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MEErP Preparatory Study on Taps and Showers

Final report

Mauro Cordella, Elena Garbarino,
Maria Calero, Fabrice Mathieux, Oliver Wolf,

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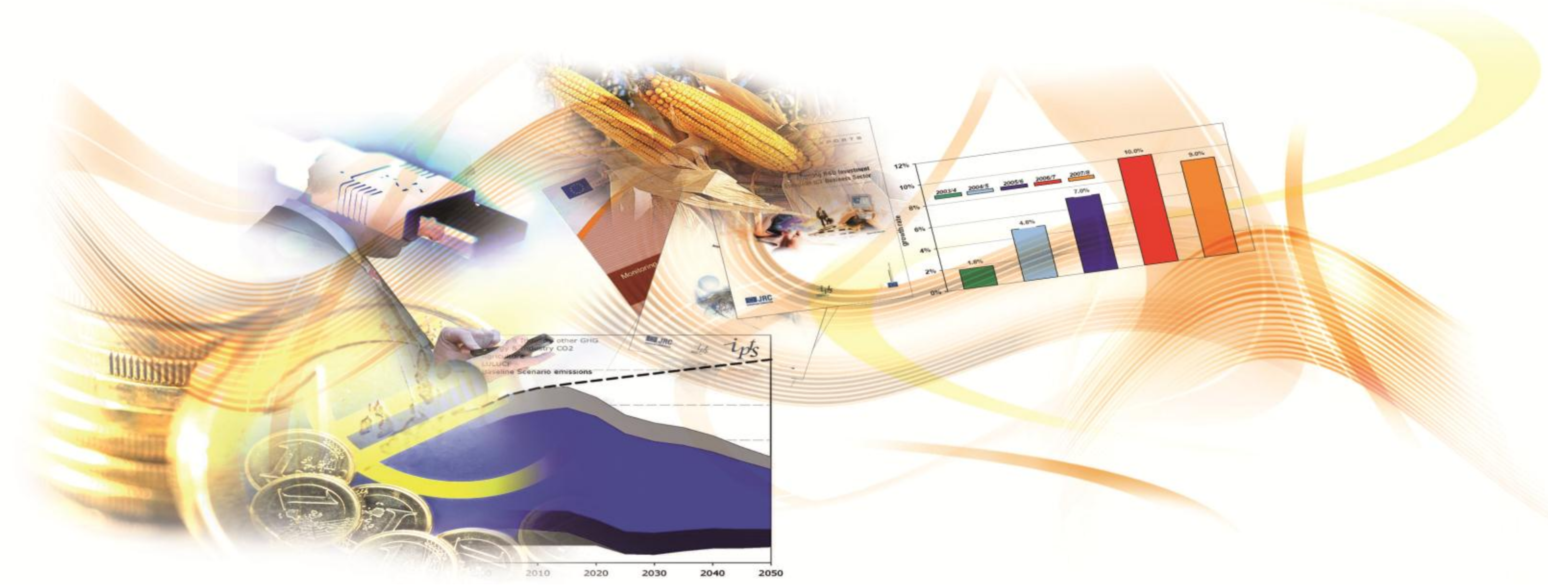

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Joint
Research
Centre

European Commission
Joint Research Centre

Contact information
Joint Research Centre, Institute for Prospective Technological Studies (IPTS)
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

https://ec.europa.eu/jrc

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Abstract

Following the publication of the Working Plan for the Ecodesign Directive (2012-2014), in April 2013 the European Commission launched a preparatory study on the product group taps and showers. The preparatory study on taps and showers has been developed by the European Commission's Joint Research Centre (JRC) following the Commission's Methodology for the Evaluation of Energy-related Products (MEErP). The research is based on available scientific information and data, adopts a life cycle thinking approach and has engaged with stakeholder experts in order to discuss key issues and to develop a wide consensus. As a final result, the JRC has produced a comprehensive techno-economic and environmental assessment with which to evaluate a possible favourable mix of policy instruments for this product group.

In summary, the study has pointed out that:

- Water consumption and scarcity is and will be a problem in many areas of the European Union.
- The water- and energy-saving potential of taps and showers at European level is significant.
- A large number of taps and shower models are on the market which offer consumers the possibility of choosing between different levels of water and energy consumption.
- Water-saving technologies represent technically effective, economically affordable and flexible product options.
- Market transformation and current policy instruments and industry initiatives are already generating some environmental benefits for this product group.
- Increased environmental improvement could be achieved through additional environmental product policy instruments.
- A strategic communication policy would be needed because user behaviour is a key issue for ensuring the effective achievement of a potential benefit with any initiative.
- Harmonised standards for measuring and calculating the water/energy efficiency of taps and shower systems would also be an important element to integrate in any policy option although this may require a considerable amount of time.

Editors:	Mauro Cordella, Elena Garbarino, JRC-IPTS
Project management:	Oliver Wolf, JRC-IPTS

The following authors have contributed to the preparation of this report:

Chapters 1, 2, 3, 4 & 7:	Mauro Cordella (JRC-IPTS), Elena Garbarino (JRC-IPTS), Oliver Wolf (JRC-IPTS)
Chapters 5 & 6:	Maria Calero (JRC-IES), Fabrice Mathieux (JRC-IES), Mauro Cordella (JRC-IPTS)

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INTRODUCTION

Background

Directive 2009/125/EC on Ecodesign[1] establishes a framework for EU Ecodesign requirements for energy-related products with a significant potential for reduction of environmental impacts. The implementation of such requirements would contribute to reaching the target of saving 20% of primary energy by 2020 as identified in the Commission's Communications on Energy 2020[2] and on the Energy Efficiency Plan 2011[3], as well as the Energy Efficiency Directive[4] and the Energy Efficiency Communication 2014[5].

Ecodesign measures may also be reinforced through Directive 2010/30/EU[6] on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products ("Energy Labelling Directive").

In April 2013, following the publication of the Working Plan for the Ecodesign Directive (2012-2014)[7], the European Commission launched a preparatory study on the product group taps and showers. According to the Study on the Amended Ecodesign Working Plan under the Ecodesign Directive[8], this product group presents significant energy savings potential, which is achievable by using already existing and economically accessible technologies (with a payback period of 1 to 20 months, while the product's lifetime is measured in years).

The preparatory study on taps and showers is being developed by the European Commission's Joint Research Centre (JRC) following the Commission's Methodology for the Evaluation of Energy-related Products (MEErP)[9].

The research is based on available scientific information and data, adopts a life cycle thinking approach and has engaged with stakeholder experts in order to discuss key issues and to develop a wide consensus. As a final result, the JRC produced a comprehensive techno-economic and environmental assessment for this product group. This provides policymakers with an evidential basis for assessing whether and how to implement a favourable mix of policy instruments in addition to EU Ecolabel and GPP criteria with which to save water and to decrease related energy consumption across the EU-28.

A Technical Working Group (TWG) was created in order to support the JRC in the study. This Technical Working Group is composed of experts from Member States, industry, NGOs and academia who have voluntarily requested to be registered as stakeholders of the study through the project website[10]. The contributions of the TWG and interaction with stakeholders form key components of the study. This has been enhanced through the organisation of three key meetings:

- First "Kick-off" meeting (27 June 2013, Barcelona);
- 1st Technical Working Group meeting (29 October 2013, Seville);
- 2nd Technical Working Group meeting (25 March 2014, Brussels).

In accordance with the MEErP, this preparatory study is made up of seven sections:

- Section 1 – Scope, definitions, standards and legislation;

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[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:en:PDF

[2] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0639:FIN:EN:PDF

[3] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0109:FIN:EN:PDF

[4] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0027&from=EN

[5] http://ec.europa.eu/energy/efficiency/events/doc/2014_eec_communication_adopted.pdf

[6] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0001:0012:en:PDF

[7] http://ec.europa.eu/enterprise/policies/sustainable-business/documents/eco-design/working-plan/

[8] http://www.ecodesign-wp2.eu/downloads/FINAL%20REPORT%20Task%203%2016-12-2011.pdf

[9] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm

[10] http://susproc.jrc.ec.europa.eu/taps_and_showers/contactus.cfm

- Section 2 – Market analysis;
- Section 3 – Analysis of user behaviour and system aspects;
- Section 4 – Analysis of technologies;
- Section 5 – Environmental and economic assessment;
- Section 6 – Design options;
- Section 7 – Policy scenarios analysis.

A brief outline of the content of each section is provided below.

Section 1: Scope, definitions, standards and legislation

This Section contains information on classification, definitions, standards and legislation of relevance for taps and showers.

Section 2: Market analysis

This Section provides information on markets, including an estimation of the quantity of products installed and sales figures, both at Member State and aggregated EU levels. Figures are based on European statistics as well as ad-hoc models and extensive consultation with stakeholders.

Section 3: Analysis of user behaviour and system aspects

This Section presents an estimation of the amount of water and energy consumed from taps and showers, System aspects are included in the analysis (i.e. water heating, water supply and distribution, waste water collection and treatment) as well as behavioural aspects. The available information is used to preliminarily assess the water and energy saving potential which may be achievable for this product group. Figures are based on European statistics as well as ad-hoc models and extensive consultation with stakeholders.

Section 4 – Analysis of technologies

This Section provides an analysis of technologies, including indications of the performance, costs, materials and market availability of products in terms of water flows.

Section 5: Environmental and economic assessment

This Section provides information on the environmental and economic impacts associated to four base cases (domestic tap, non-domestic tap, domestic shower system, non-domestic shower system) and calculated through the Ecoreport tool.

Section 6 – Design options

This Section provides information on the environmental and economic impacts associated with selected water- and energy-saving options related to the base cases and calculated through the Ecoreport tool.

Section 7 – Policy scenarios analysis

This Section provides preliminary feedback on potential policy options for taps and showers and a streamlined assessment of their impacts at EU level on the basis of the information collected during the study.

1 SCOPE

1.1 Introduction

The objective of this Section is to define the scope of the study in terms of definitions, classification, standards and legislation of relevance for taps and showers.

The rationale behind the choice of taps and showers is presented first. Conventional classification systems and definitions of relevance for this product group are then analysed. These can include: those used in European trade statistics (Eurostat) and in labelling (e.g. the EU Ecolabel), those provided in international standards, those based on functionality aspects or related to affected energy system(s).

An overview of product standards and measurement methods is then provided. The main focus is on test protocols for primary/secondary performance parameters, resource use (e.g. water, energy) and emissions, as well as other issues like safety or hygiene.

Finally, existing legislation of relevance for taps and showers is reviewed with a particular focus on existing mandatory prescriptions and labelling schemes.

1.2 Preliminary screening

New product groups considered relevant for the Ecodesign Directive have been identified in the Commission Staff Working Document on the Establishment of the Working Plan 2012-2014 under the Ecodesign Directive[11]. Among the product groups under consideration, water-related products (WrP) are evaluated as suitable for inclusion in the Ecodesign framework. Energy consumption can be directly associated to the use of such products (e.g. the consumption of electricity in taps due to the control of the water flow with sensors) or can be related to the demand for energy in other interconnected systems (e.g. water supply, water heating, waste water collection and treatment).

WrP can include a great variety of products, classified based on type and/or sector of application (e.g. agricultural, industrial, domestic urban and non-domestic urban). A preliminary screening performed by the JRC[12] presents an extensive analysis of different products and an estimation of the related water and energy consumption and of the improvement potential at the EU level. The analysis is mainly aimed at identifying products that have a high water use, that have high water (and energy) savings potential, and that are not yet included in mandatory legislation (e.g. the Ecodesign Directive and the Industrial Emissions Directive[13], previously known as the Integrated Pollution Prevention and Control Directive). A rough estimation of water and energy consumption can be calculated through the information reported there. However, more refined figures could be provided by improving the quality and precision of some data.

The greatest water use has been found in agricultural WrP (e.g. sprinklers) and in urban WrP (e.g. toilets, taps, showers, bathtubs). Industrial water demand for cooling and boilers is also significant but only aggregated values are provided.

Excluding agriculture, where changes in irrigation practices could be more effective than the implementation of product-oriented measures, and industrial applications, where water efficiency is generally high and applications are subject to the Industrial Emissions Directive, the highest water saving potential seems to be associated to toilets, taps and showers. Washing machines also present a significant saving potential, but this product group is already included in the Ecodesign Directive.

Considering that taps and showers present the highest energy saving potential, these have been identified as the most suitable candidates for the application of the Ecodesign Directive.

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[11] http://ec.europa.eu/enterprise/policies/sustainable-business/documents/eco-design/working-plan/

[12] http://susproc.jrc.ec.europa.eu/ecotapware/docs/Scoping%20document_WuP_100217.pdf

[13] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:334:0017:0119:EN:PDF

In an additional study carried-out by VHK[14] it has been estimated that the energy savings potential for taps and showers is 885 PJ/year in 2030, which is the highest among the products included in the priority list of the Working Plan for the Ecodesign Directive (2012-2014).

The initial scope of this preparatory study covers taps and showers used to obtain urban water with a quality that is fit for human use and at a desired temperature. Urban uses include personal hygiene, cleaning, cooking and drinking and other uses in urban applications. These can take place in domestic and non-domestic applications. Non-domestic applications include premises such as restaurants, shops, hotels, schools, sports centres, hospitals, offices and public buildings. An insight into different technical, economic and environmental elements related to taps and showers is presented in the following sections of this report.

1.3 Product classification and definition

The following definitions, shaped through interaction with stakeholders, shall be applied in this study:

- "Tap", also referred to as "valve" or "faucet", means a directly or indirectly, mechanically and/or automatically operated valve from which water is drawn.
- "Shower valve" means a valve controlling the release of water in shower systems.
- "Shower outlet" means:
    a. a fixed overhead or side shower outlet, body jet shower outlet or similar device which may be adjustable and which directs water from a supply system onto the user; or
    b. a moveable hand shower outlet which is connected to a tap with a shower hose and can be hung directly on the tap or on the wall with the aid of an appropriate support.
- "Shower system", also referred to as "shower", means the combination of shower outlets, hoses and interrelated control valves and/or devices.

Taps and showers are products of the valve industry consisting of several functional and design features. Conventional classification systems and technical definitions used for taps and showers have been analysed to provide a coherent description of the product group. Product classifications and definitions of interest include those used in European trade statistics, international standards and existing labelling schemes.

1.3.1 Functionality of taps and showers

The main functions of taps and showers are described in Table 1.1. These cover aspects related to: quality, safety, flow rate and temperature control and comfort.

As indicated, a shower is typically made of a valve, a hose and one or more outlets. These can be purchased as a combined unit or separate components. When sold separately, technical features of components may provide different levels of performance/flow to the users. These levels of performance/flow could also be maintained once components are combined, although the compatibility of features (e.g. flow regulators) must be ensured for the proper functioning of the product.

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[14] http://www.ecodesign-wp2.eu/downloads/FINAL%20REPORT%20Task%203%2016-12-2011.pdf

Table 1.1 Functionalities identified for taps and showers

Product	Primary functionalities	Additional functionalities
Taps	• Delivering water without impairing its hygienic and organoleptic quality and without affecting the safety of users and buildings • Allowing the user to control the flow of the delivered water	• Allowing the user to control the temperature of water at the outlet (for mixers of hot and cold water) • Delivering water in an efficient way • Delivering water in a suitable quantity and fashion to facilitate the desired activity (e.g. personal hygiene and wellness applications) without compromising an efficient performance
Showers (or shower systems)	• Delivering water without impairing its hygienic and organoleptic quality and without affecting the safety of users and buildings • Providing an effective and comfortable rinsing performance	• Delivering water in an efficient way • Delivering water in a suitable quantity and fashion to facilitate the desired activity (e.g. personal hygiene and wellness applications) without compromising an efficient performance

1.3.2 Technical classification of taps

Technical features for the classification of taps are described Table 1.2.

Table 1.2 Classification of taps based on technical features

Feature	Product	Definition
Core technology	Spindle tap	Tap where the water flow is controlled with a spindle mechanism.
	Ceramic disc tap	Tap where the water flow is controlled through two ceramic discs and one or more handles.
Possibility of controlling temperature and/or flow rate	Pillar tap	A deck-mounted device, equipped with a single inlet (cold only, hot only or pre-mixed water), that allows the user to control the flow rate.
	Mixing valve	Device that allows the user to adjust the temperature.
Design of the mixing mechanism	Mechanical mixing valve	Mixing valve that allows the user to control water flow and temperature.
	Two-handle mixer	Mixing valve with two handles for the control of hot and cold water.
	Single-control mixer (or single-lever mixer)	Mixing valve with one handle for the control of water flow and temperature.
	Thermostatic mixing valve	Mixing valve that allows the temperature and the flow of the mixed water to be set at constant values, either by the user or preset, through the control of one or two handles.

Feature	Product	Definition
		Special versions are available where only the temperature is controlled. The desired temperature is maintained in spite of the temperature or pressure variation in the pipes. Traditional thermostatic products only react to temperature changes in the inlet supplies. And traditional pressure balance valves only react to pressure changes in the inlet supplies.
Manual mechanisms for the control of flow rate and/or temperature	Flow booster	Option to intentionally override a default flow limitation or water-saving position to get a full/higher flow on demand for specific purposes. The lower flow rate position is returned after the device is released or switched back manually.
	Brake and two-stage cartridge valve	Mechanical barriers which limit the opening of the valve and which need to be overcome to deliver more water. This feature can be integrated in the cartridge itself (click-cartridges). The lower flow rate position is returned after the device is released or switched back manually.
Automatic mechanisms for the flow rate control (self-closing devices)	Push tap	Tap that starts delivering water after a mechanical operation from the user and that automatically stops the flow after a set delay time or after a certain volume is delivered. The flow and temperature of the water can be preset or adjusted by the user. This function is only possible for some designs. The majority of these products only deliver water for a default period of time with no flow or temperature adjustments allowed to end-users.
	Sensor tap	Tap that starts automatically delivering water when a movement is detected by a sensor and that terminates after a set delay time or after a certain volume is delivered. The flow and temperature of the water can be preset or adjusted by the user.
Installation	Single-hole mixing valve (or mono-bloc valve)	Deck-mounted mixing valve that needs one mounting hole.
	Two/three-hole mixing valve	Deck-mounted mixing valve that needs two/three mounting holes.
	Wall mounted mixing valve	Mixing valve which is connected to piping coming out from a wall.
	Concealed valve	Valve which is installed in or behind the wall. Only the controls and outlet(s) are visible.
Application and design	Kitchen tap	Tap/valve installed in kitchen sinks.
	Washbasin tap/valve	Tap/valve installed in washbasins.
	Bidet tap/valve	Tap/valve installed in bidets.
	Bathtub tap/valve	Tap/valve which releases water to a bathtub.
	Shower tap/valve	Tap/valve which provides water to a shower system.
	Bathtub/Shower valve	Tap/valve which can either release water to a bathtub directly or to shower outlets through hoses.
	Outdoor tap/valve	Tap/valve installed for outdoor applications (e.g. gardening).

1.3.3 Technical classification of shower systems

Technical features for the classification of shower systems are described in Table 1.3. Features completely related to the valve are reported in Section 1.3.2 and are not repeated here.

Table 1.3 Technical features for the classification of shower systems

Feature	Product	Definition
Type of outlet and related features	Showerhead	Outlet that is fixed above the head. Generally used to indicate both hand showers and showerheads.
	Hand shower (or shower handset)	Outlet that is moveable and connected to a flexible hose.
	Body spray/jet	Outlet that is fixed on a surface.
	Eco-button	Feature that allows the user to choose between a discrete number of water flow modes.
Configuration	Shower column	Self-standing equipment that includes a wall-mounted shower mixer and a showerhead, connected with a pipe. It may also feature a hand shower and/or additional outlets.
	Shower panel	Self-standing equipment that may include more than one shower outlet and body jets mounted on a vertical plate.
	Wall-mounted shower	Shower systems where the valve and delivery systems are installed on the wall.
	Concealed shower	Shower system where the valve and delivery systems are installed in or behind the wall. Only the controls and outlet(s) are visible.
	Bath/shower mixer	Shower system where the valve can either release water to a shower outlet or to a bathtub. The flow can be switched between the two applications through diverters.
Related accessories	Slide bar (also commonly known as riser rail)	Bar fixed on the wall for the movement of the outlet support.
	Shower cabin (or cabinet)	Unit with rigid plastic/glass walls to provide a watertight compartment. Shower cabins are self-contained free-standing units as opposed to shower enclosures that may utilise existing bathroom structures for support.
	Shower tray	Horizontal base that the user stands on during the shower and that allows water to be drained.

1.3.4 Classifications and definitions used for European trade statistics

PRODCOM

The PRODCOM database[15] contains statistics on the production of manufactured goods. Categories of relevance for taps and showers are reported in Table A1.1 of Annex I. A clear definition of taps and showers based on PRODCOM is not possible. Taps are included in category 28.14.12, which is differentiated into mixing valves (28.14.12.33) and other taps or valves (28.14.12.35). However, these categories also contain other types of valves used in different applications, e.g. for water cisterns. Information on the classification typically used for shower outlets is more uncertain. This may be included in the same categories used for taps or, for instance, in 25.99.11.31, 25.99.11.35 and 25.99.11.37 (all related to sanitary ware and parts of sanitary ware) or in 22.23.12.90 (similar sanitary ware).

Combined Nomenclature

The disaggregation of the Combined Nomenclature (CN)[16] is similar to PRODCOM (see Table A1.1 of Annex I). As in PRODCOM, mixing valves and other valves are differentiated (in categories 8481 80 11 and 8481 80 19, respectively) but no information is reported about the use of the product (sanitary, industry, heating). CN also disaggregates based on the materials used and does not explicitly refer to shower outlets.

NACE

The Statistical Classification of Economic Activities in the European Community (NACE)[17] shows a more aggregated structure compared to PRODCOM (see Table A1.1 of Annex I). All types of taps and valves are included in category 28.14, which group together sanitary, industrial and heating taps and valves. Similarly to in PRODCOM, shower outlets may be included in that category or in categories 25.99 (fabricated metal products) and 22.23 (manufacture of plastic ware).

1.3.5 Classifications and definitions according to international standards

An overview of existing classifications and definitions according to international standards is shown in Table A1.2 of Annex I. Based on this, basic definitions can be proposed for taps and showers.

According to BS 6100-7[18], a tap may be defined as a “small diameter manually operated valve from which water is drawn”.

According to EN 1112:2008[19] and EN 13904:2003[20]:

- A shower outlet is "a device for ablutionary purposes which allows water to be emitted in the form of jets or water droplets".
- A spray plate is "a device with orifices through which water passes and forms a spray of water with separate, definable jets or water droplets" and a spray-forming mechanism is "a device which generates a spray by other means".

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[15] http://epp.eurostat.ec.europa.eu/portal/page/portal/prodcom/introduction

[16] http://ec.europa.eu/taxation_customs/customs/customs_duties/tariff_aspects/combined_nomenclature/

[17] http://epp.eurostat.ec.europa.eu/portal/page/portal/nace_rev2/introduction

[18] BS 6100-7:2008. Building and civil engineering. Vocabulary. Services. British Standards Institution, London 2008

[19] EN 1112:2008. Sanitary tapware – Shower outlets for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

[20] EN 13904:2003. Low resistance shower outlets for sanitary tapware. European Committee for Standardization, Brussels 2003

- A shower arm is a "component which supports a showerhead and connects it to the water supply".
- Shower handsets are "moveable hand held shower outlets which are connected to the sanitary tapware via a shower hose […]" and "can be hung directly on the tapware or on the wall with the aid of an appropriate support".
- Showerheads are "fixed overhead shower outlets which direct water onto the user from above".
- Body showers are "shower outlets fixed to a vertical wall and direct water laterally onto the user".

1.3.6 Classifications and definitions according to existing labelling categories

Definitions for taps and showers have been discussed during the recent development of EU Ecolabel and GPP criteria for sanitary tapware[21,22]:

- "Tap" means a directly or indirectly, mechanically and/or automatically operated valve from which water is drawn.
- "Shower" means a combination of showerhead and interrelated control valves and/or devices.
- "Showerhead" means
  a) a fixed overhead or side shower outlet, body jet shower outlet or similar device which may be adjustable, and which directs water from a supply system onto the user; or
  b) a moveable hand held shower outlet which is connected to a tap with a shower hose and can be hung directly on the tap or on the wall with the aid of an appropriate support.

Definitions and classifications can also be found in other labelling schemes and water efficiency rating systems in place in the EU and worldwide and mentioned in the document.

1.3.7 Additional definitions of interest for specific types of product

Based on the input of stakeholders, specific types of products have been identified and described for which water saving may not be considered a relevant issue, for instance because of specific functionalities of the product or marginal market shares. These have been grouped and reported in Table 1.4.

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[21] http://www.europarl.europa.eu/RegistreWeb/search/resultDetail.htm?language=EN&reference=COM-AC_DRC(2012)D020994-03&lg=&fragDocu=FULL?epbox

[22] http://susproc.jrc.ec.europa.eu/ecotapware/stakeholders.html

Table 1.4 Additional definitions of interest for specific types of products

Product	Description
Bathtub taps/valves	Tap/valve which releases water to a bathtub. These products are required to allow bath filling as quickly as possible to prevent energy and heat loss. The size of the bathtub is the most relevant factor for water/energy consumption. The faster a bath is filled, the lower the amount of heat loss.
Household food waste disposers installed in sinks	Device installed under a kitchen sink which shreds food waste into pieces small enough to pass through plumbing. Although its use can be associated to that of taps, this is not a water-using product and thus it is outside the scope of this study. Moreover, it is not allowed in many EU countries.
Commercial kitchen taps	Commercial kitchen taps are professional tools that need to be assessed accordingly to the particular needs of their users. Water is part of the food recipe or needed to clean food in big washbasins. Hand washbasins in commercial kitchens represent an exception. Sensor-operated taps could be mandatory for these applications. Taps used in commercial kitchens are: 1. Big 3/4" taps used for filling pots or kettles. The amount of water is needed to prepare the food (soup, etc.) or to fill large basins in which food is cleaned. For this product group, water saving is not relevant and a label or other options would not make sense. 2. Normal 1/2" taps are of the same design as domestic taps. In commercial kitchens they are used to fill buckets for cleaning or hand washbasins.
Instant hot water dispensers	Devices fitted with heating elements for quickly supplying and dispensing near-boiling hot water. Some models are designed to also supply cold water. This product is of relevance for water heaters and hot water storage tanks (Lot 2).
Luxury and wellness showers	These are shower systems that sometimes have a showerhead with a diameter greater than 200 mm. However, a suitable definition has not yet been found. Definition is difficult because luxury and wellness are subjective parameters which depend on the perception of the user. Moreover, luxury devices do not necessarily mean that they perform a "wellness" function while wellness devices may be required to perform a "medical" function. In general, luxury and wellness showers should be treated as conventional products to avoid this claim being used to bypass any potential requirements.
Pre-rinse spray units	Pre-rinse spray units are designed for pre-cleaning dishes, pots and pans before they are put in a dishwasher. This is not a regular function of the majority of the products on the market (apart from commercial kitchen taps). Moreover, a simple reduction of the flow rate for this product would imply a longer use. More efficient spray nozzles could be a more effective option to save water. The most popular design is a spray gun, spring and hose on a tap. For these units, the cleaning performance is absolutely essential.
Safety showers	The function of this product is to wash a person/body part in order to provide relief and to minimise the effects of an incident as quickly as possible. Frequency of use is very low and safety is the only important parameter.

