
Total net	69 935	100.0		

Source: Final conclusions as presented in Table 7 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-8a, if any

Please use the below table for providing detailed input on individual parameters

Table 4-8b: Bill of Materials of an undercounter one-tank dishwasher (Category 2)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material / component contain regulated or restricted substances (REACH SVHC, REACH Annex XVII substances or other regulatory programmes)? If so, which?
Stainless steel					
Polypropylene (PP)					
Polyamide (PA)					
Epoxy					
Acrylonitrile Butadiene Styrene (ABS)					
Pumps (copper)					
Pumps (stack of sheets)					
Pumps (stainless steel wave)					
Pumps (Al)					
Cable (copper)					
Cable sheath (PVC)					
Cable sheath (silicone, EDPM)					
Electronics (control)					
Gaskets (EDPM)					
Total net					

Additional comments to Table 4-8b, if any

Table 4-9a: Bill of Materials of a hood-type dishwasher (Category 3)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Stainless steel	93 090	79.1	3-Ferrous	
Polypropylene (PP)	4 310	3.7	1-BlkPlastics	
Polyamide (PA)	1 000	0.8	2-TecPlastics	
Epoxy	800	0.7	2-TecPlastics	
Acrylonitrile Butadiene Styrene (ABS)	70	0.1	1-BlkPlastics	
Pumps (copper)	3 000	2.5	4-Non-ferrous	
Pumps (stack of sheets)	3 000	2.5	3-Ferrous	
Pumps (stainless steel wave)	2 500	2.1	3-Ferrous	
Pumps (Al)	3 000	2.5	4-Non-ferrous	
Cable (copper)	1 700	1.4	4-Non-ferrous	
Cable sheath (PVC)	1 000	0.8	1-BlkPlastics	
Cable sheath (silicone, EDPM)	500	0.4	1-BlkPlastics	
Electronics (control)	600	0.5	6-Electronics	
Gaskets (EDPM)	3 085	2.6	1-BlkPlastics	
Total net	**117 655**	**100.0**		

Source: Final conclusions as presented in Table 9 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-9a, if any

Please use the below table for providing detailed input on individual parameters

Table 4-9b: Bill of Materials of a hood-type dishwasher (Category 3)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material / component contain regulated or restricted substances (REACH SVHC, REACH Annex XVII substances or other regulatory programmes)? If so, which?
Stainless steel					
Polypropylene (PP)					
Polyamide (PA)					
Epoxy					
Acrylonitrile Butadiene Styrene (ABS)					
Pumps (copper)					
Pumps (stack of sheets)					
Pumps (stainless steel wave)					
Pumps (Al)					
Cable (copper)					
Cable sheath (PVC)					
Cable sheath (silicone, EDPM)					
Electronics (control)					
Gaskets (EDPM)					
Total net					

Additional comments to Table 4-9b, if any

Table 4-10a: Bill of Materials of a utensil / pot dishwasher (Category 4)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Stainless steel	165 000	80.1	3-Ferrous	
Polypropylene (PP)	3 000	1.5	1-BlkPlastics	
Polyamide (PA)	4 000	1.9	2-TecPlastics	
Epoxy	0	0.0	2-TecPlastics	
Ethylene Propylene Diene M-class rubber (EPDM)	4 000	1.9	1-BlkPlastics	
Acrylonitrile Butadiene Styrene (ABS)	0	0.0	1-BlkPlastics	
Pumps (copper)	5 000	2.4	4-Non-ferrous	
Pumps (stack of sheets)	4 000	1.9	3-Ferrous	
Pumps (stainless steel wave)	3 000	1.5	3-Ferrous	
Pumps (Al)	5 000	2.4	4-Non-ferrous	
Cable (copper)	2 400	1.2	4-Non-ferrous	
Cable sheath (PVC)	1 400	0.7	1-BlkPlastics	
Cable sheath (silicone, EDPM)	1 100	0.5	1-BlkPlastics	
Electronics (control)	2 100	1.0	6-Electronics	
Gaskets, etc. (EDPM)	6 000	2.9	1-BlkPlastics	
Total net	**206 000**	**100.0**		