1.4 Measurement methods and standards

This section describes the most relevant tests and standards for taps and showers related to:

- functional performance parameters;
- safety;
- noise;
- any other parameter considered of relevance.

These have been grouped in:

- standards valid at International and European Community level;
- standards valid at Member State level;
- Third-Country standards.

1.4.1 Main standards

In the European Committee for Standardization (CEN)[23] there are three Technical Committees (TC) that deal with sanitary appliances (TC 163), water supply (TC 164) and waste water treatment (TC 165). Each TC is composed of working groups that are responsible for specific testing issues, as indicated in Annex I in Table A1.3.

CEN standards of relevance for taps and showers at the product level are reported in Annex I in Table A1.4. Information received from stakeholders on standards at Member State and Third Country level is also reported in Annex I, in Table A1.5.

Characteristics for which testing procedures are established include:

- mechanical strength;
- acoustics;
- hydraulic characteristics (e.g. flow rate, spray pattern);
- materials;
- dimensions;
- mechanical endurance;
- leak tightness;
- backflow protection;
- mechanical performance under pressure;
- maintenance issues.

Other European standards deal with product-related issues (e.g. sanitary ware, piping, waste water system, drinking water regulations).

One of the most important European standards for taps is EN 200:2008[24] that applies to draw-off taps used in toilets, bathrooms and kitchens. This standard allows taps to be classified based on certain characteristics (e.g. supply system, type of tap, intended use, mounting method). The main standard for shower outlets is instead EN 1112:2008[25].

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[23] https://www.cen.eu/cen/pages/default.aspx

[24] EN 200:2008. Sanitary tapware – Single taps and combination taps for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

[25] EN 1112:2008. Sanitary tapware – Shower outlets for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

In terms of type, a distinction is made between pillar taps, bib taps and single-hole/multi-hole combination taps (see Figure 1.1). Supply systems are differentiated between type 1 and type 2. In type 1 systems, high-pressure water from the mains is supplied for both cold and hot water. In type 2 systems, sanitary appliances are fed with mains cold water, gravity hot water and alternative cold water supply systems. Traditionally, only one tap would be supplied directly from the mains while cold water from the tank would be supplied to all other taps. This keeps the pressure between hot and cold supplies balanced.

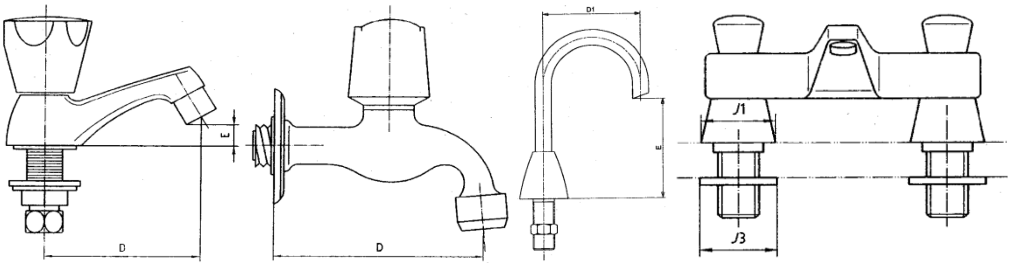

Figure 1.1 Types of taps according to EN 200:2008 (l-r: pillar tap, bib tap, single-hole combination tap, two-hole combination tap)

The standard EN 200:2008 also indicates test specifications for hydraulic characteristics (flow rate), which have been reported in Annex I in Table A1.4. Taps are classified according to flow rate as indicated in Table 1.5. Minimum flow rates to be tested for different applications are reported in Table 1.6.

Table 1.5 Classification of taps and shower outlets based on their flow rate according to EN 200:2008 and to EN 1112:2006

Water supply system	Class	Flow rate in L/min	
		Taps	Shower outlets
Type 1	ZZ	-	1.5-7.2
	Z	≤ 9	7.2-12
	A	≤ 15.0	12-15
	S	≤ 20	15-20
	B	≤ 25	20-25
	C	≤ 30	25-30
	D	≤ 38	30-38
Type 2	X	≤ 7.5	-
	Y	≤ 15	-
	R	≤ 7.5 hot and ≤ 4.2 cold	-
	E	-	3.6-8.4
	H	-	> 8.4

Table 1.6 Minimum flow rates in L/min to be tested for different applications according to EN 200:2008

Supply system	Application	Type 1	Type2
Single taps	Basin, bidet	12	7.5
	Bath	19	15
Combination taps	Basin, bidet, sink (water saving)	4-9	3-6
	Basin, bidet, sink, shower	12	7.5
	Bath	19	15

1.4.2 Description of standards and test methods of relevance for different technical aspects

Information on standards and test methods of relevance for different technical aspects related to taps and shower systems has been summarised below based on input from stakeholders.

a) Functional performance parameters

- EN 16507 on the "Influence of metallic materials on water intended for human consumption - Determination of residual surface lead (Pb) - Extraction method", EN 16058 on the "Influence of metallic materials on water intended for human consumption - Dynamic rig test for assessment of surface coatings with nickel layers - Long-term test method" are test methods for metallic materials but they do not provide any thresholds for assessing the fitness for contact with drinking water. An additional standard in this area is DIN 2459 on "Inseparable elastomer sealed connectors made of metal for metallic pipes for use in drinking water system installation - General requirements and test methods";
- For performance, comfort and water use efficiency some methods exist to assess the distribution of the flow. This might be considered a proxy for comfort or efficiency, but it is not directly correlated. BS 6340-4 describes a test for measuring flow distribution in an experimental shower rig using 3 concentric rings. AUS/NZ 3662 and Water Sense use an apparatus with 10 concentric rings. ASTM F2324-03 describes a method for assessing the rinsing efficiency of pre-rinse spray units of professional kitchens (using dried tomato sauce). A method for assessing the rinsing effectiveness of showers is being developed by CEIR for eventual future integration into the product standard.
- In the UK the majority of products are assessed against the Water Regulations. Compliance with EN standards such as EN 200 does not correspond to compliance with the Water Regulations as many aspects of the Water Regulations are not tested for within EN 200. For thermostatic mixing valves that are used in hospitals, it is necessary for high-risk applications to have a product compliant with NHS model engineering specification D 08 and verified by a third party.
- Sweden has developed two standards, SS 820000 "Sanitary tapware – Method for determination of energy efficiency of mechanical basin and sink mixing valves" and SS 820001 "Sanitary tapware – Method for determination of energy efficiency of thermostatic mixing valves with shower", that include methods for the measurement of temperature and flow distribution and rinsing ability.
- In Portugal, the test for evaluation of water efficiency is made in accordance with the Technical Specification ANQIP ETA 0807 for showers and in accordance with ETA 0809 for the taps.

- Standards and guidelines mentioned to address specifically functional performance parameters for thermostatic mixing valves include:
    - EN 1111 "Sanitary tapware – Thermostatic mixing valves (PN 10) – General technical specification".
    - EN 1287:1999 "Sanitary tapware. Low pressure thermostatic mixing valves. General technical specifications".
    - EN 15092 "Building valves. Inline hot water supply tempering valves. Tests and requirements". However, this is not a standard that covers terminal devices since the task of tempering valves is to ensure that a system does not run at too high a temperature. On the contrary, thermostatic valves are intended to control the temperature of the water delivered to the final point of use
    - Australian Standards AS 4032.1 on "Water supply - Valves for the control of hot water supply temperatures - Thermostatic mixing valves - Materials design and performance requirements"; AS 4032.2 on "Water supply - Valves for the control of hot water supply temperatures - Tempering valves and end-of-line temperature-actuated devices"; AS 4032.3-2004 on "Water supply - Valves for the control of hot water supply temperatures - Requirements for field testing, maintenance or replacement of thermostatic mixing valves, tempering valves and end of line temperature control devices" and AS 4032.4 on "Water supply - Valves for the control of heated water supply temperatures - Part 4: Thermostatically controlled taps for control of heated water supply temperatures".
    - Standards of the American Society of Sanitary Engineering (ASSE[26,27]) 1016, 1017, 1062, 1069, 1070 on temperature control.
    - KIWA[28] guidelines for testing thermostatic mixing valves and TMV2 and TMV3 certification for hospitals and high-risk applications.
    - NF 077[29] and NF 079[30] on certification rules for the NF MARK of sanitary tapware and control valves and safety valves.
    - Chinese Standard QB 2806[31] on thermostatic faucets.

b) Resource use (energy, water and other materials)

- EN 15804 on "Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products ", related to the environmental impact of construction products.
- DIN 1988-300 on "Codes of practice for drinking water installations - Part 300: Pipe Sizing".

c) Water abstraction, impoundment, storage, treatment and distribution of surface water or groundwater

- No element identified.

d) Waste production

- No element identified.

e) Emission measurement

- No element identified.

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[26] www.ASSE-plumbing.org

[27] http://media.wattswater.com/F-P-ASSECompare.pdf

[28] http://www.kiwa.nl/united_kingdom/testing.aspx?id=1194

[29] http://www.cstb.fr/fileadmin/documents/certifications/NF077/NF077R2.pdf

[30] http://www.cstb.fr/fileadmin/documents/certifications/NF079/NF079A12.pdf

[31] http://www.standardsportal.org/usa_en/prc_standards_system/standards_used_in_china.aspx

f) Safety

- EN 1111 "Sanitary tapware – Thermostatic mixing valves (PN 10) – General technical specification".
- EN 1287 on "Sanitary tapware. Low pressure thermostatic mixing valves. General technical specifications".
- EN 15092 on "Building valves. Inline hot water supply tempering valves. Tests and requirements".

g) Noise and vibrations

- EN 200 on "Sanitary tapware. Single taps and combination taps for water supply systems of type 1 and type 2. General technical specification".
- EN 246 "Sanitary tapware – General specifications for flow rate regulators".
- EN 816 "Sanitary tapware – Automatic shut-off valves PN 10".
- EN 817 "Mechanical mixing valves (PN 10) - General technical specifications".
- EN 1111 "Sanitary tapware – Thermostatic mixing valves (PN 10) – General technical specification".
- EN 1112 on "Sanitary tapware. Shower outlets for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification".
- EN 15091 "Sanitary tapware – Electronic opening and closing sanitary tapware".

h) Waste water collection and treatment which subsequently discharges into surface water

- EN 12056 on "Gravity drainage systems inside buildings. Roof drainage, layout and calculation".
- DIN 1986-30; -100.

1.4.3 Planned development and/or revision of standards

This is the status at April 2014 according to stakeholders:

- There are some standards that are due to be revised and updated such as EN 246, EN 200, EN 817, EN 15091, EN 1111, and EN 1287.
- ASSE 1016 has been modified in order to integrate lower flow rates specified by manufacturers. A revision in the Australian Code is also planned.
- The Federal Environment Agency works according to the German drinking water Directive (TrinWV) on mandatory criteria for materials and substances that come into contact with drinking water.

1.4.4 Accuracy, tolerances, reproducibility and representativeness issues in existing standards and methods

According to stakeholders, tests described in many standards are often "type tests" and not validation tests, e.g. flow rate for an actual given installation.

For performance, comfort and water use efficiency, some methods exist to assess the distribution of the flow. Methods such as BS 6340-4 and AUS/NS 3662 are reliable but the result should be considered as a measure of the flow distribution, not more. ASTM F2324-03 is very sensitive to the test conditions and therefore has reproducibility problems.

1.4.5 State of the art on standards for assessing the efficiency of products taking into account their functions

Stakeholders have been consulted intensively to gather relevant and updated information on the state of the art on standards for assessing the efficiency of products.

Harmonised standards for assessing the water and energy efficiency of taps and showers taking their function(s) into account would be important elements for comparing the performance of different product options. Nevertheless, most stakeholders have underlined that at the moment there is no work on this area at the level of international standardisation organisations and that the water flow of products is currently the only aspect which can be satisfactorily measured by means of internationally standardised methods.

The energy use is a function of water flow rate and water temperature. Higher water flow rates and higher temperatures would generally result in increased energy use, although user behaviour and the specific activity involving the use of taps and showers can also have an important influence. A reduced flow of water may indeed extend the time of use in some cases. Manufacturers can provide products with physical means for preventing the use of maximum water flow rates and/or higher temperature conditions when not necessary.

For the last 15 years, the Swedish Energy Agency (SEA) has been incentivising the development of water- and energy-efficient taps using technologies that decrease the use of water while still providing the same function(s). The SEA suggests that the main technical measures contributing to an efficient use of energy and water are as follows:

- Influencing the user not to use water with routine and to avoid wasting water and energy when not needed. This can be achieved for instance by using taps with flow boosters, two-stage cartridge taps, sensor and push taps.
- Creating efficient configurations of water beams formed of droplets mixed with air in order to fulfil a certain function (for example rinsing a plate or washing a piece of cloth) with less use of water. Aerators are important parts for this function.

A laboratory test method for measuring the energy efficiency of taps was developed by the Swedish National Testing and Research Institute in 2005-2007, with the support of a Technical Working Group composed of stakeholders from different organisations (e.g. certification bodies, industry, academia, NGOs) and managed by the SEA. The test method was standardised at national level in 2007-2010 by the Swedish Standards Institute Technical Committee TK519. A test method for measuring and calculating the energy efficiency of valves with showers has also been developed.

The standard SS 820000 "Sanitary tapware – Method for determination of energy efficiency of mechanical basin and sink mixing valves" describes a laboratory method for measuring the energy use of mechanical mixer taps used in washbasins and kitchen sinks.

The standard SS 820001 "Sanitary tapware – Method for determination of energy efficiency of thermostatic mixing valves with shower" describes a laboratory method for measuring the energy use of thermostatic mixers supplying a showerhead.

According to stakeholders involved in the development of SS 820000 and SS 820001, the main goal of the standards is to support the development and commercialisation of products presenting a reduced use of hot water without compromising consumer comfort.

The measurement of the energy efficiency of products is based on the definition of a standard function (i.e. the rinsing performance) and a series of test activities where technical characteristics are varied (e.g. water pressure, flow rate, the control setting) as indicated in Table 1.7. Activities aim at describing "conventional" uses of products and are intended to represent different user applications as closely as possible to reality. Standard cycles of activities and other characteristics of methods are, in general, considered to be easier to define for taps than for showers.

The energy consumption is calculated for each activity by measuring the water flow, temperature and time required to perform the activity. The energy consumption for all activities is then summed up to give the total energy use of taps and thermostatic mixers.

The quantity of energy used provides a measure of the energy efficiency of the product and a basis for the classification of the energy performance and the further labelling of products (see Section 1.5.3).

Table 1.7 Main elements of the standards SS 820000 and SS 820001

	Swedish Standard 820000	Swedish Standard 820001
Scope	Measuring the energy use of mechanical mixer taps used in washbasins and kitchen sinks. Determining the performance criteria on energy efficiency.	Measuring the energy use of thermostatic mixers used in shower systems (consisting of a showerhead, hose and connections to water supply pipes). Determining the performance criteria on energy efficiency.
Test description	Time for rinsing a spot of food colouring on a test cloth is measured. The time starts when coloured water reaches the inspection sheet and stops when the water running off the sheet is no longer coloured by food colouring. The test is repeated 20 times. Use of water for different standard activities characterised by defined pressure, flow rate, temperature and set position of the control stick. Activities:	Time for rinsing a spot of food colouring on a test cloth is measured. The time starts when coloured water reaches the inspection sheet and stops when the water running off the sheet is no longer coloured by food colouring. The test is repeated 20 times. Use of water for different standard activities characterised by defined pressure, flow rate, temperature and set position of the control stick. Activities:
	a-c) For the first three activities (a-c), the supply temperature of the cold water must be 10 °C ± 1 °C and that of the hot water must be 60 °C ± 1 °C. Measure the temperatures of the following settings for 60 seconds: a) Economy temperature, economy flow and supply pressure 100 kPa ± 20 kPa; b) Economy temperature, economy flow and supply pressure 300 kPa ± 20 kPa; c) Economy temperature, economy flow and supply pressure 500 kPa ± 20 kPa.	a-e) For the first five activities (a to e), the supply temperature of the cold water shall be 10 °C ± 1 °C, and that of the hot water shall be 60 °C ± 1 °C. Measure the mixer water temperature and maximum temperature at head height (20 cm below the showerhead) for 60 seconds, with the following settings: a) Mixer water temperature 38 °C ± 0.5°C, economy flow, supply pressure 100 kPa ± 20 kPa; b) Mixer water temperature 38 °C ± 0.5°C, economy flow, supply pressure 300 kPa ± 20 kPa; c) Mixer water temperature 38 °C ± 0.5°C, economy flow, supply pressure 500 kPa ± 20 kPa; d) Maximum temperature, economy flow, supply pressure 300 kPa ± 20 kPa; e) Maximum temperature, maximum flow, supply pressure 300 kPa ± 20 kPa.

	d-f) For sub-activities d to f, the supply temperature of the cold water must be 10 °C ± 1°C and that of the hot water must be 60 °C ± 1 °C, with a supply pressure of 300 kPa ± 20 kPa. Perform these activities for 60 seconds, with the following settings: d) Economy flow, with the control handle halfway between the centred position and the maximum hot water flow position. If the mixer tap control handle is at the side of the tap outlet, then "centred position" shall be taken to mean "straight upwards"; e) Economy flow, with the control handle in the centred position (90° ± 1°C). If the control handle is at the side of the tap outlet, then "centred position" shall be taken to mean "straight upwards" or "straight downwards"; f) Economy flow and mixer water temperature 38 °C ± 1 °C. g-i) For sub-activities g to i, the supply temperature of the cold water must be 10 °C ± 1°C and that of the hot water must be 60 °C ± 1 °C, with a supply pressure of 300 kPa ± 20 kPa. Adjust the mixer water temperature to 38 °C ± 1 °C, and measure and note the rinse times and flows as follows: g) Measure the rinse time at maximum flow; h) Measure the rinse time at economy flow; i) Measure the rinse time at 3 litres per minute ± 0.1 litre per minute for washbasin mixer taps, and at 5 litres per minute ± 0.1 litre per minute for kitchen mixer taps. j-l) For sub-activities j to l, the supply temperature of the cold water must be 10 °C ± 1°C and that of the hot water must be 60 °C ± 1 °C, with a supply pressure of 300 kPa ± 20 kPa. Adjust the mixer water temperature to 50 °C ± 1 °C, and measure and note the rinse times and flows as follows: j) Measure the rinse time for removing oil at maximum flow; k) Measure the rinse time for removing oil at economy flow; l) Measure the rinse time for removing oil at 3 litres per minute ± 0.1 litre per minute for washbasin mixer taps, and at 5 litres per minute ± 0.1 litres per minute for kitchen mixer taps.	f-h) For activities f to h, the supply temperature of the cold water shall be 10 °C ± 1 °C, that of the hot water shall be 60 °C ± 1 °C, and the supply pressure shall be 300 kPa ± 20 kPa. Adjust the mixer water temperature to 38 °C ± 1 °C at head height (20 cm ± 0.2 cm below the showerhead), and measure and note the rinse time and water flow. f) Measure the rinse time at maximum flow; g) Measure the rinse time at economy flow; h) Measure the rinse time at 7 litres per minute ± 0.1 litre per minute. If this flow rate cannot be delivered, make the measurement at the maximum flow that can be delivered.
Determination of the energy use	By calculating the energy use for a number of different activities defined in terms of the position of the control handle, flow rate, the mixer water temperature, supply pressure, supply temperature and rinsing time. Energy uses for the various activities are summed up. The weight assigned to activities g-l is double that of activities a-f.	By calculating the energy use for a number of different activities defined in terms of mixer control setting, flow rate, mixer water temperature, supply pressure, supply temperature and the rinsing time. Energy uses for the various activities are summed up. The weight assigned to activities f-h is four times that of activities a-e.

Reproducibility of the results is managed in the Swedish standards by requiring a relative uncertainty below 10% for 16 measurements out of 20. According to the SEA, uncertainty is typically below 5% and it is possible to repeat test methods and to attempt to reproduce conditions of use similar to in reality. However, although the appropriateness of the focus on rinsing performance and hot water only may be debatable for some applications (e.g. brushing teeth with cold water in southern regions of Europe), it was remarked that the greatest benefit of the standards is to provide a framework with which to quantify the energy consumption from products taking into account parameters related to their function.

The SEA also reported that standards are widely supported in Sweden and have contributed to the diffusion of energy-efficient taps and showers on the Swedish market that do not limit the function of the product and the comfort of users, thus ensuring a satisfactory level of consumer acceptance. The experience of the Swedish standards is also considered to be functional to the potential expansion of the tests to other countries and to the further development of harmonised European standards, which could take up to two to three years.

These standards are used in a voluntary scheme for the labelling of energy-efficient sanitary products in Sweden. To date, the Swedish energy labelling scheme has 176 taps registered from seven manufacturers including 25 shower taps registered from five manufacturers[32]. A third party certification body is also involved.

The plot of the water and energy performance of the certified taps (see Figure 1.2) indicates a huge variation in energy efficiency among products. Assuming that only the most efficient products are labelled within the scheme (class A to C), it could be expected that the variation for the total amount of products on the market would be still greater, Furthermore, analysis of certified products has apparently resulted in no correlation between energy consumption per cycle and water flow rate, although this is significantly dependent on the test conditions set in the standards. A possible correlation between flow rate and energy use could be:

Energy consumption = A · (Max. flow rate)^B

where A and B are constants which would need to be defined.

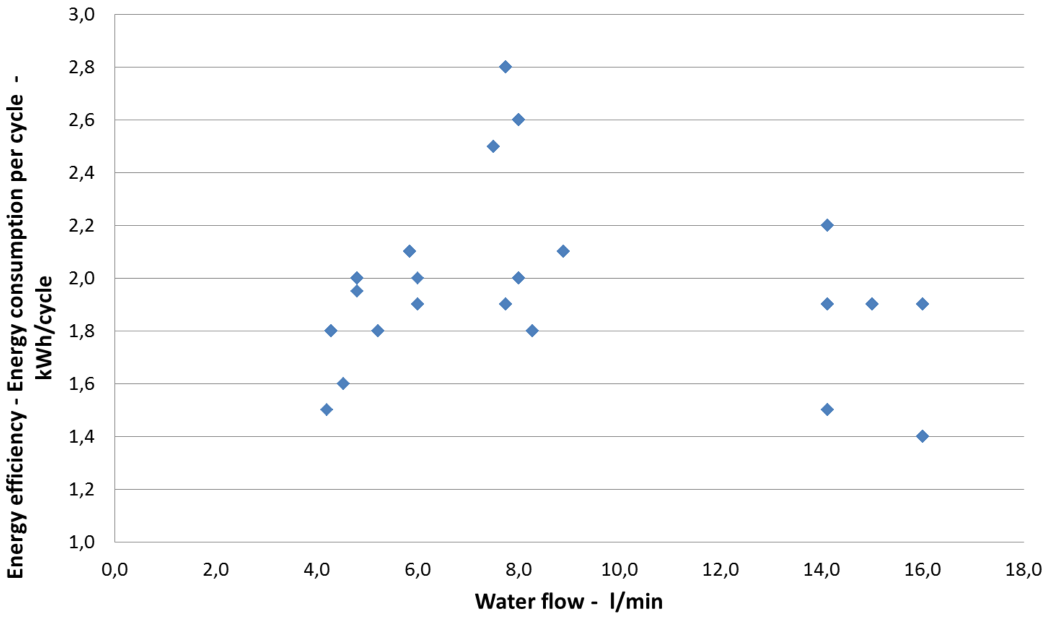

Figure 1.2. Energy efficiency vs maximum water flow based on 176 certified taps according to SS 820000

Harmonised standards would be needed for providing widely accepted methods of measurement and calculation. However, the Swedish standards are not considered suitable by several European manufacturers outside Sweden for several reasons:

- They are not applicable to all categories of products (e.g. two-handle mixers, automatic taps, and single components of showers).
- Their representativeness is considered questionable since finding a standard definition of "product function" and test activities would be difficult and subjective due to differences among product uses and users and since normal conditions of use

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[32] http://tjanster.kiwa.se/byggbranschen/produktcertifieringar/energimarkning, accessed on 08-04-2014

of products are not reflected in the tests (e.g. the rinsing performance on a textile cloth is tested while products are also designed for comfort purposes and typically used to wash body parts with the support of hands, soap and other tools).

- Their repeatability is considered to be undermined by the lack of standardisation for key features (e.g. textile cloth, food colouring, support sheet, wire mesh) and imprecise evaluation by visual check.
- They are considered to follow a theoretical approach and to be excessively complicated and demanding in terms of resources since too many tests are to be performed for each product.
- The main factor influencing the efficiency of products is the water flow, as evidenced in lab tests that show that taps/mixers with low flow rates can match class A energy efficiency. Too many interdependent criteria are also considered to be difficult for consumers to understanding and rinsing tests have too high a weight and should be removed or further investigated to improve the repeatability of results.

Based on the indications of stakeholders, some critical aspects which could be improved include the following:

- Extension of the scope.
- Revision of activities to reflect normal use of taps. In particular, those related to rinsing should be removed or modified to take real use conditions into account.
- Definition of standardised conditions (e.g. cloth and colour, vessels, shower cabins and surrounding temperature).
- More precise measurements through the use of optical sensors in place of visual inspection.
- Adaptation of tolerances on temperature to the EN standards.

CEIR informed that they are conducting a pre-normative activity for defining methods to measure the rinsing efficiency of showers. However, no indication on timing or technical details is available at the moment. It was reported that further work is necessary in order to ensure the representativeness and accuracy of tests.

Based on the elements gathered during the study, although some initiatives in this area have been started, it seems that there is a lack of widely accepted and robust methods for assessing the performance of taps and showers in terms of the water/energy used to provide a certain function.

According to some stakeholders, there could be a need for issuing specific mandates to the European standardisation organisations in order to define standard methods for measuring and calculating the water/energy efficiency of products taking into account their function(s). Existing methods could be used, update or modified accordingly. However, harmonisation of standards could require a long time period (even more than five years) since a general agreement at EU level on specific technical aspects could be challenging.

It was also reported by stakeholders from industry that a similar request has already been discussed within the CEN/TC 164 in the past. However, no standardisation work has followed, apparently because at that time the existing European standards were considered to provide a reliable and recognised set of calculation methods.

1.5 Legislation, voluntary agreements and labels

This section identifies legislation of relevance for sanitary taps and showers.

1.5.1 European Community level

Water Framework Directive and Water Blueprint

In 2000, the Water Framework Directive (WFD) established a legal basis to protect and restore clean water across Europe and to ensure its long-term, sustainable use. The general objective of the WFD is to get all water – for example, lakes, rivers, streams and groundwater aquifers – into a healthy state by 2015. The Commission has recently launched, with Communication COM(2012)673, a Blueprint to Safeguard Europe's Water Resources[33], a strategy for ensuring that enough good quality water is available to meet the needs of the population, the economy and the environment. The Communication points out concerns over water quantity and quality all across the EU and some remaining gaps in the current water legislation, as well as significant weaknesses in its implementation. In particular, 12 priority problems have been identified:

1. lack of water pricing
2. lack of metering
3. lack of labelling of traded goods
4. land use/agricultural impacts (NWRM)
5. inefficiency in buildings/appliances
6. inefficient water infrastructure
7. lack of water reuse
8. governance
9. target setting
10. drought management
11. understanding costs and benefits
12. knowledge base.

The Blueprint proposes a toolbox that Member States can use to improve water management at national, regional and river basin levels. The Blueprint outlines actions that concentrate on better implementation of current water legislation, integration of water policy objectives into other policies, and filling the gaps in particular as regards water quantity and efficiency. The objective is to ensure that a sufficient quantity of good quality water is available for people's needs, the economy and the environment throughout the EU. Recommended policy options for water efficiency are to:

- enforce water pricing/cost recovery obligations under the WFD, including metering when relevant;
- make water pricing/cost recovery an ex ante condition under the Rural Development and Cohesion policy funds;
- develop CIS Guidance on trading schemes and on a cost-benefit assessment;
- make water use reduction a precondition for some irrigation projects under Rural Development;
- develop CIS Guidance on water accounts (and ecological flow);
- develop CIS Guidance on target-setting;

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[33] http://ec.europa.eu/environment/water/blueprint/

- include water-related products in the Eco-design Working Plan;
- develop voluntary EU Ecolabel and Green Public Procurement criteria for water related products;
- spread best practices/tools to achieve a sustainable economic leakage level.

Ecodesign and Energy Labelling

No mandatory legislation or voluntary agreements currently exist at the European Union level for taps and showers. However, energy labelling and ecodesign measures exist for other water-related products. Within the framework of the Ecodesign Directive[34], minimum requirements have been set for dishwashers[35] and washing machines[36].

The Energy Labelling Directive[37] was introduced with the main objective of allowing consumers to be informed of the energy efficiency of products. In addition, the consumption of other resources or additional information can be included in the label (e.g. water consumption, noise). So far, energy labels are mandatory for water-related products, such as washing machines, dishwashers and water heaters.

EU Ecolabel

The EU Ecolabel scheme was introduced in 1992 by Council Regulation 880/92 to enable consumers to easily identify more environmentally friendly products. The scheme was amended in 2010 by Regulation EC 66/2010[38].

EU Ecolabel criteria for sanitary tapware (including both taps and showers) were published in May 2013[39]. By December 2013, two licences were awarded by the EU Ecolabel Competent Bodies of Poland and Romania. These comprise five product models. No information is available on additional EU Ecolabel licences awarded in the meantime.

Criteria for awarding the EU Ecolabel to sanitary tapware include:

1. water consumption and related energy saving
2. materials in contact with drinking water
3. excluded or limited substances and mixtures
4. product quality and longevity
5. packaging
6. user information
7. information appearing on the EU Ecolabel.

In particular, requirements on water consumption and related energy savings concern the following:

a. Maximum available water flow rate (see Table 1.8).
b. Lowest maximum available water flow rate (see Table 1.8).
c. Presence of a temperature management device / technical solution in taps and showers (e.g. hot water barriers, cold water supply in the middle position,

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[34] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:en:PDF

[35] http://www.eceee.org/Eco_design/products/domestic_dishwashers/

[36] http://www.eceee.org/Eco_design/products/domestic_washing_machines/

[37] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0001:0012:en:PDF

[38] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:027:0001:0019:EN:PDF

[39] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D0250&from=EN

thermostatic mixing valve), where the water supply is not temperature-controlled and is independent from the connected heating system.

d. Guidelines on time control for taps and showers with time control devices. In case of time limiters, the preset maximum flow period must be 15 seconds for taps and 35 seconds for showers. In case of sensors, the maximum shut-off time delay after usage must be 1 second for taps and 3 seconds for showers while the preset shut-off time cannot be longer than 2 minutes.

Table 1.8 Requirements on flow rate according to the EU Ecolabel criteria for sanitary tapware

Product sub-group		**Lowest maximum avaialble flow rate (L/min)**	**Maximum available water flow rate (L/min)**
Kitchen taps	without flow-limiting device	2.0	6.0
	with flow-limiting device[1]	2.0	8.0
Basin taps	without flow-limiting device	2.0	6.0
	with flow-limiting device[1]	2.0	8.0
Showerheads and showers[2]		4.5	8.0
Electric showers and low-pressure showers		3.0	-

[1] The flow-limiting device must allow for setting the default water flow rate (water-saving setting) at a maximum value of 6 l/min. The maximum available water flow rate shall not exceed 8 l/min.

[2] Showerheads and showers with more than one spray pattern shall fulfil the requirement for the setting with the highest water flow.

Requirements on water consumption are also included in the EU Ecolabel for tourist accommodation[40] and campsite[41] services. For both product groups, "the average water flow of the taps and showerheads excluding bathtub taps, kitchen taps and filling stations shall not exceed 9 litres/minute". Other optional requirements are also included:

- "The average flow from all taps and showerheads excluding bath taps shall not exceed 8 litres/minute".
- "At least 95 % of taps shall allow a precise and prompt regulation of the water temperature and of the water flow".
- "All showers in staff facilities, outdoor and common areas shall have a timing/proximity device, which interrupts water flow after a defined time or if not in use".

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[40] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:198:0057:0079:EN:PDF

[41] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:196:0036:0058:EN:PDF

1.5.2 Member State and Third Country level

Relevant information about legislation, agreements and labels implemented at Member State level is reported in Annex I in Table A1.6.

By comparing the different Member States, it is possible to see that:

- mandatory legislation is generally not in place and when applied is usually done at regional or municipal level and in accordance with the national building code;
- environmental labelling schemes are the most typical form of voluntary legislation for taps and showers, both with respect to the product itself or its use in accommodation services and buildings;
- labelling can be based on pass/fail criteria or on water- and energy-saving/efficiency rating systems;
- other voluntary measures include codes or guidelines for sustainable buildings.

Relevant information about legislation, agreements and labels implemented in Third Countries is reported in Annex I in Table A1.7.

As is the case in EU Member States, the majority of policy tools applied in Third Countries are represented by voluntary environmental labels. Some of these schemes only address accommodation services, and not specific products. Mandatory measures exist in some countries (e.g. Australia, Canada and Singapore). In general, mandatory requirements are defined via water efficiency labelling schemes, however, requirements due to building codes also exist. An energy label for bathroom products, supported by the government and industry, is currently implemented in Switzerland[42].

Information on regulatory instruments and labelling systems of relevance for taps and shower systems has been summarised below based on input from stakeholders.

1) Regulatory instruments of potential interest for taps and showers

a) Regulations for drinking water and materials:

- Schemes for the market approval of water using products differ from country to country (e.g. Austria – ÖVGW; Belgium – Belaqua; DK – VA approval and the new water drop; “approved for drinking water”; France - Arrêté du 29 mai 1997 and "ACS" scheme; Germany - DVGW approval; Norway – Sintef; Switzerland – SVGW; UK - WRAS approval and KIWA UK approval). A harmonised system would be necessary. Economic burdens of approvals do not depend on the size of companies. Cooperation for the development of a common approach to the hygienic approval of products in contact with drinking water has been initiated by four Member States (France, Germany, the Netherlands and the UK, the so-called 4MS group). Further information is reported at: http://www.umweltbundesamt.de/wasser-e/themen/trinkwasser/4ms-initiative.htm.
- The Federal Environment Agency works according to the German drinking water Directive (TrinWV) on mandatory criteria for materials (positive list) and substances that come into contact with drinking water. Information about the planned mandatory criteria was published (in German): http://www.umweltbundesamt.de/wasser/themen/downloads/trinkwasser/bewertungsgrundlagen_fuer_materialien_und_werkstoffe_im_trinkwasser.pdf
- The "Attestation de Conformité Sanitaire" is, according to French law, mandatory for all products in contact with drinking water, connected to the distribution network and containing at least one component made of organic material.

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[42] http://www.bfe.admin.ch/energieetikette/04901/index.html?lang=en

- For the UK, materials must be compliant with the Water Regulations – this means no specific testing for metallic products in contact with drinking water while organics in contact with drinking water shall comply with BS 6920.
- Portugal has an approval scheme for products in contact with water intended for human consumption, in accordance with Article 10 of Council Directive 98/83/EC of 3 November 1998.
- NKB 4 is one of the test methods that products need to comply with in order to ensure safe and healthy drinking water. Other tests and methods of relevance are: ACS, Wras, KTW, AS 4020, NSF 61, 4 MS group list, W270, KIWA.
- The French regulation on the energy performance of buildings ("Reglementation Thermique 2012") takes taps into account to calculate the needs for hot water, in order to estimate the overall energy consumption.
- In Spain, faucets must meet the standard UNE 19703 in order to be legally placed on the Spanish market (tests are similar to the tests in European standards). Sanitary taps are within the scope of a Spanish law (RD 358/1985 and OM 15/04/85) and if a manufacturer (or their representative) wants to sell this kind of product in Spain, the authorisation is mandatory and takes the form of a certificate issued by the government.
- Further elements of relevance for the UK are as follows:
    - The UK Water Technology List is a voluntary government initiative that provides tax breaks to the property owner if products listed in the scheme are included in any refurbishment projects. There are strict rules on tax breaks and this is a commercial scheme that is not applicable in the domestic market.
    - The 1999 Water Supply (Water Fittings) Regulations and the 2000 Water Bye-laws Scotland.
    - The UK building regulations are currently under revision and that this may have an influence on water use in new homes. The current maximum calculated water use for new homes is 125 L/person/day. Future versions of the standard will limit the maximum to 110 L/person/day for water stress areas.
- The National Building Code of Finland covers "water supply and drainage installations for buildings", in particular the following:
    - Regulation 2.6.3 states that "The water supply system must be designed so that its durability and dependability are ensured for the whole planned life expectancy"
    - Instruction 2.6.3.1 states that "The quality of the water must be taken into consideration when materials for the water supply system are selected. Pipe materials, types of joints and nominal sizes of water supply systems are presented in appendix 3. The materials of the components of the pipework, like valves, fittings, pumps, water meters, should be corrosion-proof and fit for use of food products. Parts of brass components, which are in contact with water, should be manufactured from dezincification-resistant brass. A small amount of dezincification is allowed for water fixtures".

b) Additional labelling of potential interest for taps and showers includes the following:

- In the voluntary French “Marque NF”, products are tested and ranked according to nominal flow rate and some technical features such as flow and temperature management.

- Voluntary environmental labelling for buildings such as LEED (USA), BREEAM (GB), DNGB (Germany) and HQE (France) are of potential interest for this product group, in particular BREEAM for non-domestic applications.
- In Spain there is a voluntary scheme called “VERDE” that is similar to LEED or BREEAM but that is specific and adapted to the Spanish Market. In some buildings it is compulsory to install products with this green label. One problem is that this is a very bureaucratic system, with many documents to fill in. For example, for taps it is required that the products are tested according to European standards which do not take into account water-saving features.

2) Other legislation of relevance for different technical aspects related to the products

a) Functional performance parameters

- National Building Code of Finland.
- Water Supply (Water Fittings) Regulations in the UK (most functional aspects are covered by product standards).

b) Resource use (energy, water and other materials)

- Voluntary labelling schemes have been found in Europe which focus on resource efficiency such as the ANQIP label[43], the European Water Label[44], the Swedish Energy Efficiency Labelling[45], the Swiss Energy Label for Sanitary Fittings[46], the Water Efficiency Label[47] (see Section 1.5.3 for further details).
- Requirements for maximum/minimum flow are provided in old Danish and Norwegian standards.
- National Building Code of Finland[48].
- Many Spanish Communities have adopted several generic laws to save water (e.g. Catalonia, Balearic Islands, Murcia, Madrid) because of recent droughts. Furthermore, a voluntary label for water-saving products exists in Catalonia (“Distintivo de garantía ambiental”).
- Building Regulation and Water Supply (Water Fittings) Regulations in the UK. All new dwellings are subject to a "whole house" maximum allowable water use calculation. Evidence to date indicates that new dwellings that have been designed to meet this requirement use significantly less water per person than another equivalent development. This in some cases provides a framework for maximum water use or the acceptability of "oversize products". Apart from these mandatory regulations, another voluntary initiative in the UK for resource efficiency is the Code for Sustainable Homes.
- In Portugal, the labelling programme for water efficiency implemented by ANQIP (particularly the showers and showers systems with labels A, A+ and A++) is considered in the mandatory system of certification of the energy efficiency of buildings, under Directive 2010/31/EU of the European Parliament and of the Council, of 19 May 2010, for a benefit up to 10% (water efficiency factor). The integration of efficient showers as a component for the energy certification of buildings (Directive

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[43] http://www.anqip.pt/

[44] http://www.europeanwaterlabel.eu/

[45] http://services.1kiwa.com/sweden/product-certification/energy-efficiency-labelling

[46] http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=en&name=en_163840118.pdf&endung=Energy%20Label%20Regulation%20for%20Sanitary%20Fittings

[47] http://www.well-online.eu/

[48] http://www.ym.fi/en-US/Land_use_and_building/Legislation_and_instructions/The_National_Building_Code_of_Finland#D%20Hepac%20and%20energy%20managementwastewater?

2010/31/EU of the European Parliament and of the Council) has promoted an increase in the market of these products and consumer awareness of its importance. Although the measure has only been implemented recently, the indicators show that it is an extremely important measure that must in future be extended to other products that use hot water, such as taps. It is considered that this approach is ideal, because it is integrated, contains an important stimulus for consumers and has no drawbacks.

c) Water abstraction, impoundment, storage, treatment and distribution of surface water or groundwater

- No particular element identified.

d) Waste production

- No particular element identified.

e) Emission measurement

- No particular element identified.

f) Safety

- A French regulation requires that the hot water is delivered below 50°C at the use point in the bathroom.
- In the UK there are specific safety issues for the delivery of hot water in healthcare premises (e.g. Model NHS Engineering Specification D 08). Additionally, Scottish and English Building Regulations also cover hot water safety of baths and other appliances. England and Wales have Building Regulations that state a maximum temperature control of 48°C.
- Legislation on the control of legionella bacteria in water systems (see Section 3).

g) Noise and vibrations

- In Germany, specific requirements are set in standards developed by DIN, e.g. Standard DIN 4109: "Sound insulation in buildings; requirements and testing". All taps used in multi-family houses and hospitals must comply with DIN 4109. It sets decibel values for two noise classes.

h) Waste water collection and treatment which subsequently discharges into surface water

- The Building Regulations – Sustainable Drainage Requirements - controls this in the UK.

1.5.3 European labelling schemes on resource consumption

As mentioned in Section 1.5.2, several voluntary labelling initiatives focused on resource consumption have been found in Europe for this product group, such as:

- the ANQIP label[49]
- the European Water Label[50].
- the Swedish Energy Efficiency Label[51]
- the Swiss Energy Label for Sanitary Fittings[52]

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[49] http://www.anqip.pt/

[50] http://www.europeanwaterlabel.eu/

[51] http://services.1kiwa.com/sweden/product-certification/energy-efficiency-labelling

- the Water Efficiency Label[53].

These schemes are described below, in order to understand better the approach followed, especially in terms of product categories and ranking classes.

1.5.3.1 The ANQIP label[54]

In Portugal, ANQIP has developed technical specifications for the certification and labelling of different categories of products that use water:

- flushing cisterns
- showers and shower systems
- flow reducers
- valves and flow meters.

Products are assigned to seven classes (A++, A+, A, B, C, D, E) based on their flow rate and on the presence of water-saving devices.

Ranking criteria for showerheads and shower systems, the latter defined as a shower valve with a hose and a removable or fixed showerhead, are shown in Table 1.9. In particular, the labels A+ and A are applicable to showers and shower systems which flow less than 5 and 7.2 L/minute, respectively. The presence of thermostatic valves and/or water-reducing functions allows a better grade to be obtained, as shown in Table 1.9.

Table 1.9 ANQIP label water efficiency rating for showerheads and shower systems

Flow Q [L/min]	Showerhead	Shower system	Shower system with thermostatic tap or a water reducing function	Shower system with thermostatic tap and a water reducing function
Q≤5.0	A+	A+	A++ (1)	A++ (1)
5.0<Q≤7.2	A	A	A+	A++
7.2<Q≤9.0	B	B	A	A+
9.0<Q≤15.0	C	C	B	A
15.0<Q≤30.0	D	D	C	B
30.0<Q	E	E	D	C

(1) Water-reducing functions are not considered of interest in these cases.

Ranking criteria for bathroom taps and for kitchen taps are shown in Tables 1.10 and 1.11. The A rating is given to products which have a maximum water flow rate of less than 2 L/minute in the case of bathroom taps, and 4 L/minute in the case of kitchen taps. The presence of aerators and/or water-reducing functions allows a better grade to be achieved, as shown in Tables 1.10 and 1.11.

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[52] http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=en&name=en_163840118.pdf&endung=Energy%20Label%20Regulation%20for%20Sanitary%20Fittings

[53] http://www.well-online.eu/

[54] http://www.anqip.pt/

Table 1.10 ANQIP label water efficiency rating for bathroom taps

Flow Q [L/min]	Bathroom tap	Bathroom tap with an aerator or a water-reducing function	Bathroom tap with an aerator and a water-reducing function
Q≤2.0	A	A+	A++
2.0<Q≤4.0	B	A	A+
4.0<Q≤6.0	C	B	A
6.0<Q≤8.0	D	C	B
8.0<Q	E	D	C

Table 1.11 ANQIP label water efficiency rating for kitchen tap

Flow Q [L/min]	Kitchen tap	Kitchen tap with an aerator or a water-reducing function	Kitchen tap with an aerator and a water-reducing function
Q≤4.0	A	A+	A++
4.0<Q≤6.0	B	A	A+
6.0<Q≤8.0	C	B	A
8.0<Q≤10.0	D	C	B
10.0<Q	E	D	C

The ANQIP label contains several recommendations for products with high water efficiency levels (recommendations of comfort, public health and drainage performance). For instance, bathroom taps delivering less than 2 L/minute and kitchen taps delivering less than 4 L/minute must bear a label with an advisory note recommending that they should be used with an aerator.[55]

The ANQIP label scheme is applied in Portugal, where it is included in the national building regulation. Its possible application is also under consideration in Greece and Cyprus. Some statistics on the number of products registered under the ANQIP labelling scheme are reported in Table 1.12.

Table 1.12 Number of products registered under the ANQIP labelling scheme[56]

PRODUCT	ANQIP label						
	A++	A+	A	B	C	D	E
Bathroom taps	0	1	2	4	0	0	0
Kitchen taps	0	0	1	0	0	0	0
Showerheads	0	2	20	24	13	5	1
Showers	0	7	213	0	2	0	0
Flow restrictors (aerators, etc.)	53 (only certification, with drawing of graphs pressure/flow, to allow proper selection by the consumer. No label is assigned by letters).						
Note: figures updated in January 2014							

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[55] Silva Afonso, A. and Pimentel Rodrigues, C., 2010. The Portuguese system of certifying and labeling water-efficiency products. JOURNAL AWWA, 102, 2, 52-56

[56] http://www.anqip.pt/index.php/en/technical-committees/90-comissao-tecnica-0802, January 2014

1.5.3.2 The European Water Label[57]

The European Water Label is a voluntary programme for labelling water consumption from a whole range of bathroom products:

1. baths
2. WC suites
3. cisterns
4. basin taps
5. shower controls
6. shower handsets
7. grey water recycling units
8. kitchen taps
9. urinal controllers
10. electric showers
11. replacement WC flushing devices
12. supply line flow regulators.

Depending on the amount of water delivered, products are ranked in five classes. For taps and showers these are:

- <6 L/minute
- 6-8 L/minute
- 8-10 L/minute
- 10-13 L/minute
- >13 L/minute.

The label scheme, originally created by BMA in the UK in 2006, has recently expanded to Europe and neighbouring countries and has also adopted the current name thanks to CEIR. This is a relatively simple and popular scheme which indications show is supported by manufacturers, retailers, merchants, the UK government and trade bodies of Spain (AGRIVAL), Italy (AVR) and Germany (FSK).

According to stakeholders involved in the study and close to the scheme, the growth of the European Water Label has been significant, with more than 6500 products registered in the last eight years. Statistics on taps and showers registered under the scheme are provided in Table 1.13. It has been estimated that the label could indicatively cover 40% of the market with the ambitious target of reaching 80% of the market in the next three years.

Inclusion of simplified formulas for taking energy aspects into account and expansion of the label to other product categories outside of the bathroom industry (e.g. horticultural products like hosepipes, micro-drip irrigation units and pressure washers) have been indicated as elements presently under consideration. This may create a comprehensive spectrum of water-using products across different types of industries.

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[57] http://www.europeanwaterlabel.eu/

Table 1.13 **Number of taps and showers registered under the European Water Label scheme**

Flow rate (L/min)	**Basin taps**		**Shower controls**		**Shower handsets**		**Kitchen taps**	
	Number	**%**	**Number**	**%**	**Number**	%	**Number**	**%**
< 6	572	32.6	25	2.5	50	10.9	20	7.9
6-8	309	17.6	216	21,4	42	9.2	6	2.4
8-10	630	35.9	161	15.9	119	26.0	84	33.3
10-13	9	0.5	84	8.3	163	35.6	11	4.4
>13 *	234	13.4	524	51.9	84	18.3	131	52.0
total	1754	100	1010	100	458	100	252	100
*** Flow rate (L/min)**	**Basin taps**		**Shower controls**		**Shower handsets**		**Kitchen taps**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
13-20	36	15.4	312	59.5	17	20.2	16	12.2
20-30	88	37.6	139	26.6	56	66.7	12	9.2
30-40	48	20.5	21	4.0	6	7.1	42	32.1
>40 (a)	62	26.5	52	9.9	5	6.0	61	46.5
Sub-total	234	100	524	100	84	100	131	100
(a) Figures updated in June 2014 (b) For basin taps - Low-pressure product tested at 3 bar and does not reflect how the product will be installed and used.								

1.5.3.3 The Swedish Energy Efficiency Label[58]

A voluntary energy labelling system for basin and sink taps was introduced in Sweden in 2012 and this has been extended to shower taps in 2014.

The labelling scheme is supervised by KIWA Swedcert and is based on certification requirements that are decided by an advisory group representing authorities, test laboratories, manufacturers and consumers. The main requirements are as follows:

- Approved testing in accordance with SS-EN 817 for mechanical sink/handbasin and kitchen mixer taps and in accordance with SS-EN 1111 for thermostatic mixer taps.
- Total energy use of sanitary tapware determined in accordance with the standard SS-820000 (Sanitary tapware – Method for determination of energy efficiency of mechanical basin and sink mixing valves) or the standard SS-820001 (Sanitary tapware – Method for determining the energy efficiency of thermostatic mixing valves with showers) from any laboratory accredited with EN ISO/IEC 17025.
- EN ISO 9001 or equivalent quality management systems in place for the manufacturing site(s).

The energy label is composed of seven classes from A to G, where A represents the best products (see Table 1.14). It has been reported that on average a class-A tap or thermostatic shower uses less than 1.6 kWh when tested according to the standards SS 820000 or SS 820001 whereas an E-rated product would use 3.4-4.0 kWh when tested.

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[58] http://services.1kiwa.com/sweden/product-certification/energy-efficiency-labelling

Table 1.14 **Classification system used in the Swedish energy label**

Class	Energy use per test according to SS 820000/ SS 820001 [kWh]
A	≤1.6
B	1.6-2.2
C	2.2-2.8
D	2.8-3.4
E	3.4-4..0
F	4.0-4.6
G	>4.6

Although the flow rate is an important factor, the final class is not related directly to this parameter only. In fact several measurements need to be taken, as outlined in Section 1.4.5. Only a few products are marked "A" and minimising the flow rate does not necessarily result in being awarded an A class.

Newer taps with a flow rate of 4-5 L/minute and maybe some simple energy-saving functions could usually fulfil the requirements for class C. The average potential savings achievable when a class C tap is replaced by class B or A taps have been evaluated to be equal to 21% and 43%, respectively.

Older taps with flow rates of 12 L/minute and no energy-saving functions would normally be labelled class E. The average potential savings achievable when a class E tap is replaced by a class A, B or C tap has been evaluated to be equal to 30%, 45% and 60%, respectively.

So far, 176 different products from seven different manufacturers have been tested and certified for basin and sink taps and 25 different products from five different manufacturers have been tested certified for shower taps. The analysis of these taps shows that:

- the variation in energy efficiency is great, and the variation on the market is certainly even greater since one can assume that only the most efficient products are labelled classes A to C;
- there is no correlation between energy efficiency and water flow.

1.5.3.4 The Swiss Energy Label for Sanitary Fittings[59]

The Swiss Energy Label for Sanitary Fittings is a voluntary label launched in November 2010 and run by the Swiss Department of Energy. Seven classes from A to G and assigned based on the water flow rates are defined for the following products:

- showerheads (see Table 1.15);
- single-level mixer taps and thermostatic mixer taps (see Table 1.16);
- self-closing taps with sensor (see Table 1.17);
- self-closing taps for basins and bidets (see Table 1.18);
- self-closing taps with sensor for showers (see Table 1.19);
- self-closing taps for showers (see Table 1.20);
- spray flow regulator for outlet fittings (see Table 1.21);

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[59] http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=en&name=en_163840118.pdf&endung=Energy%20Label%20Regulation%20for%20Sanitary%20Fittings

- water-saving products for showers (see Table 1.22);
- shower systems with several outlets (see Table 1.23).