Source: Final conclusions as presented in Table 12 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-10a, if any

Please use the below table for providing detailed input on individual parameters

Table 4-10b: Bill of Materials of a utensil / pot dishwasher (Category 4)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material / component contain regulated or restricted substances (REACH SVHC, REACH Annex XVII substances or other regulatory programmes)? If so, which?
Stainless steel					
Polypropylene (PP)					
Polyamide (PA)					
Epoxy					
Ethylene Propylene Diene M-class rubber (EPDM)					
Acrylonitrile Butadiene Styrene (ABS)					
Pumps (copper)					
Pumps (stack of sheets)					
Pumps (stainless steel wave)					
Pumps (Al)					
Cable (copper)					
Cable sheath (PVC)					
Cable sheath (silicone, EDPM)					
Electronics (control)					
Gaskets, etc. (EDPM)					
Total net					

Additional comments to Table 4-10b, if any

Table 4-11a: Bill of Materials of a one-tank conveyor-type dishwasher (Category 5)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Stainless steel	642 250	72.06	3-Ferrous	
Polypropylene (PP)	55 500	6.23	1-BlkPlastics	
Polyamide (PA)	6 140	0.69	2-TecPlastics	
Polyvinyl chloride (PVC)	4 600	0.52	1-BlkPlastics	
Polystyrene (PS)	4 430	0.50	1-BlkPlastics	
Acrylonitrile Butadiene Styrene (ABS)	5 000	0.56	1-BlkPlastics	
Pumps (copper)	16 825	1.89	4-Non-ferrous	
Pumps (stack of sheets)	15 625	1.75	3-Ferrous	
Pumps (stainless steel wave)	12 335	1.38	3-Ferrous	
Pumps (Al)	17 475	1.96	4-Non-ferrous	
Condenser (AL)	4 720	0.53	4-Non-ferrous	
Condenser (Cu)	7 080	0.79	4-Non-ferrous	
Ventilator, fan (AL)	17 440	1.96	4-Non-ferrous	
Ventilator, fan (Cu)	10 160	1.14	4-Non-ferrous	
Drive motor (AL)	4 000	0.45	4-Non-ferrous	
Drive motor (Cu)	5 000	0.56	4-Non-ferrous	
Cable (copper)	16 300	1.83	4-Non-ferrous	
Cable sheath (PVC)	8 640	0.97	1-BlkPlastics	
Cable sheath (silicone, EDPM)	5 170	0.58	1-BlkPlastics	
Electric contactor (copper)	10 000	1.12	4-Non-ferrous	
Electronics (control)	9 800	1.10	6-Electronics	
Gaskets (EDPM)	12 800	1.44	1-BlkPlastics	
Total net	**891 285**	**100.00**		

Source: Final conclusions as presented in Table 14 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-11a, if any

Please use the below table for providing detailed input on individual parameters

Table 4-11b: Bill of Materials of a one-tank conveyor-type dishwasher (Category 5)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material / component contain regulated or restricted substances (REACH SVHC, REACH Annex XVII substances or other regulatory programmes)? If so, which?
Stainless steel					
Polypropylene (PP)					
Polyamide (PA)					
Polyvinyl chloride (PVC)					
Polystyrene (PS)					
Acrylonitrile Butadiene Styrene (ABS)					
Pumps (copper)					
Pumps (stack of sheets)					
Pumps (stainless steel wave)					
Pumps (Al)					
Condenser (AL)					
Condenser (Cu)					
Ventilator, fan (AL)					
Ventilator, fan (Cu)					
Drive motor (AL)					
Drive motor (Cu)					
Cable (copper)					
Cable sheath (PVC)					
Cable sheath (silicone, EDPM)					
Electric contactor (copper)					
Electronics (control)					
Gaskets (EDPM)					
Total net					