Table 1.15. Criteria for showerheads

Class	Showerheads with built-in regulator Standard water volume [L/min]	Showerheads without regulator (throttle valve) Adjusted water volume [L/min]
A	4.0≤Q<6.0	4.1≤Q<6.3
B	6.0≤Q<9.0	6.3≤Q<10.0
C	9.0≤Q<12.0	10.0≤Q<14.7
D	12.0≤Q<15.0	14.7≤Q<21.7
E	15.0≤Q<18.0	21.7≤Q<36.0
F	18.0≤Q<21.0	36.0≤Q
G	21.0≤Q	

Table 1.16 Criteria for single-level mixer taps and thermostatic mixer taps

Class	Washbasin or bidet Water volume permitted [L/min]	Kitchen Water volume permitted [L/min]	Shower Water volume permitted [L/min]
A	4.0≤Q<6.0	4.0≤Q<9.0	9.0≤Q<12.0
B	6.0≤Q<8.0	9.0≤Q<12.0	12.0≤Q<15.0
C	8.0≤Q<10.0	12.0≤Q<15.0	15.0≤Q<18.0
D	10.0≤Q<12.0	15.0≤Q<18.0	18.0≤Q<21.0
E	12.0≤Q<14.0	18.0≤Q<21.0	21.0≤Q<24.0
F	14.0≤Q<16.0	21.0≤Q<24.0	24.0≤Q<27.0
G	16.0≤Q	24.0≤Q	27.0≤Q

Table 1.17 Criteria for self-closing taps with sensor

Class	Water volume [L/min]	Deactivation time	Standby use of power supply
A	4.0≤Q<6.0	Continues to flow for less than 2 seconds	Standby ≤ 0.3 W
B	6.0≤Q<8.0	Continues to flow for less than 2 seconds	Standby ≤ 0.3 W
C	8.0≤Q<10.0	Continues to flow for less than 2 seconds	Standby ≤ 0.3 W
D	10.0≤Q<12.0	Continues to flow for less than 2 seconds	Standby ≤ 0.3 W
E	12.0≤Q<14.0	Continues to flow for less than 2 seconds	Standby ≤ 0.3 W
F	14.0≤Q<16.0	Continues to flow for less than 2 seconds	Standby ≤ 0.3 W
G	16.0≤Q	Continues to flow for less than 2 seconds	Standby ≤ 0.3 W

Table 1.18 Criteria for self-closing taps for basins and bidets

Class	Water volume [L/min]	Flow time	Standby use of power supply
A	4.0≤Q<6.0	Flow time less than 7 seconds	Standby ≤ 0.3 W
B	6.0≤Q<8.0	Flow time less than 7 seconds	Standby ≤ 0.3 W
C	8.0≤Q<10.0	Flow time less than 7 seconds	Standby ≤ 0.3 W
D	10.0≤Q<12.0	Flow time less than 7 seconds	Standby ≤ 0.3 W
E	12.0≤Q<14.0	Flow time less than 7 seconds	Standby ≤ 0.3 W
F	14.0≤Q<16.0	Flow time less than 7 seconds	Standby ≤ 0.3 W
G	16.0≤Q	Flow time less than 7 seconds	Standby ≤ 0.3 W

Table 1.19 Criteria for self-closing taps with sensor for showers

Class	Water volume [L/min]	Standby use of power supply
A	9.0≤Q<12.0	Standby ≤ 0.3 W
B	12.0≤Q<15.0	Standby ≤ 0.3 W
C	15.0≤Q<18.0	Standby ≤ 0.3 W
D	18.0≤Q<21.0	Standby ≤ 0.3 W
E	21.0≤Q<24.0	Standby ≤ 0.3 W
F	24.0≤Q<27.0	Standby ≤ 0.3 W
G	27.0≤Q	Standby ≤ 0.3 W

Table 1.20. Criteria for self-closing taps with automatic, time-dependent deactivation for showers

Class	Water volume [L/min]	Maximum flow time	Stand-by use of power supply
A	9.0≤Q<12.0	Flow time max. 15 seconds	Standby ≤ 0.3 W
B	12.0≤Q<15.0	Flow time max. 15 seconds	Standby ≤ 0.3 W
C	15.0≤Q<18.0	Flow time max. 15 seconds	Standby ≤ 0.3 W
D	18.0≤Q<21.0	Flow time max. 15 seconds	Standby ≤ 0.3 W
E	21.0≤Q<24.0	Flow time max. 15 seconds	Standby ≤ 0.3 W
F	24.0≤Q<27.0	Flow time max. 15 seconds	Standby ≤ 0.3 W
G	27.0≤Q	Flow time max. 15 seconds	Standby ≤ 0.3 W

Table 1.21 Criteria for spray flow regulator for outlet fittings

Class	Spray flow regulator for outlet fittings [L/min]
A	4.0≤Q<6.0
B	6.0≤Q<8.0
C	8.0≤Q<10.0
D	10.0≤Q<12.0
E	12.0≤Q<14.0
F	14.0≤Q<16.0
G	16.0≤Q

Table 1.22 Criteria for water-saving products for showers

Class	For products which regulate water volume directly at the tap [L/min]	For all other products, the criteria for showerheads with a built-in regulator apply [L/min]
A	4.0≤Q<6.0	4.0≤Q<6.0
B	6.0≤Q<8.0	6.0≤Q<9.0
C	8.0≤Q<10.0	9.0≤Q<12.0
D	10.0≤Q<12.0	12.0≤Q<15.0
E	12.0≤Q<14.0	15.0≤Q<18.0
F	14.0≤Q<16.0	18.0≤Q<21.0
G	16.0≤Q	21.0≤Q

Table 1.23 Criteria for shower systems with several outlets

Class	Water volume permitted in shower systems with several outlets [L/min]
A	4.0≤Q<6.0
B	6.0≤Q<9.0
C	9.0≤Q<12.0
D	12.0≤Q<15.0
E	15.0≤Q<18.0
F	18.0≤Q<21.0
G	21.0≤Q

Since March 2011, the number of products registered for each product group has passed from around 400 to around 2500. In terms of distribution of products among classes, a shift towards water-saving products (classes A-C) has been registered within the respective product groups (see Tables 1.24, 1.25 and 1,26).

Table 1.24. Voluntary Swiss Energy Label - registrations for shower faucets

Class	Registered products on 18/03/2011		Registered products on 02/04/2014	
	amount	%	amount	%
A	0	0.0%	26	12.7%
B	0	0.0%	17	8.3%
C	1	1.0%	7	3.4%
D	7	6.8%	14	6.8%
E	10	9.7%	19	9.3%
F	33	32.0%	50	24.4%
G	52	50.5%	72	35.1%
Total	103	100.0%	205	100.0%

Table 1.25 Voluntary Swiss Energy Label - registrations for kitchen mixers

Class	Registered products on 18/03/2011		Registered products on 02/04/2014	
	amount	%	amount	%
A	5	14.3%	64	23.0%
B	14	40.0%	127	45.7%
C	13	37.1%	72	25.9%
D	3	8.6%	15	5.4%
E	0	0.0%	0	0.0%
F	0	0.0%	0	0.0%
G	0	0.0%	0	0.0%
Total	35	100%	278	100.06%

Table 1.26 Voluntary Swiss Energy Label - registrations for bath mixers

Class	Registered products on 18/03/2011		Registered products on 02/04/2014	
	amount	%	amount	%
A	0	0.0%	25	16.0%
B	0	0.0%	17	10.9%
C	7	9.2%	15	9.6%
D	11	14.5%	16	10.3%
E	19	25.0%	28	17.9%
F	39	51.3%	48	30.8%
G	0	0.0%	7	4.5%
Total	76	100.0%	156	100.0%
Note: measurement point at the shower outlet				

1.5.3.5 The Water Efficiency Label (WELL)[60]

The WELL is a product classification system of the European sanitary valve industry that can be applied to:

- sanitary and kitchen drain valves
- shower valves, showerheads and shower hoses
- urinal flush systems
- WC flush systems
- accessory components.

Valves for filling bath tubs, for connection to household units supplied with water and for gardening are excluded from this classification.

The classification system differentiates between domestic and non-domestic sectors. Sanitary valves in the private sector must fulfil additional functions and thus users should be allowed to opt for using water in wellness applications. Meanwhile, water saving is considered a priority in the public/commercial sector for economic reasons. Greater hygiene requirements are also demanded for this sector.

A proof of conformity with possibly existing EN standards for the product is basically required by a WELL classification. This has to be substantiated by a test report, which is provided by a laboratory that is accredited according to ISO 17025.

The WELL assessment categories for sanitary, kitchen and shower valves, including showerheads and shower hoses, are:

- volume (flow rate)
- temperature
- time (for the public sector).

A two-star classification is the maximum that can be achieved in each category, as shown in Table 1.27. Valves for the public sector can receive a score of up to six stars (efficiency classes A to F) whilst the maximum number of stars in the private sector is four (efficiency classes A to D). The requirements for the different star classifications in the "Home" and "Public" areas are identical, however fewer criteria are tested for the "Home" category.

If a sanitary valve is made up of several individual components, or if accessory components are offered which can increase the efficiency of a valve, these products can score two extra stars each in two categories (1) flow rate and temperature; 2) upgrade, efficiency classes A-B). These additional classification features are added to a valve combination.

All of those valves where the user cannot influence the hot water temperature (e.g. cold water pillar taps) cannot be included under the evaluation criteria for temperature. The classification points for temperature in the Home and Public categories are omitted in this case.

Unless otherwise stated, an appraisal by a laboratory is sufficient to prove fulfilment of the evaluation criteria, where that appraisal should be or can be sensibly performed in the context of the EN test.

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[60] http://www.well-online.eu/

Table 1.27 Scoring criteria of the WELL classification system

Parameter	Sanitary outlet valves				Shower valves/ showerheads/showers	
	Wash basin valves		Kitchen valves			
Volume (flow rate)	Pressure-dependent, volume-regulating solution 6.0<Q≤9.0	☆	Pressure-dependent, volume-regulating solution 9.0<Q≤12.0	☆	Pressure-dependent, volume-regulating solution 9.0<Q≤12.0	☆
	Pressure-independent, volume-regulating solution 4.0<Q≤6.0	☆☆	Pressure-independent, volume-regulating solution 6.0<Q≤9.0	☆☆	Pressure-independent, volume-regulating solution 4.5<Q≤9.0	☆☆
Temperature	Flow rate-independent temperature setting	☆	Flow rate-independent temperature setting	☆	Flow rate-independent temperature setting	☆
	Temperature limit and cold water valves	☆☆	Temperature limit and cold water valves	☆☆	Temperature limit and cold water valves	☆☆
Time (omitted for home)	Time controlled self-closing valves with or without sensor activation	☆	Time controlled self-closing valves with or without sensor activation	☆	Time controlled self-closing valves with or without sensor activation	☆
	Sensor valves with use-dependent on/off function	☆☆	Sensor valves with use-dependent on/off function	☆☆	Sensor valves with use-dependent on/off function	☆☆

According to EUnited, the industry organisation running the scheme, the value of the WELL is that:

- conformity with all relevant European standards and national regulations concerning drinking water has to be proven before a label is granted;
- many important valve producers in the EU have applied for the label so far;
- market surveillance is guaranteed through independent third party supervision;
- any political measurement implemented to save water in the EU will automatically lead to reduced flow rates within valves.

The WELL has been indicated as the only voluntary labelling scheme which deals with drinking water hygiene. Water-saving measures would imply that the residence time of warm water within supply lines will be longer. This could have a significant negative influence on drinking water hygiene. Within the scheme it is acknowledged that lowering the storage tank temperature for hot water from 60 °C (nominal temperature) to, for instance, 45 °C may result in the growth of legionella. One of the basic principles applied within the WELL scheme is that health protection comes before energy savings.

1.6 Potential barriers to producers

Some stakeholders think that at the moment there are some technical constraints and regulatory elements which create difficulties for producers. More specific comments from stakeholders are reported below.

- Approvals are a market entry barrier for SMEs and they should be harmonised between countries.
- The variety of different schemes, labels and associated certifications is a clear problem for manufacturers. This represents both a technical problem, due to the sometimes unwelcome criteria, and an economic problem, due to the very high associated costs.
- The national requirements for materials accepted in contact with drinking water are different in different EU Member States. This creates barriers for trade. The 4MS procedure has not been discussed or accepted at EU level. New legislation in Denmark, "Godkendt til Drikkevand", would require specific marking and testing for taps. The German Drinking Water Regulation (§ 17) and the requirements of the Federal Environment Agency (UBA) set criteria for the applicability of materials aiming at a higher standard of drinking water quality.
- Producers would have difficulties to respect restrictions on the content of hazardous substances in materials without applying some derogations, as for instance specified in the EU Ecolabel criteria for sanitary tapware.

2 MARKET ANALYSIS

The objective of this chapter is to provide an overview of the market for taps and showers, in particular focusing on:

- the quantification of the EU production and trade volume in terms of units;
- the quantification of the EU market size in terms of products sold and products already installed (defined as "stock" in this document);
- the definition of the market and production structure in terms of countries, producers and trends;
- the quantification of users' expenditure data.

2.1 Generic economic data

2.1.1 Introduction

This section describes market data on taps and showers and aims at estimating the EU consumption of these products based on the formula:

- Sales in EU = Production in EU + imports from Third Countries (to EU) – export to Third Countries (from EU).

Due to lack of information for Croatia, it has been decided to refer generally to the EU-27 and to include data for the new Member State of the EU-28 when available. However, it should be remembered that, Croatia's population being about 1% of the total EU population, the inclusion of such information is not considered to produce a significantly appreciable variation.

Data from the official EU statistics have been considered and analysed according to the MEErP. Furthermore, since some country-specific data have been provided by stakeholders, this information has been scaled up to the EU as a whole, based on the population, and compared to the official EU statistics.

Statistics on production and on imports and exports can be obtained from the PRODCOM and the ComExt databases[61]. However, due to some inherent limitations of the EU statistics, a number of assumptions and calculations are needed.

PRODCOM categories are used for the collection and dissemination of statistics on the production of manufacturing goods. For those products that are manufactured within a MS' territory, a MS should report on: (1) the value of production in euros, (2) the volume sold in thousands of units and (3) the total weight in thousands of kilograms. In practice, only information on the value and mass of production is usually reported. Moreover, it should be noted that national statistical institutes in each MS are not required to survey businesses with less than 20 employees. Thus it is impossible to know whether all the production has been reported or what percentage of production has been quantified.

Combined Nomenclature (CN) is used for the collection and dissemination of statistics on EU trade. The system is used by the European Union for statistical and tariff purposes. Data on

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[61] http://epp.eurostat.ec.europa.eu/portal/page/portal/prodcom/data/database

the value (Euro) of trade (internal and external) as well as on the quantity (kg) traded are reported. Usually, one or more CN codes correspond to each PRODCOM code.

PRODCOM categories and corresponding CN codes of potential interest for taps and showers are listed in Annex I, Table A1.1. No product category focuses specifically on taps and showers. According to stakeholders, the common practice of industry is to report information on taps and shower valves in the two aggregated categories that are shown in Table 2.1. Pillar taps are included in the CN 8481 80 19 category. However, it must be noted that these categories can also include other items (e.g. industrial valves and valves for other purposes) and therefore the proposed market data could be overestimated, as will be discussed in Section 2.1.4. For shower outlets, it is difficult to identify a clear category, although they are considered excluded from the categories of relevance for taps and shower valves. The number of shower outlets will be estimated considering the relative ratio between valves and outlets from other reports available on market information for this sector.

Table 2.1 Taps and Shower valves - PRODCOM codes and corresponding 2012 CN codes

Code		Description
PRODCOM	28.14.12.33	Mixing valves for sinks, washbasins, bidets, water cisterns, etc. excluding valves for pressure-reducing or oleohydraulic/pneumatic power transmissions, check valves, safety/relief valves.
CN	8481 80 11	Mixing valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures.
PRODCOM	28.14.12.35	Taps, cocks and valves for sinks, washbasins, bidets, water cisterns etc. excluding valves for pressure-reducing/oleohydraulic transmissions, check, safety, relief and mixing valves.
CN	8481 80 19	Taps, cocks and valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures (excluding mixing valves)

2.1.2 EU production

Following the MEErP, EU Member States' production from 1995 to 2012 has been evaluated for the two PRODCOM categories identified (28.14.12.33 and 28.14.12.35). Since production data for 1990 is not reported in PRODCOM, it has been possible to track time series from 1995. Data reported refer to the EU-15 until 2003. For the following years it has been decided to refer generally to the EU-27 because of the lack of information for Croatia. Data for this Member State of the EU-28 has been included when available. However, it should be remembered that, Croatia's population being about 1% of the total EU population, the inclusion of such information is not considered to produce a significantly appreciable variation.

Information on EU production in 1995 and 2012 is reported in Table 2.2, in both thousands of kilograms and millions of euros. Production data across all Member States in 1995 and 2012 are reported in Table A2.1 and A2.2 of Annex II, respectively.

Table 2.2 Production in volume sold and value in 1995 and 2012

	PRODCOM 28.14.12.33		PRODCOM 28.14.12.35	
	(10^3 kg)	(M EUR)	(10^3 kg)	(M EUR)
EU-15* (1995)	76,388	1,315	126,283	1,884
EU-27* (2012)	98,896	2,316	300,000	2,400

* Note that the EU 15 – EU-27 total includes estimates and confidential data not published in Annex II Table A.2.1 and A.2.2.

According to the PRODCOM database, the EU-27 production in 2012 was 99 million kg, or EUR 2,316 million, for the 28.14.12.33 category and 300 million kg, or EUR 2,400 million, for the 28.14.12.35 category. The two categories together total 399 million kg, or EUR 4,716 million. The following general observations can be made:

- For code **28.14.12.33,** Germany and Italy are the largest producers in terms of mass of product (31% and 26%, respectively) followed by Portugal (12%). Looking at the value of production in euros, Germany leads (43%), followed by Italy (22%) and then Portugal (7%).
- For code **28.14.12.35,** Italy is the largest producer (21% in terms of mass and 34% in terms of value). Information for Germany and Portugal is confidential but it is considered to play an important role, with the contribution from other countries being relatively marginal.

In order to convert the above production data to production units, it is necessary to define two key parameters:

1. the split between taps and shower valves under the two PRODCOM codes and the split between shower valves and shower outlets; and
2. the average weight of the different product types.

A series of assumptions has been made with the help of stakeholders and these are highlighted within blue boxes to give the possibility of checking their soundness.

- All products reported in PRODCOM refer to valves (taps and shower valves) included within the scope of the project, including pillar taps. Shower outlets are excluded from these statistics.
- The share of taps and showers (or shower systems) sold (in terms of units) and/or installed in domestic premises represents 90% of the market and the remaining part (10%) is sold and/or installed in non-domestic premises;
- The ratio between taps and shower valves is **3:1** for the domestic sector and **30:1** for the non-domestic sector (both in terms of units).
- The resulting ratio between taps and shower valves in the overall market is **5.7:1.**
- The number of shower outlets can be estimated considering the average shower valve's and outlet's lifetime in the domestic and non-domestic sector. The ratio between shower outlets and shower valves is therefore **1:1.6** (in terms of units).
- A shower (or shower system) is composed of a shower valve and a shower outlet.

According to these assumptions, the production and consumption of taps and shower valves is split as follows:

- 85% of the total units sold are taps;
- 15% of the total units sold are shower valves.

The weight of taps and showers depends, among others, on design features such as size and materials used. Information on the weight of different product types has been collected through stakeholder consultations and reported in Table 2.3. It must be noted that products on the market present a significant variation in weight, which makes it difficult to define exact distributions of values.

Table 2.3 Information on the weight of products

Product	Average weight for one unit of product	Weight range	
		Min.	Max.
Taps	Basin mixer: 1 kg Bath/shower mixer: 2.5 kg	0.5 kg (basin pillar tap)	4 kg (thermostatic mixer)
	From a manufacturer: 1.7 kg	1.3 kg	2.1 kg
	From a global retailer: 1.8 kg	1.2 kg	3.5 kg
Shower panels and columns	Shower panel: 10 kg Shower column: 4 kg	3 kg	15 kg
Shower outlets	100 mm plastic hand shower: 0.4 kg 150 mm metallic showerhead: 1.5kg	0.1 kg (basic plastic hand shower)	5-10 kg (larger showerheads)

The following assumptions have been made:

- The average weight of taps and shower outlets is evaluated as the average of the provided data (see Table 2.4).
- Shower systems are made of a shower valve and a shower outlet. Thermostatic valves are present in 50% of the shower systems, and mechanical mixing valves in the other 50%.

The average weights of taps, shower valves and shower outlets considered for estimating the product units are reported in Table 2.4. These have been defined based on the information gathered from stakeholders and generally agreed with them in the course of the study, although recent and opposing indications from a few representatives suggest the presence of some inherent uncertainty in this information also within industry (one stakeholder suggested halving the average value for shower outlets, another indicated that the average weight of products has been underestimated). It was also reported by a few stakeholders that the percentage of thermostatic valves present in shower systems might be overestimated for some Member States such as Spain and the UK. However, the reported value seems consistent with the market trends and thus it is not certain that any modifications applied to this parameter would add significant detail to the results of the estimation. In any case, information on the distribution of weights has been used estimating the possible variation in units of products.

Table 2.4 Indications of distribution of products' weight

Product	Average product (kg)	Min. (kg)	Max. (kg)	Calculated variation on average weight	
Tap	1.8	0.5	4.0	-21%	+36%
Shower valve	2.9	1.8	4.0	-11%	+11%
Shower outlet	1.0	0.1	10.0	-26%	+264%
Shower system	3.9	1.9	14.0	-15%	+76%

According to the proposed weights, the production and consumption of taps and shower valves is split as follows:

- 78% of the total volume sold in weight is made up of taps;
- 22% of the total volume sold in weight is made up of shower valves.

Production data for taps, shower valves and outlets in 1995 and 2012 have been updated taking into consideration the assumptions made on market share, taps-to-shower valves and shower valves-to-outlets ratios and product weights. Results for 1995 and 2012 are shown in Table 2.5, in both thousands of kg and millions of euros (production data across all Member States are reported in Annex II Tables A2.3 and A2.4).

EU production in terms of product units in 1995 and 2012 has been also calculated and reported in Table 2.6 (data for all Member States are reported in Annex II Tables A2.5 and A2.6).

Based on the information contained in the PRODCOM database and on the assumptions made, it is estimated that 173 million units of taps, 30 million units of shower valves and 48 million units of shower outlets were produced in the EU-27 in 2012. This corresponds to 310 million kg, or EUR 3,677 ,million, for taps and 87 million kg, or EUR 1,039 million, for shower valves. According to the above-mentioned assumptions, it is estimated that 48 million kg of shower outlets were produced in 2012, while their production value is not available.

Table 2.5 Production in volume sold and value in 1995 and 2012

	Taps		Shower valves		Shower outlets
	(10^3 kg)	**(M EUR)**	**(10^3 kg)**	**(M EUR)**	**(10^3 kg)**
EU-15* (1995)	158,010	2,494	44,662	705	24,377
EU-27* (2012)	310,994	3,677	87,903	1,039	47,978

* Note that the EU-15 – EU-27 total includes estimates and confidential data not published here

Table 2.6 Calculated production in 1995 and 2012

	Taps (10^3 units)	Shower valves (10^3 units)	Shower outlets (10^3 units)
EU-15 (1995)	87,783	15,401	24,377
EU-27 (2012)	172,774	30,311	47,978

Production trends that take the previous assumptions into account are shown in Figure 2.1.

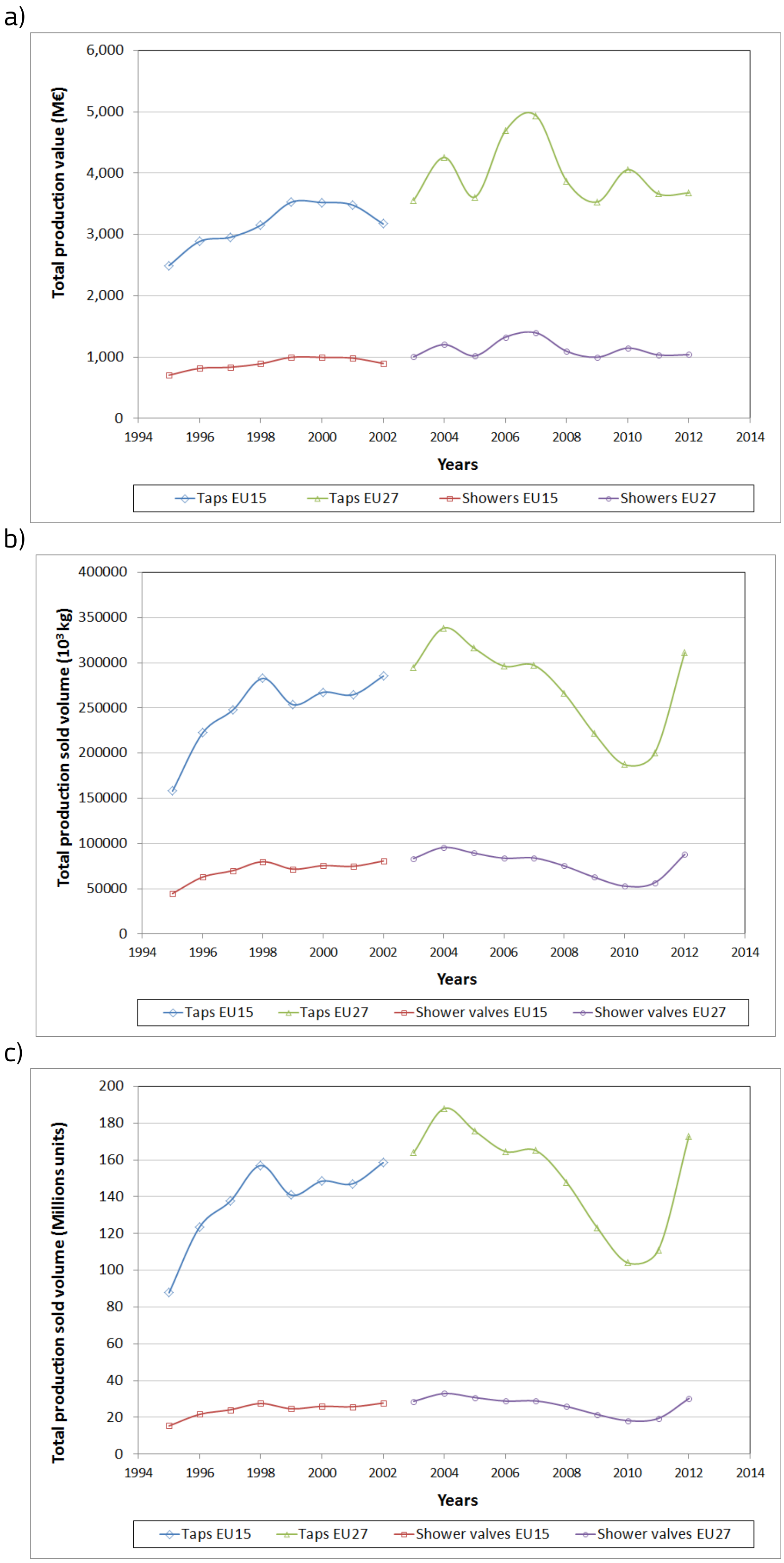

Figure 2.1 Production trends for the EU-15 from 1995 to 2003 and for the EU-27 from 2003 to 2012

2.1.3 EU trade

2.1.3.1 Total value of EU trade

Eurostat statistics on imports and exports[62], presenting the sum of EU-27 intra- and extra-Europe trade data for taps and showers, have been evaluated considering CN codes 8481 80 11 (Mixing valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures) and 8481 80 19 (Taps, cocks and valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures - excluding mixing valves), as indicated in Table 2.1.

Information on imports and exports from 1995 to 2012 is reported in Table 2.7 as thousands of kg of products and million euros traded (import and export data for all Member States are reported in Annex II Table A2.7 and Table A2.8).

The same assumptions made when analysing the production volume (see section 2.1.2) have been applied to the evaluation of imports and exports of taps, shower valves and corresponding shower outlets. Results for 1995 and 2012 are reported in Table 2.8 as thousands of kg and millions of euros, respectively (data for all Member States are reported in Annex II Tables A2.9 and A2.10). The average weights reported in Table 2.4 have also been used to provide an indication of the units of product imported and exported from 1995 and 2012. Results for the years 1995 and 2012 are shown in Table 2.9 (imported and exported units of product for all Member States are reported in Annex II Tables A2.11 and A2.12).

It has been calculated that:

- 84 million taps, 15 million shower valves and 23 million shower outlets were imported into the EU-27, in 2012; and
- 66 million taps, 12 million shower valves and 18 million shower outlets were exported from the EU-27, in 2012.

The following general observations can be made:

- For code CN 8481 8011, the largest importers in 2012 in terms of value were Belgium, Germany, and France, while in terms of mass they were Germany, France, Italy and the UK. The largest exporters in terms of value were Germany, Italy, Portugal and Bulgaria, while in terms of mass they were Germany, Italy, Portugal and Spain.
- For code CN 8481 8019, the largest importer in 2012 in terms of value was the UK, followed by Germany, Italy and France, while in terms of mass it was still the UK, followed by Germany, Italy and Spain. The largest exporters, both in terms of value and mass, were Germany, France, Italy and Spain.

Table 2.7 Total imports and exports in 1995 and 2012

Country	CN 8481 80 11				CN 8481 80 19			
	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)
EU-15 (1995)	38,676	52,309	579	843	26,494	59,245	305	350
EU-27 (2012)	135,535	115,439	1,968	2,183	58,585	37,141	701	642

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[62] http://epp.eurostat.ec.europa.eu/newxtweb/

Table 2.8 **Total imports and exports of taps, shower valves and shower outlets in 1995 and 2012**

Country	Imports (10^3 units)			Exports (10^3 units)		
	Taps	Shower valves	Shower outlets	Taps	Shower valves	Shower outlets
EU-15 (1995)	50,808	14,361	7,838	86,971	24,582	13,417
EU-27 (2012)	151,342	42,777	23,348	118,957	33,623	18,352
Country	**Imports (M EUR)**			**Exports (M EUR)**		
	Taps	**Shower valves**	**Shower outlets**	**Taps**	**Shower valves**	**Shower outlets**
EU-15 (1995)	689	195	Not available	930	263	Not available
EU-27 (2012)	2,081	588	Not available	2,203	623	Not available

Table 2.9 **Calculated imports and exports of taps, shower valves and shower outlets in 1995 and 2012**

Country	Imports (10^3 units)			Exports (10^3 units)		
	Taps	Shower valves	Shower outlets	Taps	Shower valves	Shower outlets
EU-15 (1995)	28,227	4,952	7,838	48,317	8,477	13,417
EU-27 (2012)	84,079	14,751	23,348	66,087	11,594	18,352

2.1.3.2 Intra-EU trade and extra-EU trade

The breakdown of the total value of trade within and outside the EU-27 is summarised in the following paragraph.

Intra-EU trade

Intra-EU-27 imports of mixing valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures (CN 8481 8011) in 2012 represented 53% by weight of all imports of Member States in the same year. Germany was the largest importer of goods from other Member States (26.1% of the overall mass of intra-EU imports), followed by France (22.6%), Italy (5.5%), Austria (4.6%) and Spain (4.5%). In terms of economic value, intra-EU imports represented 65% of all imports of Member States. French and German intra-EU imports represented 24% and 22.7% by value, respectively, of the overall imports from Member States, followed by the Netherlands (5.8%), Italy (5%), and Spain (4.8%).

Intra-EU exports of the same category represented 70% of all exports in kg. Further analysis of the intra-EU export data indicated that Germany and Italy were the most important exporters representing, respectively, 26.7 % and 20.4 % of the quantity (kg) of all intra-EU exports, followed by Portugal with 13.7%, and Spain with 6.1%. In terms of value (euros), the intra-EU exports represented 66% of the total value of all the EU exports. German exports represented 36.7 % of intra-EU-27 exports, followed by Italy (21.5 %) and Portugal (10.4 %).

Intra-EU-27 imports of taps, cocks and valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures (excluding mixing valves) (CN 8481 8019) in 2012 represented 54% by weight of all imports of Member States in the same year. Germany was the largest importer of goods from other Member States (13.4 % of the overall mass of intra-EU imports), followed by the UK (13.2%), Portugal (10%) and France (9.1%). In terms of economic value, intra-EU imports represented 58% of all imports of Member States. The UK intra-EU imports represented 19% by value of the overall imports from Member States, followed by Germany (12.3%), Belgium (10.2 %) and France (10.1%).

Intra-EU exports of the same category represented 48% of all exports in kg. Further analysis of the intra-EU export data indicated that Italy was the most important exporter, representing 29.1% of the quantity (kg) of all intra-EU exports, followed by Germany (28.3%), Slovenia (5.2%) and Belgium (3.8%). In terms of value (in euros), the intra-EU exports represented 52% of the total value of all the intra-EU exports. German exports represented 34.5% of intra-EU exports, followed by Italy (25.7%).

Extra-EU trade

In terms of share of the total trade, overall extra-EU trade is considered to be the complement to 100% of the overall intra EU-trade.

For sinks, washbasins, bidets, water cisterns, baths and similar fixtures (CN 8481 8011), most of the imports to the EU-27 in 2012 came from China, representing 80% by weight of all extra-EU imports and 37.5% of all the intra- and extra-EU imports. In terms of value, this represents 70% of the extra-EU imports and 24% of all the intra- and extra-EU imports.

The EU-27's main export destinations were Russia and Saudi Arabia, which represented, respectively, 18% and 10.5% by weight of all extra-EU exports. In terms of value, this represents, respectively, 16% of the extra-EU imports and 8% of all the intra- and extra-EU imports.

For taps, cocks and valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures (excluding mixing valves) (CN 8481 8019), most imports to the EU-27 in 2012 came from China, representing 88% by weight of all extra-EU imports and 41% of all the intra- and extra-EU imports. In terms of value, this represented 77.5% of extra-EU imports and 32% of all the intra- and extra-EU imports.

The EU-27's main export destination was Russia, which represented 16% by weight of all extra-EU exports (8.2% of all the intra- and extra-EU exports). In terms of value, Russia represents 14% of all exports (6.8% of all the intra- and extra-EU exports in value). Saudi Arabia was the second main export destination with 9.5% by weight and 9% by value of all exports outside the EU, representing 4.7% of the weight and 4.1% by value of all the intra- and extra-EU exports.

2.1.4 EU sales and trade

The EU-27 apparent consumption of taps and showers in terms of product units has been evaluated based on the data on production and trade reported in the previous sections. The apparent consumption has been calculated according to the following formula:

EU-27 sales and trade = production in EU-27 + imports to EU-27 – exports from EU-27

Results for 1995 and 2012 are shown in Table 2.10 (results for all Member States are reported in Annex II Tables A2.13 and A2.14). As an estimate, 191 million taps, 33 million shower valves and 53 million shower outlets may have been sold in the EU-27 in 2012.

The largest apparent consumption of taps, shower valves and shower outlets seems to take place in Italy (14.9% of the overall apparent consumption of taps, shower valves and shower outlets), followed by Germany (8% of taps, shower valves and shower outlets consumption), France (7.2% of taps, shower valves and shower outlets consumption) and then the UK (5.6% of taps, shower valves and shower outlets consumption).

However, it must be observed that the PRODCOM data for German production are incomplete and that the apparent consumption of this country could in reality be underestimated.

Table 2.10 EU apparent consumption in 1995 and 2012

Country	**Taps (10^3 units)**	**Shower valves (10^3 units)**	**Shower outlets (10^3 units)**
EU-15 (1995)	67,693	11,876	18,798
EU-27 (2012)	190,766	33,468	52,975

Some stakeholders have provided national data on apparent consumption of taps and showers for different years (2008 or 2012). Information referring to 2008 has been updated to 2012, aggregated and then scaled up to European level based on the registered population. The stakeholders' data and results of the new estimation are shown in Table 2.11.

It is worth noting that figures on taps obtained from EU statistics are almost identical to those calculated with reference to 2008 in another study related to the development of EU Ecolabel and GPP criteria for sanitary tapware[63] (191 million units versus 185 million). Figures for shower valves, instead, are almost halved (33 million units versus 62 million). This mainly depends on the different assumptions made on the average weight of a shower valve since market figures in terms of weight and value are similar.

Figures on apparent consumption for shower outlets (53 million units) appear consistent with the data coming from the scale-up (58 million units, +10% of the value from EU statistics). The apparent consumption of taps and shower valves calculated from EU statistics is instead relatively higher than that resulting from the scale-up of information from stakeholders (3.2 times higher for taps, 1.8 times higher for shower valves and 2.8 times more for taps and shower valves together).

This should provide a certain degree of robustness to the estimation procedure followed and indicate that the main source of uncertainty is related to the quality and the clustering of the EU statistics and the information provided by stakeholders. It could also be that the apparent consumption of taps and shower valves obtained from EU statistics may be overestimated because PRODCOM categories and CN codes account for other types of valves than taps and shower valves for domestic or domestic-type uses.

Considering the ratio between the units of taps and shower valves (5.8 from EU statistics versus 3.2 from the scale-up) and the ratio between the units of shower valves and shower outlets (1.6 from EU statistics versus 3.1 from the scale-up), it seems that the data provided by stakeholders for taps and shower valves are consistent with the assumptions made in this

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[63] http://susproc.jrc.ec.europa.eu/ecotapware/

study for the domestic sector but could overestimate the apparent production of shower outlets and not cover the market of valves for the non-domestic sector.

Furthermore, it should be noted that the choice of the average weight of the products significantly influences the split by weight between taps and shower valves. This has been a key parameter to determine the apparent consumption in terms of units of product. An indicative range of weights has been presented in Table 2.4, based on the information provided by stakeholders. Taking into consideration the weight variation, the apparent consumption could vary from -76% to +124% for taps and from -91% to +111% for shower valves and shower outlets. In particular, considering lower average weights, the ratio between the apparent consumption calculated from EU statistics and the results of the scale-up of national information decreases from 3.2 to 2.4 for taps and from 1.8 to 1.6 for shower valves. This could indicate that the average weights of products on the market could be lower than those considered, although, as indicated, the same statistics and information from stakeholders contain inherent uncertainty.

Although uncertainty is significant and results must be interpreted carefully, the estimations provided indicate a range of values within which the actual data on consumption of taps and showers valves and outlets could be included.

Table 2.11 Comparison of data on sales from different sources

	Year	**Population**	**Taps (M units)**	**Shower valves (M units)**	**Shower outlets (M units)**	**Ratio Taps to Shower valves**	**Ratio Shower valves to Shower outlets**
France	2012	65,327,724	8.5*	1.7*	7.6*	4.9	4.4
UK	2012	63,456,584	7*	2.3*		3.0	
Germany*	2012	81,843,743	-	3.8*		-	
EU-27 - scale-up	**2012**	**502,623,021**	**60**	**19**	**58**	**3.2**	**3.1**
EU-27 apparent consumption (EU statistics)	**2012**	**502,623,021**	**191**	**33**	**53**	**5.8**	**1.6**
% compared to EU-27 apparent consumption (EU statistics)	2012	100%	32%	57%	110 %		
*Data provided by stakeholders							

2.2 Market and stock data

2.2.1 Installed "stock" and penetration rate

The quantity of installed products and the forecast of the stocks for the years to come have been quantified following and updating an estimation procedure presented in the preliminary study for the development of EU Ecolabel and GPP criteria for sanitary tapware. In alignment with the analysis of the generic economic data presented in Section 2.1, and in order to allow a direct comparison of the obtained outcomes, the quantification of installed products has generally referred to the EU-27. It has to be pointed out that Croatia joined the EU in 2013 and that its population forms about 1% of the total EU population. Nevertheless, data for Croatia has been provided separately when available. Figures for the EU-28 are not considered to be appreciably different from those of the EU-27.

A set of assumptions has been made because of the lack of statistical information on the number of taps and showers (shower systems) installed in domestic and non-domestic premises. These assumptions are highlighted within the blue boxes.

2.2.1.1 Domestic stock

The estimation of the domestic stock has been based on the average number of taps and showers installed per apartment and house, which has been considered to be constant throughout the EU-27. The number of taps installed per apartment/house has been considered equal to that used in a preliminary study for the development of EU Ecolabel and GPP criteria for sanitary tapware[64]. The number of showers (shower systems) installed per apartment/house has been considered one third of the number of taps. No differentiation between shower valves and bath valves has been made. However, as shown in Section 3, the frequency of use of water for bathing seems considerably lower than for showering at EU level.

Assumptions:

- According to Eurostat, houses form 60% of all dwellings across the EU-27 and apartments the remaining 40%[65]. This parameter has been considered constant over the EU-27 and time.
- 4.5 taps and 1.5 showers (shower systems) per apartment and 5.5 taps and 1.83 showers (or shower systems) per house are installed on average in the EU-27. The ratio between taps and showers (shower systems) is thus 3:1.

Assumptions have been generally agreed with stakeholders. Additional statistics on housing across the EU are necessary in order to estimate the total number of taps and showers installed in domestic dwellings. The total number of dwellings in the EU-27 in 2010 has been extracted from Eurostat, integrating data missing for some countries with the information contained in the Housing Europe Review 2012[66], which also provides statistics on the number of dwellings in Europe in 2010. The total number of houses and apartments was then calculated and scaled-up to 2011-2015.

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[64] http://susproc.jrc.ec.europa.eu/ecotapware/

[65] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Housing_statistics

[66] http://www.housingeurope.eu/www.housingeurope.eu/uploads/file_/HER%202012%20EN%20web2_1.pdf

Some additional statistical data provided by stakeholders over the course of the study indicate that the share of apartments in 24 selected Member States could vary from 19% to 75%, with 48% as an average value, which gives some support to the assumptions made.

Vacant and second homes have been accounted for in the computation of the total housing, and it must be noted that these are used only for estimating the number of products installed in the EU and that this is independent and decoupled from the quantification of water and energy consumption presented in Section 3.

It was also indicated that the stock model does not consider that shower systems can have more than one outlet (e.g. shower stations and shower columns). However, it is considered that the installation of shower systems with multi-outlets is deemed to be less typical than that with a single outlet. In any case this would not have an influence on the total consumption of water estimated in Section 3, in particular considering that consumers would typically use one outlet at a time.

The forecasts in a preliminary study for the development of EU Ecolabel and GPP criteria for sanitary tapware were estimated considering the growth of the total number of dwellings proportional to the growth of the population (+6% over five years). This value was corrected in the VHK report "Study on Amended Working Plan under the Ecodesign Directive. Task 3"[67] because it was considered to exceed the expected increase of households in 2030. Based on this, VHK considered a reduced growth factor for 2020-2025 (1.02) and for 2025-2030 (1.01).

In order to provide a more realistic forecast, reduced growth factors based on statistics on EU population have been considered. Growth factors are reported in Figure 2.2 at five-year intervals. The cumulative growth factor is also provided for the sake of completeness in the same figure.

In this study it has been assumed:

- The growth factor for domestic and non-domestic dwellings has been based on the population increase rate, as it is shown in Figure 2.2.
- According to the population growth, the domestic and non-domestic dwellings will increase, cumulatively, by almost 4% from 2010 to 2030 and this value is comparable to the increase in urban water consumption in Europe from 2000 to 2030[68].

Assumptions have been generally agreed with stakeholders. However, it was pointed out that the supply and demand of available housing is not meeting the population growth projections and that the available housing is, in real terms, significantly falling behind population growth in many Member States. However, in the absence of more robust and quantified information, the growth factors considered in the model could provide more plausible indications than those, for instance, available from other studies in the same field [69][70].

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[67] http://www.ecodesign-wp2.eu/downloads/FINAL%20REPORT%20Task%203%2016-12-2011.pdf

[68] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

[69] http://susproc.jrc.ec.europa.eu/ecotapware/

[70] http://www.ecodesign-wp2.eu/downloads/FINAL%20REPORT%20Task%203%2016-12-2011.pdf

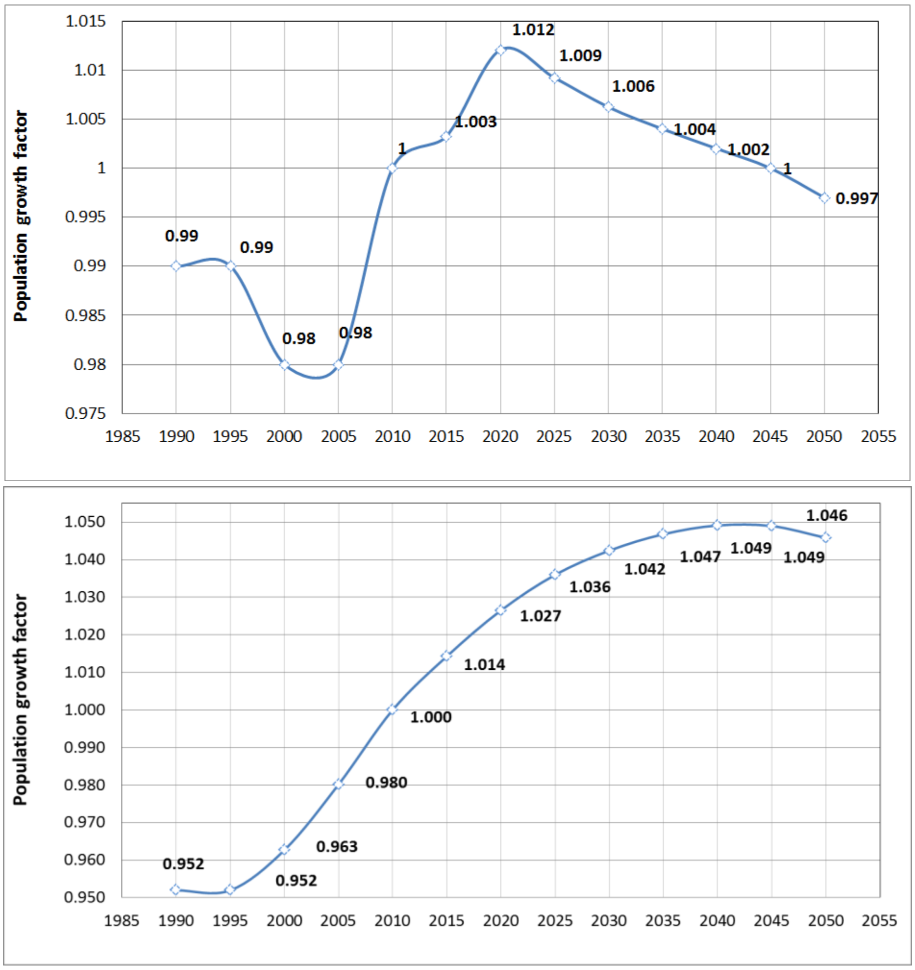

Figure 2.2 Elementary and cumulative population growth factors in the EU-27

Estimated stocks of taps, shower valves and shower outlets installed in the domestic sector are reported in Table 2.12 (stock data in the domestic sector for all Member States are reported in Annex II Tables A.2.15, A.2.16, A.2.17, A.2.18, A.2.19 and A.2.20).

Table 2.12 Stock of taps, shower valves and shower outlets in the domestic sector from 2010 to 2015 and forecast for 2020, 2025, 2030, 2050

Product		EU-27 stock (M units)									
		2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2020**	**2025**	**2030**	**2050**
Taps		1,193	1,196	1,197	1,203	1,207	1,210	1,225	1,236	1,244	1,248
Shower system	**Shower valves**	398	399	399	401	402	403	408	412	415	416
	Shower outlets	398	399	399	401	402	403	408	412	415	416

2.2.1.2 Non-domestic stock

The non-domestic stock of taps and showers in the EU-27 has been estimated through the quantification of the products installed in four different sectors:

1. business,
2. healthcare,
3. tourism,
4. education.

Business

EU classification of enterprises is shown in Table 2.13. According to Eurostat[71], more than 99% of businesses in Europe are SMEs.

Table 2.13 Business categories[72]

	Number of employees	Turnover OR	Balance sheet total
Micro	<10	≤ € 2 M	≤ € 2 M
Small	<50	≤ € 10 M	≤ € 10 M
Medium	<250	≤ € 50 M	≤ € 43 M
Large	>251	> € 50 M	> € 43 M

For all the categories of business, the stock for taps and showers has been evaluated on the basis of the number of employees[73]. According to the OECD[74] and UNECE[75], employment in the private sector is 83% of the total employment. This percentage has been considered for evaluating the total number of employees in the private and public sectors. The assumptions are reported below.

- 100% of private businesses provide employees with showering facilities.
- 1 shower per 100 employees is present in all categories of companies.
- Separate showers are provided for male and female employees.
- The ratio between taps and shower valves is equal to 30:1.
- An additional 20% of employees work in public administrations.

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[71] http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/

[72] http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/

[73] http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/files/supporting-documents/2012/annual-report_en.pdf

[74] http://www.oecd-ilibrary.org/sites/9789264075061-en/05/01/index.html?contentType=&itemId=/content/chapter/9789264061651-13-en&containerItemId=/content/serial/22214399&accessItemIds=/content/book/9789264075061-en&mimeType=text/html

[75] http://w3.unece.org/pxweb/dialog/Saveshow.asp?lang=1

The assumptions were generally agreed on during the study. Nevertheless, it was qualitatively reported that not all categories of companies in the UK provide shower facilities and, where provided, these are typically individual showers used by both male and female employees.

Healthcare

The estimation of the number of taps and showers installed in the healthcare sector has been based on the analysis of the hospital beds across the EU-27. Information is provided in Eurostat [76]. The assumptions are reported below.

- 1 bathroom with 1 tap for every bed (average across all Member States).
- 1 shower for every 4 beds (average across all Member States).
- 1 kitchen tap for every 75 beds (average across all Member States).

A general consensus was reached on the assumptions during the study. Nevertheless, it was qualitatively reported that the UK Health Building Notes indicate, as best practice for healthcare premises, the presence of one bathroom for every 30 beds and that typically the bathroom would also include a shower facility.

Tourism

The estimation of the number of taps and showers installed in the tourism sector has been based on the number of beds available in touristic accommodation across the EU-27. Information is provided in Eurostat[77]. The assumptions are reported below.

- For 50% of beds, 1 bathroom with 1 tap and 1 shower.
- For the other 50% of beds, 1 bathroom with 1 tap and 1 shower for every 2 beds.
- 1 kitchen tap for every 100 beds.

Education

The estimation of the number of taps and showers installed in the education sector has been based on the number of students/pupils (at all levels) across the EU-27. Information is provided in Eurostat[78]. The assumptions are reported below.

- 1 tap, 1 shower and 1 kitchen tap for every 100 students/pupils.

Forecasts and results

Forecasts for non-domestic premises for future years have been estimated based on the population growth factors shown in Figure 2.2.

Estimated stocks of taps, shower valves and shower outlets in the non-domestic sector are reported in Table 2.14 (estimated stock for the Member States are reported in Annex II Tables A2.22, A2.23, A2.24, A2.25 and A2.26).

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[76] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=0&language=en&pcode=tps00046

[77] http://epp.eurostat.ec.europa.eu/portal/page/portal/tourism/data/database

[78] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_enrl1tl&lang=en

Table 2.14 **Stock of taps, shower valves and shower outlets in the non-domestic sector from 2010 to 2015 and forecast for 2020, 2025, 2030, 2050**

Product		EU-27 stock (M units)									
		2010	2011	2012	2013	2014	2015	2020	2025	2030	2050
Taps		70.6	70.8	70.8	71.1	71.4	71.6	72.5	73.1	73.6	73.8
Shower system	Shower valves	23.9	23.9	23.9	24.1	24.1	24.2	24.3	24.4	24.5	24.5
	Shower outlets	23.9	23.9	23.9	24.1	24.1	24.2	24.3	24.4	24.5	24.5

The stock model does not reflect the fact that shower systems can have more than one outlet (e.g. shower stations and shower columns). However, the installation of shower systems with multi-outlets is considered to be less typical than those with a single outlet. Qualitatively, it may be that the sales of shower outlets have been underestimated by up to 20%. However, this would not have an influence on the total consumption of water estimated in Section 3, in particular considering that consumers would typically use one outlet at a time.

2.2.1.3 Summary of findings for the domestic and non-domestic sectors

Taps:

- The EU-27 stock of taps installed in the domestic sector has been estimated at 1.20 billion units for 2012. The non-domestic stock is considered to represent about 6% of that value (70.8 million installed units). Calculated values are almost identical to the estimation provided in the study for the development of EU and GPP criteria for sanitary tapware (1.07 billion units for domestic taps and 78 million units for non-domestic taps).
- It is considered that the domestic stock of taps could grow by about 5% between 2010 and 2050 to 1.25 billion installed units. The non-domestic stock of taps could instead grow by about 5% between 2010 and 2050 to 73.8 million installed units.
- The Member States where most of the domestic stock of taps was installed in 2012 were Germany (17.1%), France (14.1%), Italy (12.4%), the UK (11.7%), and Spain (10.7%).
- The Member States where most of the non-domestic stock of taps was installed in 2012 were Germany (17.6%), France (14.2%), Italy (11.5%), Spain (9.5%) and Poland (4.9%).