Additional comments to Table 4-11b, if any

Table 4-12a: Bill of Materials of a multi-tank conveyor-type dishwasher (category 6)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Stainless steel	980 000	76.5	3-Ferrous	
Polypropylene (PP)	58 000	4.5	1-BlkPlastics	
Polyamide (PA)	18 660	1.5	2-TecPlastics	
Epoxy	0	0.0	2-TecPlastics	
Ethylene Propylene Diene M-class rubber (EPDM)	12 000	0.9	1-BlkPlastics	
Acrylonitrile Butadiene Styrene (ABS)	0	0.0	1-BlkPlastics	
Pumps (copper)	39 020	3.0	4-Non-ferrous	
Pumps (stack of sheets)	37 070	2.9	3-Ferrous	
Pumps (stainless steel wave)	25 370	2.0	3-Ferrous	
Pumps (Al)	44 880	3.5	4-Non-ferrous	
Cable (copper)	19 800	1.5	4-Non-ferrous	
Cable sheath (PVC)	11 440	0.9	1-BlkPlastics	
Cable sheath (silicone, EDPM)	8 360	0.7	1-BlkPlastics	
Electronics (control)	15 400	1.2	6-Electronics	
Gaskets, etc. (EDPM)	15 000	1.2	1-BlkPlastics	
Total net	**1 285 000**	100.0		

Source: Final conclusions as presented in Table 16 of Task 4 final report of 2011 Preparatory study

Additional comments to Table 4-12a, if any

Please use the below table for providing detailed input on individual parameters

Table 4-12b: Bill of Materials of a multi-tank conveyor-type dishwasher (category 6)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material / component contain regulated or restricted substances (REACH SVHC, REACH Annex XVII substances or other regulatory programmes)? If so, which?
Stainless steel					
Polypropylene (PP)					
Polyamide (PA)					
Epoxy					
Ethylene Propylene Diene M-class rubber (EPDM)					
Acrylonitrile Butadiene Styrene (ABS)					
Pumps (copper)					
Pumps (stack of sheets)					
Pumps (stainless steel wave)					
Pumps (Al)					
Cable (copper)					
Cable sheath (PVC)					
Cable sheath (silicone, EDPM)					
Electronics (control)					
Gaskets, etc. (EDPM)					
Total net					

Additional comments to Table 4-12b, if any

Please use the below table for providing detailed input on individual parameters

Table 4-7a: Bill of Materials of an undercounter water-change dishwasher (Category 1)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Total weight				

Source: Final conclusions as presented in final report of 2011 Preparatory study

Answer Q4:

Table 4-7b: Bill of Materials of an undercounter water-change dishwasher (Category 1)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material / component contain
Total weight					

Please use the below table for providing detailed input on individual parameters

Table 4-8a: Bill of Materials of an undercounter one-tank dishwasher (Category 2)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Lot24, T4 report, Table 12				
Total weight				

Source: Final conclusions as presented in final report of 2011 Preparatory study

Answer Q4:

Table 4-8b: Bill of Materials of an undercounter one-tank dishwasher (Category 2)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material /
copy column A					
Total weight					

Please use the below table for providing detailed input on individual parameters

Table 4-9a: Bill of Materials of a hood-type dishwasher (Category 3)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Lot24, T4 report, Table 14				
Total weight				

Source: Final conclusions as presented in final report of 2011 Preparatory study

Answer Q4:

Table 4-9b: Bill of Materials of a hood-type dishwasher (Category 3)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material /
copy column A					
Total weight					

Please use the below table for providing detailed input on individual parameters

Table 4-10a: Bill of Materials of a utensil / pot dishwasher (Category 4)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Lot24, T4 report, Table 12				
Total weight				

Answer Q4:

Table 4-10b: Bill of Materials of a utensil / pot dishwasher (Category 4)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material / component
copy column A					
Total weight					

Please use the below table for providing detailed input on individual parameters

Table 4-11a: Bill of Materials of a one-tank conveyor-type dishwasher (Category 5)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Lot24, T4 report, Table 13				
Total weight				

Source: Based on final conclusions as presented in final report of 2011 Preparatory study for WM4

Answer Q4:

Table 4-11b: Bill of Materials of a one-tank conveyor-type dishwasher (Category 5)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material /
copy column A					
Total weight					

Please use the below table for providing detailed input on individual parameters

Table 4-12a: Bill of Materials of a multi-tank conveyor-type dishwasher (category 6)

Material / component	Weight in g	Weight in %	Material category	Comments on individual rows
Lot24, T4 report, Table 16				
Total weight				