Showers (or shower systems):

- The EU-27 stock of showers (or shower systems) in the domestic sector has been estimated at 399 million units in 2012. The non-domestic stock is considered to represent about 6% of that value (23.9 million installed units). Calculated values for the non-domestic sector are comparable with the estimation provided in the study for the development of EU and GPP criteria for sanitary tapware (30 million units for non-domestic showers). The estimation of the number of showers installed in the domestic sector is instead higher (406 million units versus 261 million) mainly because of the different assumptions made about the number of showers per apartment/house in the EU-27.
- It is considered that the domestic stock of showers stock could grow by about 5% between 2010 and 2050 to 416 million installed units. The non-domestic stock of

showers could instead grow by about 5% between 2010 and 2050 to 24.5 million installed units.

- The Member States where most of the domestic stock of showers was installed in 2012 were Germany (17.1%), France (14.1%), Italy (12.4%), the UK (11.7%), and Spain (10.7%).
- The Member States where most to the non-domestic stock of showers was installed in 2012 were France (17.2%), Italy (15.7%), Germany (12.6%), Spain (11.2%) and the UK (10.7%).

For the sake of comparison, in terms of EU-27 population in 2012, the breakdown is the following: Germany (16%), France and the UK (13% each), Italy (12%), Spain (9%) and Poland (8%).

2.2.2 Annual sales

Annual sales of taps and showers have been calculated using estimated stock data and the average lifespan of products.

Assumptions considered:

- Frequency of substitution = 1 / average lifetime of the product.
- Annual sales = product installed x frequency of substitution.

Indications of technical and real lifetimes of taps and showers in domestic and non-domestic premises have been provided by stakeholders and are reported in Table 2.15. Based on this data, average lifetimes have been considered for taps and showers, as indicated in Table 2.16.

Estimated sales of taps and showers in the domestic and non-domestic sectors are reported in Tables 2.17 and 2.18, respectively. Estimated sales across all the Member States are reported in Annex II Tables A2.27, A2.28, A2.29, A2.30, A2.31 and A.2.32 for the domestic sector and in Annex II Tables A2.33, A2.34, A2.35, A2.36, A2.37 and A.2.38 for the non-domestic sector.

Table 2.15 Indications of technical and real lifetimes (years) for taps and showers across the EU

Product	**Average lifetime in years (min.-max.)**	
	Real	**Technical (as declared by manufacturer)**
Taps, domestic	16 (10-40) in France	25 (15-50) in France
	3-10 (3-50) in the UK	Variable among manufacturers in the UK
Taps, non-domestic	8-12 (5-20) in France	25 (10-50) in France
	5-10 (5-20) in the UK	Variable among manufacturers in the UK
Shower outlets, domestic	10 (5-15) in France	15 (2-25) in France
	2-10 (2-30) in the UK	Variable among manufacturers in the UK
Shower outlets, non-domestic	7 (5-15) in France	15 (5-25) in France
	5-10 (5-15) in the UK	Variable among manufacturers in the UK
Industrial kitchen taps	5 (1-10)	15 (10-20)

Table 2.16 **Average lifetimes in years**

Product	Average lifetime in years (min.-max.)	
	Domestic sector	Non-domestic sector
Taps and shower valves	16 (3-50)	10 (5-20)
Shower outlets	10 (2-30)	7 (5-15)

With reference to loss of performance, mainly concerning the water flow rate, stakeholders have indicated that limescale deposit may reduce the flow rate although it could be difficult to quantify how much. However, this does not seem a relevant aspect to consider since the phenomenon does not occur if the products are cleaned/maintained properly.

Table 2.17 **Estimated sales of taps, shower valves and shower outlets in the domestic sector from 2010 to 2015 and forecast for 2020, 2025, 2030, 2050**

Product	EU-27 sales (M units)									
	2010	2011	2012	2013	2014	2015	2020	2025	2030	2050
Taps	74.6	74.8	74.8	75.2	75.4	75.7	76.6	77.3	77.8	78.0
Shower valves	24.9	24.9	24.9	25.1	25.1	25.2	25.5	25.8	25.9	26.0
Shower outlets	39.8	39.9	39.9	40.1	40.2	40.3	40.8	41.2	41.5	41.6

Table 2.18 **Estimated sales of taps, shower valves and shower outlets in the non-domestic sector from 2010 to 2015 and forecast for 2020, 2025, 2030, 2050**

Product	EU-27 sales (M units)									
	2010	2011	2012	2013	2014	2015	2020	2025	2030	2050
Taps	7.06	7.08	7.08	7.11	7.14	7.16	7.25	7.31	7.31	7.31
Shower valves	2.39	2.39	2.39	2.41	2.41	2.42	2.45	2.47	2.49	2.50
Shower outlets	3.41	3.42	3.42	3.44	3.45	3.46	3.50	3.53	3.56	3.57

2.2.2.1 Summary of estimated sales for the domestic and non-domestic sectors

A summary of the estimated sales of taps and showers in the domestic and non-domestic sectors is presented below.

Taps:

- Domestic and non-domestic sales of taps in the EU-27 in 2012 have been estimated to be 74.8 million and 7.1 million units, respectively. Sales sum up to 81.9 million units, which falls within the range of uncertainty indicated for the apparent consumption of taps (60-191 million).
- Domestic sales of taps are foreseen to grow from 74.8 million units in 2012 to 78.0 million in 2050 (+4%).
- Non-domestic sales of taps are foreseen to grow from almost 7.1 million units in 2012 to 7.3 million in 2050 (+3%).
- The Member States with the highest sales of taps in the domestic sector in 2012 were Germany (17.1%), France (14.1%), Italy (12.4%), the UK (11.7%), and Spain (10.7%).
- The Member States with the highest sales of taps in the non-domestic sector in 2012 were Germany (17.6%), France (14.2%), Italy (11.5%), Spain (9.5%) and Poland (4.9%).

Showers (or shower systems):

- Domestic and non-domestic sales of shower valves in the EU-27 in 2012 have been estimated to be 24.9 million and 2.4 million units, respectively. Sales sum up to 27.3 million units, which falls within the range of uncertainty indicated for the apparent consumption of shower valves (19-33 million).
- Domestic and non-domestic sales of shower outlets in the EU-27 in 2012 have been estimated to be 39.9 million and 3.4 million units, respectively. Sales sum up to 43.3 million units, which is below the range of uncertainty indicated for the apparent consumption of showers (53-58 million).
- Domestic sales of shower valves are foreseen to grow from over 24.9 million units in 2012 to almost 26.0 million units in 2050 (+4%). Non-domestic sales of shower valves are foreseen to grow from over 2.4 million units in 2012 to almost 2.5 million units in 2050 (+4%).
- Domestic sales of shower outlets are foreseen to grow from over 39.9 million units in 2012 to almost 41.6 million units in 2050 (+4%). Non-domestic sales of shower outlets are foreseen to grow from over 3.4 million units in 2012 to almost 3.6 million units in 2050 (+4.4%).
- The Member States with the highest sales of shower valves and shower outlets in the domestic sector in 2012 were Germany (17.1%), France (14.1%), Italy (12.4%), the UK (11.7%), and Spain (10.7%)
- The Member States with the highest sales of shower valves and shower outlets in the non-domestic sector in 2012 were France (17.5%), Italy (16%), Germany (12.8%), Spain (11.4%) and the UK (10.9%).

2.2.3 Summary of results from the market, stock and sales analyses

The overall results from the analyses of market, stock and sales are summarised in Table 2.19. The average lifetimes for all taps, shower valves and shower outlets have been estimated by dividing the figures estimated for stock and sales.

Table 2.19 Overview of stock and apparent consumption

Results of the analysis		Taps (2012)	Shower valves (2012)	Shower outlets (2012)
Stock of taps (M units)	Domestic	1,197	399	399
	Non-domestic	71	24	24
	Total	1,268	423	423
Sales (M units)	Domestic	75	25	40
	Non-domestic	7	2	3
	Total	82	27	43
Apparent consumption (M units)				
	(scale-up)	60	19	58
	(EU statistics)	191	33	53
Average lifetime (years)	Domestic	16	16	10
	Non-domestic	10	10	7
	Total			
	• from stock and total sales	15.5	15.7	9.8
	• on the assumption that 90% is domestic	13.9	13.9	8.8

Considering the EU-27 total stock and sales of taps in 2012 equal to 1,268 million and 82 million units, respectively, the average lifetime of the product would be 15.5 years. Starting with the assumption that 90% of the market is domestic, and considering the average lifetimes reported in Table 2.19, the lifetime of taps would be 13.9 years. However, it could be that shares of non-domestic stock and sales are lower than 10% (6% and 9% respectively).

Considering the EU-27 total stock and sales of shower valves in 2012 equal to 423 million and 27 million units, respectively, the average lifetime of the product would be 15.7 years. Starting with the assumption that 90% of the market is domestic, and considering the average lifetimes reported in Table 2.16, the lifetime of shower valves would be 13.9 years. However, it could be that shares of non-domestic stock and sales are lower than 10% (6% and 7% respectively).

Considering the EU-27 total stock and sales of shower outlets in 2012 equal to 423 million and 43 million units, respectively, the average lifetime of the product would be 9.8 years. Starting with the assumption that 90% of the market is domestic, and considering the average lifetimes reported in Table 2.16, the lifetime of shower outlets would be 8.8 years. However, it could be that shares of non-domestic stock and sales are lower than 10% (6% and 7% respectively).

Estimations made by considering the apparent consumption from statistics instead of the total sales would yield halved lifetimes for all taps. Based on this, the modelling of stock and sales should be more robust and the apparent consumption estimation based on EU statistics could be overestimated for taps. For shower valves and outlets, estimation made by considering the apparent consumption from statistics instead of the total sales would yield a

23-24% shorter lifetime (12 years compared to 15.5 for shower valves and 7.5 years compared to 9.8 for shower outlets). Based on this result, the model for shower valves and outlets appears sufficiently accurate.

2.3 Market structure and trends

As a rule of thumb, more than 50% of the companies producing taps and showers are considered to be SMEs. However, trends for future years could see the absorption of some SMEs into larger companies. Industrial kitchen taps instead seem to represent a niche market (about 1% of the domestic market which may double in the near future) mainly run by SMEs.

In terms of application, depending on the country, 80-96% of the taps and showers sold on the market are intended for domestic applications. 90% can be considered a sound average at European level. Moreover, it has been reported that 25% of the taps sold in France are kitchen taps.

The taps and showers distribution network can be complex and involve different actors. Information on market structure, market channels and major players at European level has been gathered through stakeholder consultations and is presented here.

A global retailer has pointed out that they only sell products in their own stores, without any external companies working as distributors. However, market channels can include large stores for direct sales to consumers, specialised retailers and distributors, trade associations, online sellers, importers, manufacturers of sinks, basins, showers, bathrooms and kitchens, and also construction companies. For instance, it has been indicated that the breakdown in the UK could be:

- Trade: 60% for taps and 55% for showers;
- Retail: 20% for taps and 20% for showers;
- Distributor: 15% for taps and 20% for showers;
- Internet: 5% for taps and 5% for showers.

It has been also reported that 60% of the market in France is carried by professional distributors and the remaining 40% is mainly DIY. The French market for taps and showers is dominated by important brands. Wholesalers and DIY stores usually sell own brand products. Moreover, some specialised companies (SMEs) are very strong in the non-domestic market.

Based on the feedback received from the stakeholders, the major players in different countries are listed in Table 2.20. Some additional information on the market segmentation is provided in Section 4 on the analysis of technologies.

Table 2.20 Major players and key contacts in the taps and showers market identified through stakeholder consultations

EU Country / Product type	Major players and key contacts
France	Wholesalers: Saint Gobain, Tereva, Comafranc/Aubade DIY: Leroy Merlin, Castorama (Kingfisher), Manufacturers: Grohe, Hansgrohe, Kohler/Jacob Delafon, Ideal Standard/Porcher, Roca, Presto, Delabie
Germany	Valves association: VDMA Industrial kitchen taps: Echtermann, Knauss, KWC Germany
Portugal	Large stores: Leroy Merlin, AKI, Isibuild, etc.
UK	Ceramic: Keramag, Duravit Ag, Kohler UK, Twyford Bathrooms (Sanitec Group) Suppliers: Villeroy & Boch, VitrAbad Gmbh, Kohler and Ideal Standard, Kohler Mira (new brand for showers), Grohe, Hansgrohe, Kludi, Ideal Standard, Hansa, Bristan Group, Roca, Samuel Heath & Sons, Triton (primarily for electric showers) Key importers: VitraA, Dahll from China, Lecico from Egypt, Roca and Porcelanosa form Spain
Industrial kitchens	Pentagast Group, Citti Group, Metro, MKN, Electrolux, Blanco, Franke

2.4 Consumer expenditure base data

Relevant information on average EU consumer prices, installation, repair and maintenance costs and disposal costs are provided in the following sections.

2.4.1 Average EU consumer prices

Indications of consumer prices have been gathered through stakeholder consultations for this study and other studies related to taps and showers[79]. Indicative prices for taps and showers in domestic and non-domestic applications are presented in Table 2.21. However, according to stakeholders, prices can vary greatly depending on the supply channel, commercial contracts, market segmentation of product (e.g. low, middle and luxury) and country. For instance, it was reported that in France the average price for a conventional tap is EUR 60 (calculated by dividing the total turnover by the total sales), while the typical price of one unit of product could vary from EUR 35 to EUR 65-100 in the entire EU.

A market research report from AMA showed that extra-EU imports usually represent cheaper products originated from China, Thailand, Turkey and the Middle East. Growth of lower value imports can increase the level of price competition across all sectors of the market[80].

Table 2.21 Indications of the prices of kitchen taps, bathroom taps, shower valves and shower outlets

Design feature	**Cost range in EUR for one unit of product (median)**			
	Kitchen taps	**Bathroom taps**	**Shower valves**	**Shower outlets**
Single control mixer	10-500 (35-100)	15–500 (35-65)	15–300 (35-65)	
Double-handle mixer • Spindle • Ceramic discs	10–500 (35-50) 10-500 (35-100)	20–150 (35-50) 15-500 (35-65)	20–150 (35-50) 15-300 (35-65)	
Pillar taps (pair)		10-150 (20-50)		
Thermostatic mixer	25-800 (60-200) Not common feature	25-800 (60-200)	25-800 (60-200)	
Self-closing tap (mechanical)	30–300 (50-120) Not common feature	30–300 (50-120)	30–700 (50-120), varying from valve to complete shower column	
Infra-red sensor tap	100–600 (185-250)	100–600 (185-250)	100–600 (185-250)	
Industrial kitchen tap	150-300 (150)			
Hand shower				5-150 (40)
Showerhead				20-200 (100)

Average purchase prices have been estimated based on the information provided by stakeholders and are reported in Table 2.21 and below:

1. Conventional tap/valve: 60 (35-85) EUR

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[79] http://susproc.jrc.ec.europa.eu/ecotapware/docs/First%20Interim%20Report%20-%20Updated%20draft%2004%2003%2011.pdf

[80] Bathroom Market UK 2006. AMA Research Ltd, November 2006.

2. Aerator + flow regulator: 70 (45-95) EUR
3. Thermostatic valve: 130 (60-200) EUR
4. Taps with diverters: 80 (50-110) EUR
5. Two-stage taps: 75 (55-95) EUR
6. Push tap: 80 (45-110) EUR
7. Sensor tap: 210 (185-235) EUR
8. Shower outlet: 70 (40-100) EUR.

2.4.2 Installation, maintenance and repair costs

Information on the indicative costs of installation, maintenance and repair has been collected with the support of stakeholders during this and other studies related to taps and showers[81] and revised based on practical considerations.

Installation, repair and maintenance costs are variable and depend on product and on who undertakes the work and where. Some users undertake it themselves, for example for the replacement of showerheads, while others will engage a professional plumber. For instance, the installation rate in Germany is approximately EUR 40 per hour. Maintenance and repair costs will also vary depending on the part that needs to be replaced, which will also be determined by the type of product installed. Indicative installation, maintenance and repair costs are included in Table 2.22.

During the lifetime of taps and showers there are usually very few replacements of parts. Aerators could be replaced periodically, even by the user. For the change of other parts, the intervention of the plumber could be necessary, as for instance in the case of seals, valves, diverters and cartridges. Maintenance operations can cost up to EUR 100, spare parts included.

Table 2.22 Installation, maintenance and repair costs

Domestic or non-domestic	Installation cost (EUR)	Maintenance and repair cost (EUR)	Frequency of maintenance and repair	Disposal (EUR)
Kitchen taps • Domestic • Non-domestic	Up to 150. A large proportion of consumers are able to install, maintain and make small repairs.	Up to 100	Seldom. The product is usually replaced in the domestic sector. Repair costs are more relevant for the non-domestic sector.	Free of charge (or even remunerated)
Bathroom taps • Domestic • Non-domestic	Up to 150. A large proportion of consumers are able to install, maintain and make small repairs.	Up to 100	Seldom. The product is usually replaced in the domestic sector. Repair costs are more relevant for the non-domestic sector (maintenance every 2-5 years).	Free of charge (or even remunerated)
Shower valves and/or outlets • Domestic • Non-domestic	Up to 150. A large proportion of consumers are able to install, maintain and make small repairs.	Up to 100	Seldom. The product is usually replaced in the domestic sector. Repair costs are more relevant for the non-domestic sector (maintenance every 2-5 years).	Free of charge (or even remunerated)
Outdoor taps • Domestic • Non-domestic	Up to 150. A large proportion of consumers are able to install, maintain and make small repairs.	Up to 100	Seldom. The product is usually replaced in the domestic sector. Repair costs are more relevant for the non-domestic sector (maintenance every 2-5 years).	Free of charge (or even remunerated)

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[81] http://susproc.jrc.ec.europa.eu/ecotapware/docs/First%20Interim%20Report%20-%20Updated%20draft%2004%2003%2011.pdf

Typical spare parts and indicative costs are indicated in Table 2.23. Detailed information has also been reported for the parts of a pre-rinse spray unit that could be replaced during the use of the product, together with an indication of the related costs for the user. The industrial kitchen industry reported that it provides an engineering service that repairs taps and pre-rinse spray units as soon as a problem arises.

Table 2.23 Indicative cost of spare parts

Typical spare parts replaced in taps, shower valves and shower outlets		Cost (EUR)	Product of appliance	Frequency of replacement
Aerators	Single unit	5-10	Any tap with a threaded outlet	Due to wear and highly dependent on water quality and lime formation. May require regular maintenance (typically once every 3-5 years although even 1 year without regular cleaning may necessitate replacement) and affect the lifetime of this component. Customers might also change the aerator to change the flow pattern.
Ceramic disc cartridges	Single unit	40-50 for thermostatic valves, 20-30 for other valves	Mainly thermostatic and single control valves	Seldom (it may be once every 5-10 years). Usually the entire product is replaced.
Compression valves	Single unit	5	Spindle taps	Seldom (it may be once every 3-10 years). Usually the entire product is replaced.
Hoses	Single unit	5 if in plastic, 15 if in metal	Shower systems	Seldom (it may be once every 2-5 years)
O-Rings	Box of mixed O-rings for taps (approx. 115) Single unit	10 0.2	All valves	Seldom (it may be once every 5-10 years)
Tap heads	Single unit	10	Mainly pillar taps, two-handle valves and thermostatic valves	Seldom (it maybe be once every 5-10 years). Usually the entire product is replaced
Washers	Box of mixed washers for taps (approx. 80)	10	All valves and shower outlets	Seldom (it may be every 5 years)

Note: Costs refer to component only without considering the price of repair and maintenance. Cost of spare parts considered for conventional products.

2.4.3 Disposal costs

Not much information has been obtained in relation to the disposal costs for taps and showers. End-of-life disposal costs for these products will vary depending on the installation and the country.

Taps and showerheads may be disposed of alongside other waste, for example other bathroom fittings or construction waste. However, it seems that taps are usually collected by installers and recycled in order to recover value from metals. Indicatively, it can be considered that 90-95% of metal-based products are recycled. Based on this, disposal of these products should be in most of cases free of charge or remunerated.

2.4.4 Additional consumer expenditure data

2.4.4.1 Energy prices

Indicative data on gas and electricity prices have been provided in the "MEErP 2011 Methodology Report - Part 1: Methods"[82]. Information can also be found directly in the Eurostat website[83].

Prices for gas, oil and electricity for householders and industrial consumers, and referred to 2011, have been gathered and presented in Table 2.24. Prices are exclusive of any tax and are based on the first semester of each year. Average annual price growth in the EU-27 has been estimated and is reported in Table 2.24. Annual price growth across all Member States is reported in Annex II Table A2.39.

Table 2.24 Energy prices without taxes for households and industry in the EU-27

	Gas (2011) [84]	**Oil (2011)** [85]	**Electricity (2011)** [86]
Price for households	11.94 EUR/GJ	606 EUR/1000 l (heating gas oil)	0.128 EUR/kWh
Price for industry	8.96 EUR/GJ	437 EUR/1000 l (heavy oil)	0.093 EUR/kWh
Estimated annual price increase[87]	3%	5%	5%

2.4.4.2 Water prices

Indicative data on water prices have been provided in the MEErP Methdology Report - Part 1: Methods[88].

The EuP Task 2 report for Washing Machines[89] presented data from the OECD 2006 report "Infrastructure to 2030: Telecom, Land Transport, Water and Electricity". This indicated that the cost of water supply and waste water infrastructure in Europe for the year 2000 was as follows:

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[82] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

[83] http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables

[84] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00113&plugin=1

[85] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

[86] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00115&plugin=1

[87] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

[88] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

[89] http://www.ecowet-domestic.org/index.php?option=com_docman&task=cat_view&gid=17&Itemid=48

- Water supply and combined sewer – EUR 2.54/m^3
- Water supply and separate sanitary sewer – EUR 2.29/m^3.

Additional analysis in the Task 2 Washing Machines report estimated that the European average price for water supply and sewerage is EUR 2.5/m^3.

Water prices have risen as countries move towards the full cost recovery under the Water Framework Directive. In countries with high water prices, like the Netherlands and France, the water price is now above EUR 4/m^3 (including sewerage tax). In 2011 the average EU water price including sewage tax was estimated at EUR 3.70/m^3, with an annual nominal growth rate of 2.5% (more or less equal to inflation)[90]. In 2013 the water price was updated to EUR 3.887/m^3.

2.4.4.3 Interest and inflation rates

Indicative data on interest and inflation rates have been provided in the "MEErP 2011 Methodology Report - Part 1: Methods"[91]. Information can also be found directly in the Eurostat website[92].

EU-27 information on inflation rates[93] and long-term interest rates[94] for the period 2007-2012 has been gathered and presented in Table 2.25. Inflation rates and long-term interest rates across all the Member States are reported in Annex II Tables A2.40 and A2.41.

Table 2.25 EU-27 inflation rate[95] and long-term interest rate (10-year average)[96]

	2007	2008	2009	2010	2011	2012
Inflation rate (%)	2.4	3.7	1	2.1	3.1	2.6
Long-term interest rate (%)	4.56	4.54	4.13	3.82	4.30	3.72

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[90] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

[91] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

[92] http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables

[93] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00118

[94] http://epp.eurostat.ec.europa.eu/portal/page/portal/interest_rates/data/database

[95] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00118

[96] http://epp.eurostat.ec.europa.eu/portal/page/portal/interest_rates/data/database

2.4.4.4 Summary

Table 2.26 gives a summary of average EU-27 consumer expenditure data and rates that have been taken from the "MEErP 2011 Methodology Report - Part 1: Methods"[97].

Table 2.26 Summary of energy, water and financial rates in the EU-27 (at 01.01.2011)[98]

	Domestic incl. VAT	Long-term growth per year	Non-domestic excl. VAT
Electricity (EUR/kWh)	0.18	5%	0.11
Gas (EUR/GJ (LHV))	14.54	3-5%	8.90
Oil (gas oil) (EUR/1000 l)	824	5%	Not Available
Water (EUR/m^3)	3.70	2.50%	Not Available
Interest rate	7.7%	Not Available	6.5%
Inflation rate	2.1%		
Discount rate (EU default)	4%		
Energy escalation rate*	4%		
VAT	20%		
* real (inflation corrected) increase			

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[97] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

[98] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

3 USERS AND SYSTEM ASPECTS

The objective of this chapter is to report and analyse information on the consumption of resources and on any other relevant environmental impacts associated with the use of taps and showers.

The two main resources consumed during the use of these products are water and energy. Water and energy consumption is influenced by several factors, including: product technology used, user behaviour patterns, and technical systems in which the product is used.

Products must indeed be seen as part of a system. The consideration of system aspects is important for determining "indirect" burdens associated to the use of products. In the present context, the product system is considered to include:

- water abstraction, impoundment, storage, treatment and distribution of surface water or groundwater;
- water supply, heating and control at the user location;
- waste water collection and treatment which subsequently discharges into surface water.

This section in particular focuses on user behaviour and system aspects while product technologies are analysed in Chapter 4.

3.1 Water availability and consumption in Europe

Water differs from other resources due to the unique characteristics as it moves through the meteorological, hydrological and hydrogeological cycles. Because of this, the availability of water varies in time and space, and also within countries. Even when water is abundant on a national scale, local areas may experience conditions of water shortage or over-exploitation of water during different time periods or seasons. This is typical for river basins and touristic areas in the Mediterranean regions, but also for urban centres, for small islands and for some northern regions[99]. The phenomenon can be worsened in case of drought conditions, which have been recorded all across Europe, as shown in Figure 3.1.

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[99] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

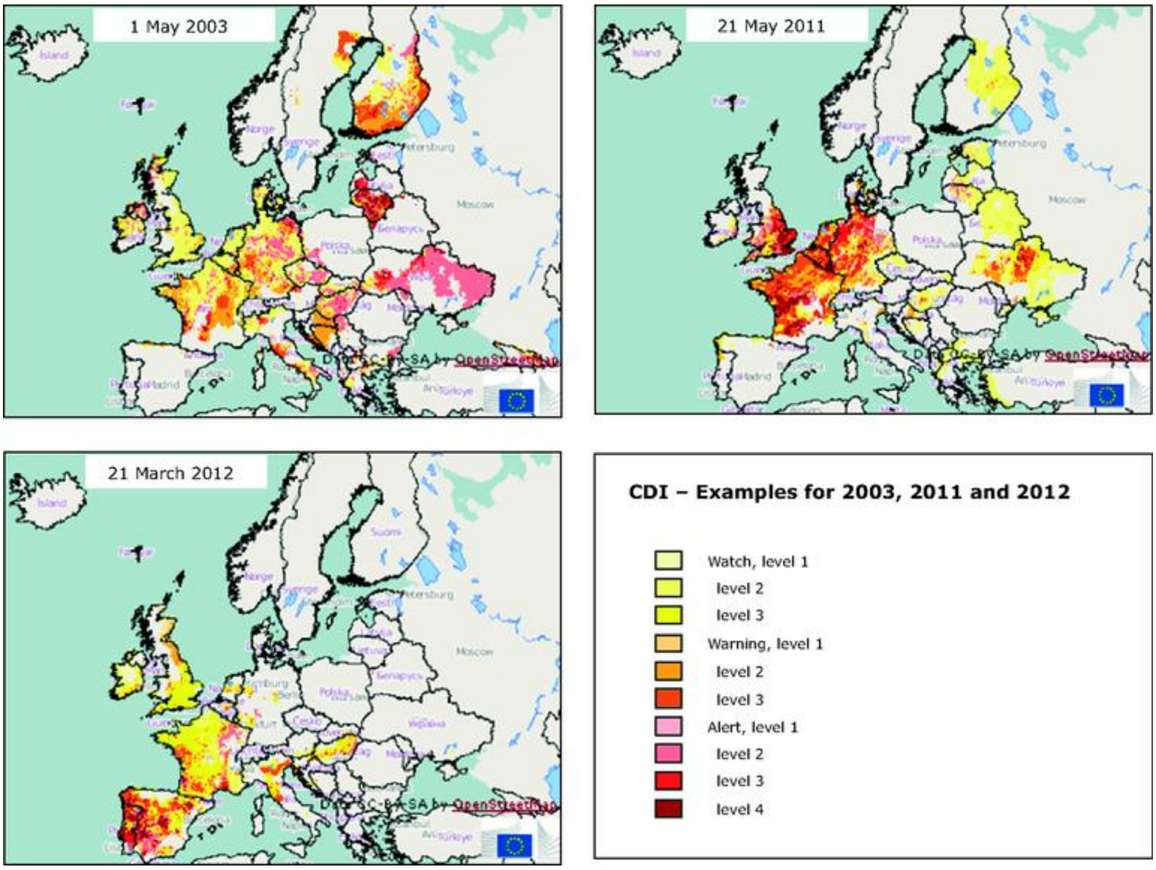

Figure 3.1 Drought conditions in Europe over time[100] (CDI = Combined Drought Index[101])

A measure of the water depletion stress is represented by the Water Exploitation Index (WEI), which is expressed as the percentage of fresh water available in a certain area that is withdrawn to fulfil the water needs of that area. According to the European Environment Agency, the warning threshold, which distinguishes a non-stressed region from a scarce water region, is around 20%, with severe scarcity occurring where the WEI exceeds 40%[102]. WEIs for some countries of Europe are shown in Figure 3.2, which illustrates that several countries approach or exceed the 20% and 40% thresholds (Cyprus, Belgium, Spain, Italy, Malta, Turkey, Germany, Poland and France). Results are qualitatively similar to those which could be obtained through the FAO's Aquastat database[103]. The number of regions facing water stress conditions could increase in the coming years as climate change will influence both the supply and demand for water.

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[100] http://www.eea.europa.eu/data-and-maps/figures/mapping-of-drought-conditions-in-europe

[101] CDI takes into consideration three factors: precipitation, temperature, and vegetation (see http://www.faoswalim.org/downloads/CDI%20Brochure.pdf)

[102] http://www.eea.europa.eu/soer/synthesis/synthesis/natural-resources-and-waste-2014/view

[103] http://www.fao.org/nr/water/aquastat/data/query/results.html

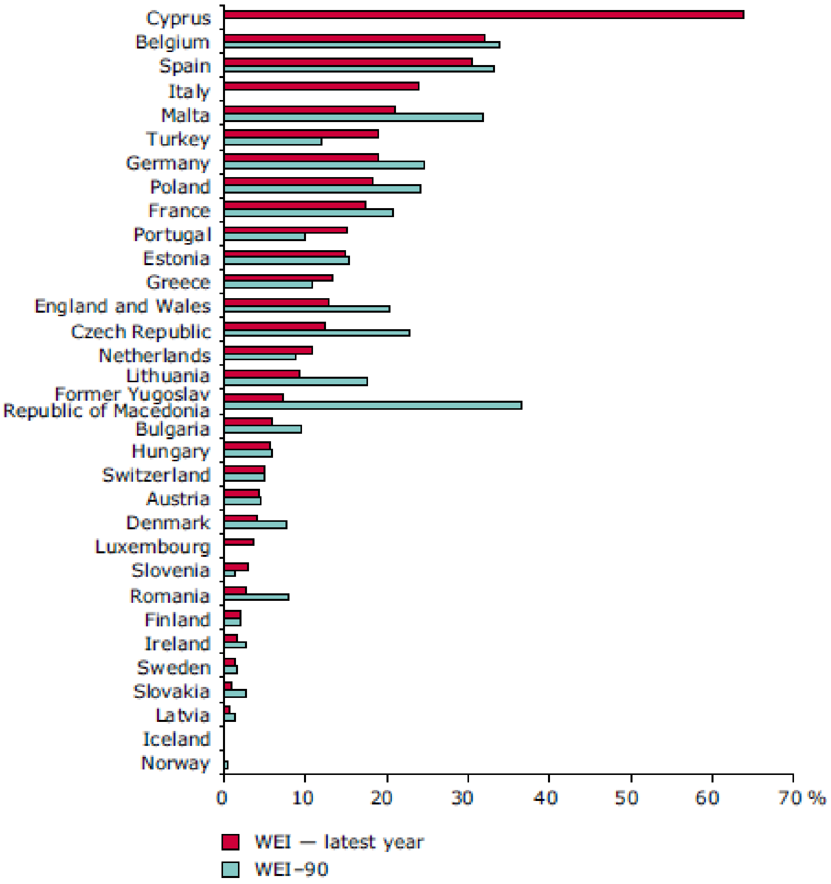

Figure 3.2 **Water Exploitation Index in Europe in the late 1980s/early 1990s (WEI-90) compared to most recent years available (1998 to 2007)**[104]

Based on the FAO's Aquastat database[105], the total fresh water abstraction in the EU-28 was about 240 000 million m^3/year in 2008-2012. Water abstraction seems to have decreased by about 13% in the last 14 years, as shown in Figure 3.3.

For the year 2000, the European Environmental Agency estimates that the water abstraction of the EU-27 plus Norway, Switzerland and Turkey was 307 000 million m^3. Adapting this value to the EU-28 through the FAO's Aquastat database would provide 261 000 million m^3/year[106]. The total water abstraction of the EU-27 is elsewhere quantified at 247 000 million m^3/year prior to 2002 (248 000 million m^3/year also considering Croatia)[107]. It is thus worth observing that the value estimated for 1998-2002 based on the FAO's Aquastat database (256 000 million m^3/year, see Figure 3.3) is very close and included within this interval of values.

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[104] http://www.eea.europa.eu/soer/synthesis/synthesis/natural-resources-and-waste-2014/view

[105] http://www.fao.org/nr/water/aquastat/data/query/results.html

[106] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

[107] http://www.ecologic.eu/2175

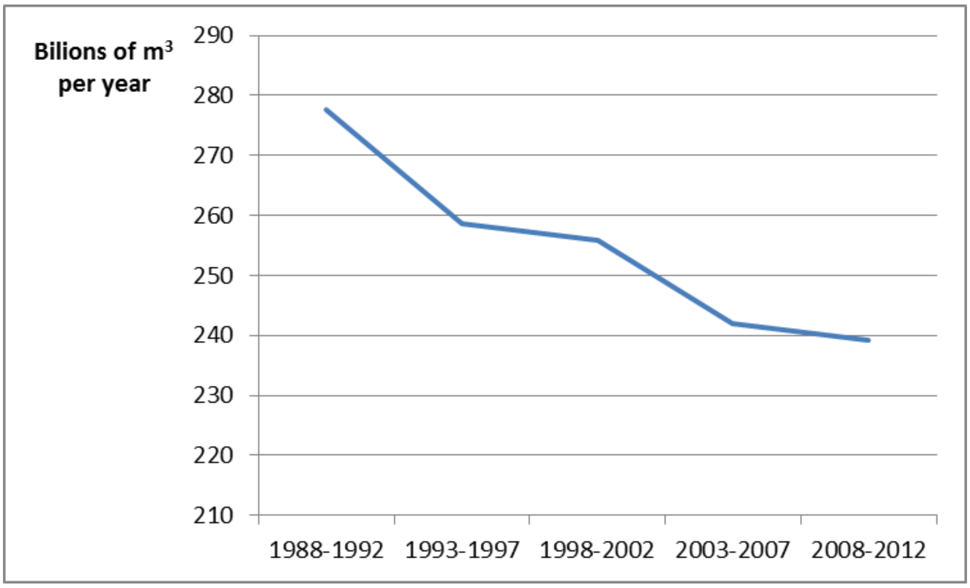

Figure 3.3 **Total fresh water abstraction in the EU-28 from 1988 to 2012**[108]

It has been estimated through the FAO's Aquastat database[109] that about 55% of fresh water abstracted in the EU-28 in 2008-2012 was used by industry for energy production and manufacturing. Urban and agricultural use of water indicatively counts for another 20% and 25%, respectively. According to the European Environment Agency, 44% of the water abstracted in 2000 was used for energy (seven tenths) and manufacturing (three tenths), 32% for agriculture and 24% for urban use[110]. The breakdown reported elsewhere is: 59% for energy (three quarters) and manufacturing (one quarter), 24% for agriculture and 17% for urban use[111]. Figures provided in the literature are characterised by a certain variability, but they allow the magnitude of the contribution of different sectors to the water depletion problem to be defined.

However, the breakdown by sector of use varies quite widely across Europe. For instance, the pressure of agriculture is much higher in Mediterranean countries (44% of total water use in Italy, 60% in Spain, 73% in Portugal, 86% in Cyprus and 89% in Greece) than in the rest of Europe. The percentage of public supply of water is also not homogeneous[112].

Much of the water abstracted is "sequestrated" and returned to hydrological basins although in a polluted or partially cleaned form and in a different location. It is considered that 80% of the water used in agriculture in Europe is either absorbed by crops or evaporates from fields and that 80% of the water used in manufacturing and households is returned to the local environment. In electricity generation, 95% of the abstracted water is returned warmer, affecting local ecosystems[113].

Water consumption in Europe is apparently decreasing, as also reflected in Figure 3.3 in terms of fresh water abstraction. According to the European Environment Agency, this trend is expected to continue in the future. In most places, this reduction is the result of the introduction into the power sector of cooling towers that use far less water than existing

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[108] elaboration from http://www.fao.org/nr/water/aquastat/data/query/results.html

[109] http://www.fao.org/nr/water/aquastat/data/query/results.html

[110] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

[111] http://www.ecologic.eu/2175

[112] elaboration from http://www.fao.org/nr/water/aquastat/data/query/results.html

[113] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

cooling systems. They are expected to allow around a two-thirds reduction of water abstraction for cooling across Europe, even if current projections of a doubling in thermal electricity production prove correct. However, this does not necessarily mean the presence of more water in Europe's rivers since most of the water abstracted for cooling is returned to rivers and since actual water losses through evaporation in these new systems are higher than for conventional cooling systems[114].

Meanwhile demographic and economic trends are likely to increase water use in other sectors. Urban use in Europe can be expected to rise by 3% from 2000 to 2030. This is mainly due to increased wealth conditions and diminishing household size, a function, among others, of social and demographic trends. The increase in second homes and mass tourism, including water-intensive activities such as watering golf courses, also raises the per capita water use. It is possible, however, that trends to increase domestic water use could be compensated by regulations or economic incentives to encourage people to switch to more efficient water-using products[115]. Water abstraction for manufacturing and agriculture is also expected to grow (+43% and +11%, respectively)[116].

Geographically, water consumption has shown different trends in different parts of Europe, and this is likely to continue. Water use is stable in southern Europe and decreasing in western Europe. This decrease is attributed mostly to behavioural changes, technological improvements and the prevention of water losses in distribution systems, supported by water pricing. Eastern Europe has experienced substantial decreases in water use — the average annual water use in the period 1998 to 2007 was around 40% lower than in the early 1990s — mainly as a result of the introduction of water meters, higher water prices, and the closure of some water-intensive industries[117]. Northern Europe is likely to see substantial reductions in water abstraction, as power plants change to modern cooling systems. However, the overall consumption of water could rise if climate change causes increased use of irrigation in agriculture. The impact in southern Europe could be even bigger (+20% by 2030 in the area under irrigation) and in many places there may be not enough water to meet the increased demand, so that technological and policy measures could be needed[118].

In the past, European water management has largely focused on increasing supply by drilling new wells, constructing dams and reservoirs, investing in desalination and large-scale water-transfer infrastructures. Increasing problems of water scarcity and drought indicate the need for a more sustainable management approach. There is a particular need to invest in demand management that increases the efficiency of water use and its potential for recycling[119]. Water abstraction could for instance be increased through water-efficiency standards for water-using products and reducing leakage rates in distribution systems[120]. The loss in the supply network varies from below 10% up to 50% of the total water supply[121]. In some places this leakage is not strictly "lost", since it recharges groundwater, from where it can be pumped to the surface again. However, in many places this is impossible because groundwater can be too contaminated to be used[122].

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[114] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

[115] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

[116] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

[117] http://www.eea.europa.eu/soer/synthesis/synthesis/natural-resources-and-waste-2014/view

[118] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

[119] http://www.eea.europa.eu/soer/synthesis/synthesis/natural-resources-and-waste-2014/view

[120] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

[121] http://www.ecologic.eu/2175

[122] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

3.2 Domestic and non-domestic water consumption

3.2.1 Quantification of urban water use across the EU-28

Different sectors compete for the use of water: energy, industry, agriculture and public supply. The scope of this preparatory study covers taps and showers used to derive water for personal hygiene, cleaning, cooking and drinking in both domestic and non-domestic applications. For this reason, the focus of the study is to analyse the consumption of water for urban use, including intended domestic and non-domestic uses.

According to the information from the FAO's Aquastat database reported previously, water abstraction for urban use in the EU-28 was estimated to be 49 700 million m^3/year for 2008-2012, about 20% of the total water abstraction. This has the same order of magnitude as the value obtainable with the data provided by the European Environment Agency (62 500 million m^3/year) in 2000. The average contribution of the urban sector to the total water abstraction varies from 17% to 24% considering the three sources of information cited above. However, figures on the proportion of the water abstracted for urban use differs depending on the country.

According to EUREAU, the total drinking water abstraction in Europe was 47 000 million m^3 in 2008. This is interpreted to be delivered for domestic and non-domestic purposes, with about 20% average loss in the water supply network[123]. However, EUREAU's figure only includes abstraction and delivery by EUREAU members (about 82.5% in terms of population). Scaling up this value to the total population and removing the urban consumption of Iceland, Norway and Switzerland (as reported in the FAO's Aquastat database), the consumption of drinking water for the EU-28 would result as equal to 55 200 million m^3/year.

EUREAU also reports that the water delivered for domestic and non-domestic uses corresponds on average respectively to 57% and 23% of the total amount of drinking quality water abstracted in Europe.

Table 3.1 provides information on the daily per capita consumption of water across the EU-28, according to different sources. Information also includes urban delivery of water for domestic and non-domestic uses. The average abstraction of water for urban use is about 265 L/person/day, according to the FAO[124] and EEA[125]. According to EUREAU[126], the delivery of water for domestic and non-domestic use is about 150 L/person/day and 50 L/person/day, respectively, which together makes about 76% of the values estimated from the FAO and EEA for the abstraction of water for urban use. Taking water losses into account, the average figures provided by EUREAU should be quite consistent with those calculated from the other sources. However, variation between countries can be significant.

Use of water in the domestic and non-domestic sectors of the EU-28 has been calculated for 2012 from EUREAU's data (see Table 3.2). Values for Latvia have been estimated as the

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[123] http://eureau.org/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/user_upload/documents/8.%20Reports/EUREAU%20Statistics%20Overview%20on%20Water%20and%20Wastewater%20in%20Europe%20-%202008%20%28Edition%202009%29.pdf&t=1415198059&hash=fecaf81eefec3967e2c7e0ac5e66a3e300a33216

[124] http://www.fao.org/nr/water/aquastat/data/query/results.html

[125] http://www.eea.europa.eu/data-and-maps/figures/sectoral-use-of-water-in-regions-of-europe

[126] http://eureau.org/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/user_upload/documents/8.%20Reports/EUREAU%20Statistics%20Overview%20on%20Water%20and%20Wastewater%20in%20Europe%20-%202008%20%28Edition%202009%29.pdf&t=1415198059&hash=fecaf81eefec3967e2c7e0ac5e66a3e300a33216

average of those for Estonia and Lithuania; values for Slovenia as the average of those for Austria, Croatia and Hungary. However, these assumptions do not affect the calculation significantly given the little demographic weight of these two countries. Average data have been considered for water losses in the water supply network[127].

The estimated consumption of water for urban use is 37 425 million m^3/year, which becomes equal to 49 329 million m^3/year taking water losses into account. 74% of this water can be allocated to domestic use and the remaining 26% to non-domestic use.

Based on the statistics on water use mentioned above, it can be observed that the most water-demanding countries in the EU-28 are as follows:

- Italy (16%), France (15%), Germany and the UK (14% each) and Spain (12%) in the domestic sector. The five countries sum together to account for 70% of the EU-28 domestic use of water.
- The UK (17%), Spain (16%), Italy (15%), Germany (9%), France (7%) and Romania (6%) in the non-domestic sector. The six countries sum together to account for 69% of the EU-28 non-domestic use of water;
- Italy and the UK (15% each), France and Spain (13% each) and Germany (12%) considering the total delivery of water. The five countries sum together to account for 68% of the EU-28 total use of water.

The results would be qualitatively similar taking losses of water in the distribution system into account.

The next steps of the analysis are to estimate:

1. which share of the urban use of water in the EU-28 can be allocated to taps and showers installed in domestic and non-domestic premises; and
2. how much of this share is hot water and what is the energy demand associated with its heating.

This information has then to be coupled with elements related to water delivery and heating in order to understand the real consumption of water and energy of the product system. These are addressed in detail in Sections 3.3 and 3.4.

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[127] http://www.ecologic.eu/2175

Table 3.1 Urban water use in the EU-28 and domestic and non-domestic split

	Domestic water use (L/person/day) 2008 (EUREAU[128])	Non-domestic water use (L/person/day) 2008 (EUREAU)	Urban water abstraction (L/person/day) 2001 (EEA[129])	Urban water abstraction (L/person/day) 2008-2012 (FAO[130])
Austria	143	70	203	226
Belgium	105	47	192	189
Bulgaria	114	25	372	360
Croatia	136	95		333
Cyprus	269	40	140	47
Czech Republic	97	55	209	188
Denmark	124	68	216	190
Estonia	128	45	144	110
Finland	138	92	212	209
France	169	28	269	256
Germany	126	29	185	170
Greece	218	22	225	206
Hungary	135	17	201	182
Ireland	188	129	335	
Italy	200	67	479	434
Latvia	115[a]	30[a]	20	187
Lithuania	102	14	100	126
Luxembourg	154	66	234	235
Malta	75	55	141	234
Netherlands	122	62	213	206
Poland	78	25	157	262
Portugal	71	36	208	170
Romania	118	76	301	192
Slovakia	86	41	200	161
Slovenia	138[b]	61[b]	302	222
Spain	190	93	256	340
Sweden	185	118	284	291
UK	168	74	291	333
EU-28	149	53	262	267

(a) Estimated as average of Estonia and Lithuania.
(b) Estimated as average of Austria, Croatia and Hungary.

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[128] http://eureau.org/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/user_upload/documents/8.%20Reports/EUREAU%20Statistics%20Overview%20on%20Water%20and%20Wastewater%20in%20Europe%20-%202008%20%28Edition%202009%29.pdf&t=1415198059&hash=fecaf81eefec3967e2c7e0ac5e66a3e300a33216

[129] http://www.eea.europa.eu/data-and-maps/figures/sectoral-use-of-water-in-regions-of-europe

[130] http://www.fao.org/nr/water/aquastat/data/query/results.html

Table 3.2 Average delivery of water for domestic and non-domestic use in the EU-28 and the total amount of abstracted water needed

Country	Population in 2012 (millions)	Domestic use of water (L/p/d)	Non-domestic use of water (L/p/d)	Domestic use of water (M m^3/yr)	Non-domestic use of water (M m^3/yr)	Total urban use of water (M m^3/yr)	Water loss in the water supply network (%)	Water abstracted for urban use (M m^3/yr)
EU-28	507	149	53	27544	9881	37425	24	49329
Austria	8	143	70	441	216	656	10[a]	729
Belgium	11	105	47	425	190	616	30[b]	879
Bulgaria	7	114	25	305	67	372	50	743
Croatia	4	136	95	218	153	371	40[c]	618
Cyprus	1	269	40	85	13	97	25[c]	130
Czech Republic	11	97	55	372	211	583	30	833
Denmark	6	124	68	252	138	391	10	434
Estonia	1	128	45	60	21	82	17[e]	98
Finland	5	138	92	272	181	453	15	533
France	65	169	28	4030	668	4697	30	6711
Germany	82	126	29	3764	866	4630	10	5145
Greece	11	218	22	898	91	989	25[e]	1319
Hungary	10	135	17	489	62	551	35	848
Ireland	5	188	129	314	216	530	34	803
Italy	59	200	67	4336	1452	5788	25	7718
Latvia	2	115	30	86	22	108	17[e]	130
Lithuania	3	102	14	112	15	127	17[e]	153
Luxembourg	1	154	66	30	13	42	10[a]	47
Malta	0	75	55	11	8	20	25[d]	26
Netherlands	17	122	62	745	379	1124	10[a]	1248
Poland	39	78	25	1097	352	1449	30[f]	2070
Portugal	11	71	36	273	139	412	25[a]	549
Romania	21	118	76	920	592	1512	30	2160
Slovakia	5	86	41	170	81	251	27	343
Slovenia	2	138	61	104	46	149	40	248

Country	Population in 2012 (millions)	Domestic use of water (L/p/d)	Non-domestic use of water (L/p/d)	Domestic use of water (M m^3/yr)	Non-domestic use of water (M m^3/yr)	Total urban use of water (M m^3/yr)	Water loss in the water supply network (%)	Water abstracted for urban use (M m^3/yr)
Spain	46	190	93	3204	1568	4772	25	6362
Sweden	9	185	118	640	408	1049	17	1264
UK	63	168	74	3891	1714	5605	22	7186

(a) Set equal to Germany.
(b) Set equal to France.
(c) Set equal to Slovenia.
(d) Set equal to Greece, Italy and Spain.
(e) Set equal to Sweden.
(f) Set equal to Czech Republic and Romania.

3.2.2 Domestic water consumption and energy demand

3.2.2.1 Quantification of domestic water consumption

Higher standards of living are changing water demand patterns. This is reflected mainly in increased domestic water use, especially for personal hygiene. The result is that most of urban water consumption is for domestic use, 74% as the EU-28 average according to the calculated estimate.

Domestic water use varies among countries, regions and persons, depending on factors which include: product technology mix, use practices, cultural behaviour and the policy instruments deployed in a certain territory.

EU-28 statistics on the domestic use of water are reported in Table 3.1 and in Table 3.2, referring to average demand per capita and per country, respectively. Distribution losses will be taken into account in a second stage.

Total domestic consumption of water must be split between different uses in order to understand the share of water allocable to taps and showers. Domestic uses include: toilet flushing, showering and bathing, washbasin taps, drinking and cooking, dish washing by hand and by machine, clothes washing by hand and by machine, cleaning and other indoor uses, outdoor uses such as gardening and car washing.

The literature has been screened in order to gather sample of data on water consumption per capita for specific domestic uses and for different countries of the EU-28. Information has been selected that:

1. presents both data on water consumption per capita and a detailed breakdown of water use;
2. is representative of different areas of Europe.

The screening has led to the selection of data for: Austria[131], Germany[132], the Netherlands[133], Belgium[134], Denmark[135], Finland[136], the UK (three sources[137,138,139]), Spain[140] and Italy (two sources[141,142]). Deviation from EUREAU's figures varies from -22% to +25%, depending on the country.

Based on the information collected, water use at home has been modelled for four areas:

- Central and Eastern Europe and the Balkans.
- Nordic and Baltic Europe.
- The UK and Ireland.

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[131] http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0809bqtd-e-e.pdf

[132] http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0809bqtd-e-e.pdf

[133] http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0809bqtd-e-e.pdf

[134] http://www.brico.be/wabs/fr/19041/ami-renovateur/conseil-du-mois/economiser-lrsquo-eau-a-la-maison-comme-au-jardin.do

[135] http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0809bqtd-e-e.pdf

[136] http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0809bqtd-e-e.pdf

[137] http://www.energysavingtrust.org.uk/About-us/The-Foundation/At-Home-with-Water

[138] http://www.south-staffs-water.co.uk/publications/your_home/WaterUseHome.pdf

[139] Bathroom Scrappage Scheme Report: "Building the Case for a Bathroom Scrappage Scheme. Detailed Findings produced by Gough Mandarin Ltd." December 2010, Ref: 2010/L594 (private communication)

[140] http://www.efimarket.com/blog/cuanta-agua-se-consume-en-los-hogares-espanoles/

[141] http://www.buonpernoi.it/acqua/

[142] http://agenziacasa.comune.fi.it/export/sites/agenziacasa/materiali/ACQUA.pdf

- Southern Europe.

The distribution of values for water consumption per capita (average, minimum and maximum) has been modelled for each area and for each domestic use identified above. This is to allow the definition of three scenarios for analysis: a baseline scenario (Base), a worst case scenario (WS) and best case scenario (BS).

The results of the modelling for Central and Eastern Europe and the Balkans (hereafter CEEB) are shown in Table 3.3. These have been based on information for Austria, Germany, the Netherlands and Belgium. Deviation of the starting data from EUREAU's figure varies from -9% to +14%.

According to the model, the baseline scenario for water use in CEEB is 126.0 L/p/d, which is 1% lower than the population-weighted average value obtainable using EUREAU's data. The best and worst case scenarios are 18% less and 23% higher than the baseline scenario.

With respect to the breakdown by water use, the main assumptions made are the following:

- When information on the use of water for personal hygiene (bathing, showering and washbasin) was aggregated, as was the case for Austria, Germany and Belgium, the split between different uses was based on the Netherlands' shares (4% bathing, 86% showering, 9% washbasin).
- When information on the use of water for dish washing was aggregated, as was the case for Austria, Germany and Belgium, the split between washing by hand and by machine was based on the Netherlands' shares (56% washing by hand, 44% washing by machine).
- When information on the use of water for clothes washing was aggregated, as was the case for Austria, Germany and Belgium, the split between washing by hand and by machine was based on the Netherlands' shares (10% washing by hand, 90% washing by machine).
- When information on the outdoor use and other uses of water was reported together, the outdoor use was rescaled to the percentage for the Netherlands (4.1%) and the difference accounted for as other indoor uses.