Source: Final conclusions as presented in final report of 2011 Preparatory study

Answer Q4:

Table 4-12b: Bill of Materials of a multi-tank conveyor-type dishwasher (category 6)

Material / Component	Weight in g	Weight in %	Material category	Share of recycled content in %	Does the material /
copy column A					
Total weight					

Tables for MEErP Task 3 questions on volumes

Q4-3: The following Table 4-13a shows the average volume of the final packaged product for the various professional dishwasher categories. These values shall be used to calculate the environmental impacts resulting from distribution. Do you agree with the assumptions made for professional dishwasher categories specified in Table 4-13a below? Please specify your comments in the right hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters,

Table 4_13a: Average volume and weight of the final packaged product in the different categories of professional dishwashers

Professional dishwasher category	Average volume of the final packaged product	Average weight of the final packaged product	Comments on individual rows
Category 1: Undercounter water-change dishwashers	0.40 m^3	ca. 50 kg	
Category 2: Undercounter one-tank dishwashers	0,48 m^3	ca. 80 kg	
Category 3: Hood-type dishwashers	1.03 m^3	ca. 135 kg	
Category 4: Utensil/pot dishwashers	4.95 m^3	ca. 225 kg	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	12.25 m^3	ca. 975 kg	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	16.58 m^3	ca. 1465 kg	

Source: Based on final conclusions as presented in Table 19 of Task 4 final report of 2011 Preparatory study

Additional comments to Q4-3 (if any):

Please use the below table for providing detailed input on individual parameters

Table 4_13b: Average volume and weight of the final packaged product in the different categories of professional dishwashers

Professional dishwasher category	Average volume of the final packaged product	Average weight of the final packaged product
Category 1: Undercounter water-change dishwashers		
Category 2: Undercounter one-tank dishwashers		
Category 3: Hood-type dishwashers		
Category 4: Utensil/pot dishwashers		
Category 5: One-tank conveyor-type dishwashers (belt/basket)		
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)		

Source: Final conclusions as presented in final report of 2011 Preparatory study

Tables for MEErP Task 3 questions on packaging

Q4-4: The following Table 4-14a shows the average types and weight of the packaging of the various professional dishwasher categories. These values shall be used to calculate the environmental impacts resulting from packaging. Do you agree with the assumptions made for professional dishwasher categories specified in Table 4-14a below? Please specify your comments in the right hand column (per row) or in the answer box below the table (general comments). To provide detailed input on the various parameters, please use the empty Table 4-14b on the right,

Table 4_14a: Average type and weight of the packaging in the different categories of professional dishwashers

Professional dishwasher category	EPS (weight in g)	PE-Foil (weight in g)	Polystyrene (weight in g)	Wood (weight in g)	Cardboard (weight in g)	Comments on individual rows
Category 1: Undercounter water-change dishwashers	724	172	-	1011	635	
Category 2: Undercounter one-tank dishwashers	-	-	500	6000	2750	
Category 3: Hood-type dishwashers	-	-	500	12250	4750	
Category 4: Utensil/pot dishwashers	-	-	500	16000	3500	
Category 5: One-tank conveyor-type dishwashers (belt/basket)	-	-	2940	63500	15500	
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)	-	-	5290	141180	33530	

Source: Based on final conclusions as presented in Tables 5, 7, 9, 12, 14, and 16 of Task 4 final report of 2011 Preparatory study

Additional comments to Q4-3 (if any):

Please use the below table for providing detailed input on individual parameters

Table 4_14b: Average type and weight of the packaging in the different categories of professional dishwashers

Professional dishwasher category	EPS (weight in g)	Polystyrene (weight in g)	PE-Foil (weight in g)	Wood (weight in g)	Cardboard (weight in g)	other materials (weight in g)	recycled content of packaging (%)
Category 1: Undercounter water-change dishwashers							
Category 2: Undercounter one-tank dishwashers							
Category 3: Hood-type dishwashers							
Category 4: Utensil/pot dishwashers							
Category 5: One-tank conveyor-type dishwashers (belt/basket)							
Category 6: Multi-tank conveyor-type dishwashers (belt/basket)							

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