Table 3.3 **Water consumption at home and calculated breakdown by use pattern in Central and Eastern Europe and the Balkans**

Use pattern	Water use (L/p/d)			
	Baseline		Best scenario	Worst scenario
Baths	2.0	2%	1.6	2.5
Showers	40.0	32%	32.9	49.8
Taps, washbasin	6.3	5%	3.6	9.5
Taps, kitchen – drinking/cooking	3.8	3%	3.5	4.0
Taps, kitchen – dish washing	4.2	3%	3.8	4.5
Taps, indoor – clothes washing	1.8	1%	1.6	2.3
Taps, indoor – other uses	6.6	5%	5.0	9.3
Outdoor	5.2	4%	4.8	5.6
Toilet flushing	36.7	29%	29.7	43.0
Dishwasher	3.3	3%	3.0	3.6
Washing machine	16.3	13%	14.4	20.6
Total	126.0	100%	103.9	154.7
Total according to EUREAU	127.9		78 (Poland)	190 (Slovenia)

The results of the modelling for Nordic and Baltic Europe (hereafter NBE) are shown in Table 3.4. These have been based on information for Denmark and Finland. Deviation of the starting data from EUREAU's figure varies from -17% to +6%, depending on the country.

According to the model, the baseline scenario for water use in NBE is 123.0 L/p/d, which is 15% lower than the population-weighted average value obtainable using EUREAU's data. The best and worst case scenarios are 15% less and 15% more than the baseline scenario.

With respect to the breakdown by water use, the main assumptions made are the following:

- Information on the use of water for personal hygiene (bathing, showering and washbasin) was aggregated, and the split between different uses was based on the Netherlands' shares (4% bathing, 86% showering, 9% washbasin).
- Information on the use of water for dish washing was aggregated, and the split between washing by hand and by machine was based on the Netherlands' shares (56% washing by hand, 44% washing by machine).
- Information on the use of water for clothes washing was aggregated, and the split between washing by hand and by machine was based on the Netherlands' shares (10% washing by hand, 90% washing by machine).
- Information on the outdoor use and other uses of water was split equally between the two different use patterns.

Table 3.4 **Water consumption at home and calculated breakdown by use pattern in Nordic and Baltic Europe**

Use pattern	Water use(L/p/d)			
	Baseline		Best scenario	Worst scenario
Baths	2.3	2%	2.1	2.5
Showers	45.6	37%	41.9	49.3
Taps, washbasin	4.9	4%	4.5	5.2
Taps, kitchen – drinking/cooking	6.2	5%	5.8	6.6
Taps, kitchen – dish washing	9.2	8%	8.8	9.6
Taps, indoor – clothes washing	2.1	2%	1.5	2.6
Taps, indoor – other uses	2.1	2%	1.5	2.6
Outdoor	23.1	18%	16.0	30.1
Toilet flushing	7.3	6%	6.9	7.6
Dishwasher	2.0	2%	1.6	2.5
Washing machine	18.4	15%	14.4	22.4
Total	123	100%	105.0	141.0
Total according to EUREAU	145.4		102 (Lithuania)	185 (Sweden)

The results of the modelling for the UK and Ireland (hereafter UKAI) are shown in Table 3.5. These have been based on three sources of information for the UK. Deviation of the starting data from EUREAU's figure varies from -15% to -11%, depending on the country.

According to the model, the baseline scenario for water use in UKAI is 147.3 L/p/d, which is 13% lower than the population-weighted average value obtainable using EUREAU's data. The best and worst case scenarios are 8% less and 49% more than the baseline scenario.

With respect to the breakdown by water use, the main assumptions made are the following:

- When information on the use of water for personal hygiene (bathing, showering and washbasin) was aggregated, the split between different uses was based on the figures provided by the Energy Saving Trust (20% bathing, 63% showering, 18% washbasin).
- When information on the use of water for dish washing was aggregated, the split between washing by hand and by machine was based on the figures provided by the Energy Saving Trust (80% washing by hand, 20% washing by machine).
- When information on the use of water for clothes washing was aggregated, the split between washing by hand and by machine was based on the Netherlands' shares (10% washing by hand, 90% washing by machine).
- Other information on the indoor use of water has been split in line with the ratios presented for the Netherlands. Drinking and cooking water was considered to be half of the sum of the water used for washing dishes and clothes by hand, as an approximation of the ratio for the Netherlands.

Table 3.5 **Water consumption at home and calculated breakdown by use pattern in the UK and Ireland**

Use pattern	Water use(L/p/d)			
	Baseline		Best scenario	Worst scenario
Baths	10.6	7%	9.1	11.4
Showers	33.2	23%	28.4	35.6
Taps, washbasin	17.1	12%	9.9	31.5
Taps, kitchen – drinking/cooking	3.9	3%	3.6	4.5
Taps, kitchen – dish washing	6.3	4%	5.7	7.2
Taps, indoor – clothes washing	1.6	1%	1.4	1.8
Taps, indoor – other uses	16.0	11%	9.6	26.3
Outdoor	4.4	3%	2.8	6.0
Toilet flushing	37.9	26%	31.2	45.0
Dishwasher	1.6	1%	1.4	1.8
Washing machine	14.7	10%	12.8	16.2
Total	147.3		115.9	187.3
Total according to EUREAU	169.3		168 (the UK)	188 (Ireland)

The results of the modelling for Southern Europe (hereafter SE) are shown in Table 3.6. These have been based on information for Spain and Italy. Deviation of the starting data from EUREAU's figure varies from -22% to +25%, depending on the country.

According to the model, the baseline scenario for water use in SE is 199.7 L/p/d, which is 6% higher than the population-weighted average value obtainable using EUREAU's data. The best and worst case scenarios are 36% less and 45% more than the baseline scenarios.

With respect to the breakdown by water use, the main assumptions made are the following:

- Information on the use of water for personal hygiene (bathing, showering and washbasin) was aggregated and the split between different uses was based on the Netherlands' shares (4% bathing, 86% showering, 9% washbasin).
- Information on the use of water for dish washing was aggregated and the split between washing by hand and by machine was based on the Netherlands' shares (56% washing by hand, 44% washing by machine).
- Information on the use of water for dish and clothes washing by hand was based on the Netherlands' figures.
- Consumption of drinking and cooking water in Spain was considered to be half of the sum of the water used for washing dishes and clothes by hand, as an approximation of the ratio for the Netherlands.
- Information on outdoor use and other uses of water in Spain was split equally between the two different use patterns.

Table 3.6 **Water consumption at home and calculated breakdown by use pattern in Southern Europe**

Use pattern	Water use(L/p/d)			
	Baseline		Best scenario	Worst scenario
Baths	3.2	2%	2.4	4.2
Showers	63.2	32%	48.2	84.3
Taps, washbasin	15.3	9%	9.0	26.8
Taps, kitchen – drinking/cooking	8.2	4%	3.0	17.5
Taps, kitchen – dish washing	7.7	4%	3.0	14.3
Taps, indoor – clothes washing	2.6	1%	1.7	3.3
Taps, indoor – other uses	17.7	9%	6.0	32.0
Outdoor	13.7	7%	6.0	20.0
Toilet flushing	40.4	20%	31.3	50.0
Dishwasher	7.5	4%	4.3	10.7
Washing machine	20.4	10%	13.2	26.7
Total	199.7		127.9	289.8
Total according to EUREAU	187.5		71 (Portugal)	269 (Cyprus)

Domestic water use in the EU-28 has been estimated for the three modelled scenarios considering the population in 2012. The results are shown in Table 3.7 in terms of total water consumption and in Table 3.8 in terms of percentage contributions of the different user patterns.

Table 3.7 **Estimation of EU-28 domestic water use in 2012 for the three scenarios (absolute values)**

Use pattern	Baseline (M m^3/yr)	Best scenario	Worst scenario
Baths	644	-17%	19%
Showers	8384	-19%	25%
Taps, washbasin	1846	-41%	67%
Taps, kitchen - drinking/cooking	930	-30%	52%
Taps, kitchen - dish washing	1037	-27%	36%
Taps, indoor - clothes washing	364	-20%	26%
Taps, indoor - other uses	1931	-46%	63%
Outdoor	1308	-34%	30%
Toilet flushing	6862	-20%	20%
Dishwasher	802	-23%	24%
Washing machine	3188	-19%	26%
Total	27296	-24%	31%

Table 3.8 **Estimation of EU-28 domestic water use in 2012 for the three scenarios (percentage contributions to the total)**

Use pattern	Baseline	Best scenario	Worst scenario
Baths	2%	3%	2%
Showers	31%	33%	29%
Taps, washbasin	7%	5%	9%
Taps, kitchen - drinking/cooking	3%	3%	4%
Taps, kitchen - dish washing	4%	4%	4%
Taps, indoor - clothes washing	1%	1%	1%
Taps, indoor - other uses	7%	5%	9%
Outdoor	5%	4%	5%
Toilet flushing	25%	26%	23%
Dishwasher	3%	3%	3%
Washing machine	12%	12%	11%
Total	100%	100%	100%

In particular, it is interesting to observe the following:

- EU-28 domestic water consumption in 2012 is estimated to be 27 296 million m^3, and this could vary from -24% to +31%.
- Dividing the total domestic water consumption of the baseline scenario by the population in the EU-28 in 2012 results in a domestic water consumption per capita of 147.4 L/d, which is almost identical to the figure provided by EUREAU (149 L/d).
- The main source of water consumption at home is represented by bathing and showering, estimated to total 33% altogether in the baseline scenario (93% showers and 7% baths, roughly). The relative share of baths and showers does not change significantly in the other scenarios, although it could be that water use for bathing is higher for some countries. According to the Energy Saving Trust, the ratio between water use in bathing and showering is 1:3. This could be considered an upper limit, as nowadays there is an apparent trend towards showering. A higher share was set for bathing in a preliminary study for the development of EU Ecolabel and GPP criteria for sanitary tapware[143] (40% of the 35% allocated to personal hygiene) although it could be that this overestimates the weight of bathing across the EU.
- Most of the water is used in bathrooms: 65% in the baseline scenario (63-67% in the other scenarios). This is followed by indoor use of water from taps (16% in the baseline scenario, 13-18% in the other scenarios), washing machines (15% in the baseline scenario, 14-15% in the other scenarios), outdoor use (4% in the baseline scenario, 4-5% in the other scenarios).
- The results are qualitatively similar to the estimation provided by UNEP in 2004[144] (33% toilet flushing, 20-32% bathing and showering, 15% washing machines and dishwashers, 3% cooking and drinking) and in a preliminary study for the development of EU Ecolabel and GPP criteria for sanitary tapware[145] (35% bathing, showering and personal hygiene, 25% toilet flushing, 14% clothes washing (95% by

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[143] IPTS Scoping Document, February 2010 http://susproc.jrc.ec.europa.eu/ecotapware/docs/Scoping%20document_WuP_100217.pdf

[144] http://www.grid.unep.ch/products/3_Reports/freshwater_atlas.pdf

[145] IPTS Scoping Document, February 2010 http://susproc.jrc.ec.europa.eu/ecotapware/docs/Scoping%20document_WuP_100217.pdf

machine and 5% by hand), 8% dish washing (75% by hand and 25% by machine), 5% drinking and cooking, 5% room cleaning, garden irrigation, car washing, 8% other).

Although estimations are based on a water consumption data sample and domestic water consumption could vary widely among and within Member States, water consumption from taps and showers is considered to account for a significant proportion of domestic water use (about 60% in all the scenarios of this study).

3.2.2.2 Quantification of total water demand from taps and showers in the domestic sector

The figures reported in Tables 3.7 and 3.8 refer to the total water use at home, which includes water consumption from the use of different water-using products. The quota of water consumption due to taps and showers is of interest for this study.

With the exception of toilet flushing and dish and clothes washing by machine, all other water uses are considered to involve the presence of taps and showers in the bathroom(s), the kitchen and other parts of a house. The share allocated to baths has been counted as an application requiring the presence of taps.

Based on this assumption, the total EU-28 water use at home from taps and showers is 16 444 million m^3/year for 2012. In terms of consumption per capita this is equivalent to 88.8 L/p/d (similar to the 75 L/p/d calculated in the preliminary study for the development of EU Ecolabel and GPP criteria for sanitary tapware[146]). The range of uncertainty regarding these values is between -27% and +37%. This would represent 60% of the total water consumption at home (58-63% considering the three scenarios). Water demand in showers is considered to represent 51% of the total (47-56% considering the three scenarios). In other terms, the split between taps and showers would be:

- 8060 million m^3/year (5227-11971 million m^3/year) for taps;
- 8384 million m^3/year (6783-10483 million m^3/year) for showers.

It must be note that these figures do not take water loss in the distribution system into account.

3.2.2.3 Quantification of energy demand from taps and showers in the domestic sector

The total water demand at home from taps and showers has been split between hot and cold water use at the outlet. The energy demand associated to the use of hot water has been also estimated.

Some assumptions have been made based on the input from stakeholders and common-sense considerations:

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[146] IPTS Scoping Document, February 2010 http://susproc.jrc.ec.europa.eu/ecotapware/docs/Scoping%20document_WuP_100217.pdf

- 80-100% of the water used for bathing and showering is hot and flows at a temperature of between 36°C and 40°C.
- 30-50% of the water from washbasin taps is hot and flows at a temperature of between 32°C and 38°C.
- 40-60% of the water used for washing dishes and clothes is hot and flows at a temperature of between 32°C and 38°C.
- 0% of the water used for drinking, cooking and other indoor and outdoor uses is hot.
- The average temperature of inlet water across Europe is 15°C. According to stakeholders, inlet water temperature can vary from 5°C to 20°C. The average inlet water temperature is 8.6°C in Sweden, 12°C in Portugal, 13.4-15°C in the UK. The choice of 15°C is thus a sensible assumption which should prevent the energy demand associated to hot water being overestimated.
- The temperature of water leaving the boiler is 60°C. For 100 litres of hot water at the outlet with a temperature of 40°C, 55.56 litre of hot water at 60°C are required from the boiler. For 100 litres of hot water at the outlet with a temperature of 32°C, 37.78 litres of hot water at 60°C are required from the boiler.

Average values have been considered for the estimated hot water demand in the baseline scenario, while an interval of variation has been considered in the two more extreme scenarios. The results are shown in Table 3.9 and in Table 3.10.

The EU-28 domestic demand for hot water at the outlet of taps and showers has been estimated as being 9546 million m^3 in 2012. In terms of consumption per capita this is equivalent to 51.7 L/p/d. The range of uncertainty regarding these values is between -31% and +45%. The hot water demand at the outlet of taps and showers is considered to represent 55-62% of the total water use in these products.

The associated demand of water from the boiler, to heat up the water used in taps and showers, is estimated at 4792 million m^3. In terms of consumption per capita this is equivalent to 25.9 L/p/d. The range of uncertainty regarding these values is between -37% and +59%. The hot water demand from the boiler is considered to represent 25-34% of the total water use in taps and showers.

The breakdown of the hot water demand from taps and showers is the following: 79% for showering, 8% for washbasin taps, 5% for dish washing with kitchen taps, 6% for bathing, 2% for clothes washing with other taps.

It is worth observing that the results from this estimation are consistent with the information provided by other sources on hot water use from the boiler:

- according to the VHK Lot-2 Ecodesign Study on water heaters[147], the EU-25 average demand for hot water from boilers is 24 L/p/d;
- according to the Swedish Energy Agency and to a study from Finland, hot water from the boiler represents about one third of water use at home, which matches with the 25-34% estimated in this study;

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[147] http://www.ecohotwater.org

- according to some stakeholders, the per capita demand for hot water from the boiler is 27-72 L/p/d.

The 25.9 L/p/d calculated in this study would thus provide a conservative estimate of the hot water demand associated with taps and showers.

Table 3.9 **Estimation of the EU-28 domestic demand for hot water from taps and showers – Baseline scenario**

Use pattern	**Baseline scenario**			
	Hot water at the outlet (32-40°C)		**Hot water from the boiler (60°C)**	
Baths (M m^3/yr/%)	579.7	6%	296.3	6%
Showers (M m^3/yr/%)	7545.7	79%	3856.6	80%
Taps, washbasin (M m^3/yr/%)	738.4	8%	328.2	7%
Taps, kitchen - drinking/cooking (M m^3/yr/%)	0	0%	0	0%
Taps, kitchen - dish washing (M m^3/yr/%)	518.7	5%	230.6	5%
Taps, indoor - clothes washing (M m^3/yr/%)	182.2	2%	81.0	2%
Taps, indoor - other uses (M m^3/yr/%)	0	0%	0	0%
Outdoor (M m^3/yr/%)	0	0%	0	0%
Total hot water demand in taps and showers (M m^3/yr)	9564.7	100%	4792.6	100%
Total demand of water in taps and showers (M m^3/yr)	16444.2		16444.2	
Hot water / Total (%)	58		29	
Per capita demand of hot water (L/p/d)	51.6		25.9	

Table 3.10 **Estimation of the EU-28 domestic demand for hot water from taps and showers – Relative variation of Worst and Best Scenarios (WS and BS) compared to the Baseline Scenario**

Use pattern	**Hot water at the outlet (32-40°C)**		**Hot water from the boiler (60°C)**	
	BS	**WS**	**BS**	**WS**
Baths (M m^3/yr)	425.3	765.9	198.5	425.5
Showers (M m^3/yr)	5427.0	10483.1	2532.8	5824.4
Taps, washbasin (M m^3/yr)	325.3	1539.8	122.9	787.0
Taps, kitchen - drinking/cooking (M m^3/yr)	0.0	0.0	0.0	0.0
Taps, kitchen - dish washing (M m^3/yr)	304.2	847.8	114.9	433.3
Taps, indoor - clothes washing (M m^3/yr)	116.7	275.5	44.1	140.8
Taps, indoor - other uses (M m^3/yr)	0.0	0.0	0.0	0.0
Outdoor (M m^3/yr)	0.0	0.0	0.0	0.0
Total hot water demand in taps and showers (M m^3/yr)	6598.5	13912.2	3013.2	7611.1
Total demand of water in taps and showers (M m^3/yr)	12011.0	22454.1	12011.0	22454.1
Hot water/Total (%)	55	62	25	34
Per capita demand of hot water (L/p/d)	35.6	75.1	16.3	41.1

Considering that the average temperature of inlet water is 15°C and the temperature at the boiler is 60°C, the energy demanded for heating 4792.6 million m^3 of water in the EU-28 is:

$4.187\ \text{kJ}\cdot\text{kg}^{-1}\cdot\text{K}^{-1} \cdot 4.792\cdot10^{12}\ \text{kg} \cdot 45\ \text{K} = 9.030\cdot10^{14}\ \text{kJ} = 9.030\cdot10^{14}\ \text{kJ} = 9.030\cdot10^{5}\ \text{TJ}$ (variation range: $5.677\cdot10^{5}$–$1.434\cdot10^{6}$ TJ).

This value does not take into account heating system efficiency and heat exchange losses, which will be analysed in Section 3.3.

Considering that about 80% of hot water is used in showers, the split between taps and showers is:

- $1.764\cdot10^{5}$ TJ for taps;
- $7.266\cdot10^{5}$ TJ for showers.

It must be remarked that these figures do not take into account the energy conversion efficiency of the heating system or other losses of energy due for instance to heat exchange, distribution and temperature control. These will be taken into account in a second step.

3.2.3 Non-domestic water consumption and energy demand

3.2.3.1 Quantification of water use in the non-domestic sector

According to the estimation calculated using data from EUREAU, water delivery in 2012 in the EU-28 has been:

- 27 544 million m³/year for the domestic sector (about three quarters of the total);
- 9881 million m³/year for the non-domestic sector (about one quarter of the total).

Information on the split of water consumption in the non-domestic sector between different uses is limited and uncertain.

An analysis on the water consumption split between different non-domestic activities and uses in the UK has been carried out for Defra's Market Transformation Programme (MTP)[148] and the findings are reported in Table 3.11.

Table 3.11 Water use in the non-domestic sector in the UK

Activity	Water consumption (M m³/yr)	Toilets and urinals	Washbasin taps	Showers / baths	Kitchen taps	Washing machines	Others
Food and drink	261.3	12%	1%	0%	0%	0%	87%
Retail	177.3	14%	2%	0%	1%	0%	83%
Hotels	127.3	8%	7%	9%	2%	0%	74%
Education	115.7	28%	3%	1%	4%	0%	64%
Health and social	29.7	45%	8%	0%	4%	0%	44%
Recreation, culture, sport	6.7	74%	4%	0%	0%	0%	22%
Public administration and defence	11.0	63%	2%	0%	5%	0%	30%
Others	1380.8	4%	1%	0%	0%	0%	94%
Total	2109.831	8.5%	2.0%	0.5%	0.8%	0.0%	88%

According to Defra's MTP, the UK's total water consumption in the non-domestic sector is about 2100 million m³/year. This is 23% higher than the value estimated in this study from EUREAU's data. This deviation could be due to the possible inclusion of water distribution

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[148] http://efficient-products.ghkint.eu/spm/download/document/id/959.pdf

losses in the UK's study. However, what is interesting to note is that the share of domestic-type use of water in the non-domestic sector is only 12% of the total (71.8% toilet flushing, 17% washbasin taps, 4.7% showering and bathing, 6.5% kitchen taps, 0.1% washing machine). This has been quantified through a bottom-up calculation. The complement to 100% should mainly include heating and cooling and outdoor uses. However, the total figure for the UK could make sense and thus it could be that the domestic-type use is underestimated.

This assumption could be confirmed by looking at the figures provided by two other sources, EWF Property Maintenance[149] and Architechstok[150], as reported in Table 3.12. Without taking outdoor and other uses into account and considering bathing in the non-domestic sector negligible, MTP's shares for toilet and urinal flushing, showering and use of taps in washbasins, kitchens and other indoor uses would be comparable with those provided by the two sources mentioned above. As an additional input, information is also provided by the US EPA[151]. Integrating EPA's shares into the MTP calculation model, it results that the weight of domestic-type uses is 45% (71.1% toilet flushing, 21.5% washbasin taps, 1.4% showering and bathing, 5.9% kitchen taps, 0.0% washing machine), while outdoor and other uses take the figure up to 100% (see Table 3.12).

3.2.3.2 Quantification of total water demand from taps and showers in the non-domestic sector

All in all, the information gathered has allowed the building of a distribution of uncertainty regarding the water use share in the non-domestic sector. As indicated in Table 3.12, the baseline, worst and best scenarios have been modelled for the non-domestic use of showers and taps. Total non-domestic use of water allocated to taps and showers is 21.1% (2.8-37%) and 3.7% (variation range: 0.5-6.7%), respectively. Multiplying these values by the total EU-28 non-domestic water consumption calculated from EUREAU's data, it is possible to estimate the total delivery of water in taps and showers in the non-domestic sector (see Table 3.13):

- 2086.8 million m^3/year for taps (variation range: 273.1-3651.8 million m^3/year);
- 362.9 million m^3/year for showers (variation range: 54.20-660.9 million m^3/year).

Considering 507 million people living in the EU-28, 80 L/use for showering (10 L/minute for 8 minutes) and 10 L/use for taps (10 L/minute for 1 minute) , the figures provided would be equivalent to:

- the use of taps in the non-domestic sector for 1.1 times per person per day (variation range: 0.1-2.0);
- the use of showers in the non-domestic sector for 8.9 times per person per year (variation range: 1.3-16.3).

Considering water used in washbasin taps as 70% of the water used in all the taps installed in non-domestic premises, the use of washbasin taps would be 0.8 times per person per day (variation range: 0.1-1.3) which would become 2.6 times per person per day (variation range:

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[149] http://ewf-pm.com/rainwater-harvesting/commercial/

[150] http://architechstok.wordpress.com/tag/buildings/

[151] http://www.epa.gov/watersense/commercial/types.html

0.4-4.3) considering 3 L/use, achievable for instance through a more efficient technology (6 L/minute) and a more efficient use of water (0.5 minutes).

It must be remarked that these figures do not take into account water loss in the distribution system.

Table 3.12 **Water use from taps and showers in the non-domestic sector according to different sources and for the three scenarios**

Use pattern	EWF[152]	Architech-Stok[153]	Defra's MTP[154]		MTP with US EPA shares[155]	Base line	BS	WS
			Without outdoor and others	With outdoor and others				
Showers	5.8%	6.7%	4.7%	0.5%	0.6%	3.7%	0.5%	6.7%
Taps, washbasin	21.2%	24.2%	17.0%	2.0%	9.6%	14.8%	2.0%	24.2%
Taps, kitchen	9.0%	11.8%	6.5%	0.8%	2.6%	6.1%	0.8%	11.8%
Taps, other uses indoor	1.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	1.0%
Toilet flushing	63.0%	54.4%	71.8%	8.5%	31.9%	Not relevant for this study		
Outdoor and others	0.0%	2.9%	0.1%	88.2%	55.2%			

Table 3.13 **Estimation of the EU-28 total water use from taps and showers in the non-domestic sector**

Use pattern	Baseline	Best scenario	Worst scenario
Showers (M m^3/yr)	362.91	54.20	660.91
Taps (M m^3/yr)	2086.77	273.06	3651.80

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[152] http://ewf-pm.com/rainwater-harvesting/commercial/

[153] http://architechstok.wordpress.com/tag/buildings/

[154] http://efficient-products.ghkint.eu/spm/download/document/id/959.pdf

[155] http://www.epa.gov/watersense/commercial/types.html

3.2.3.3 Quantification of energy demand from taps and showers in the non-domestic sector

The total water demand from taps and showers in the non-domestic sector has been split between hot and cold water use at the outlet. The energy demand associated to the use of hot water has also been estimated.

Some assumptions have been made based on the input from stakeholders and common-sense considerations:

- 80-100% of the water used for showering is hot and flows at a temperature of between 36°C and 40°C.
- 30-50% of the water from taps is hot and flows at a temperature of between 32°C and 38°C.
- The average temperature of inlet water across Europe is 15°C.

Average values have been considered for estimated hot water demand in the baseline scenario, while an interval of variation has been considered in the two more extreme scenarios. The results are shown in Table 3.14.

Table 3.14 Estimation of EU-28 non-domestic demand for hot water from taps and showers

Use pattern	Scenario (Hot water at the outlet)					
	Baseline		Best Scenario		Worst Scenario	
Shower (M m³/yr/%)	327	28%	43.4	35%	661	27%
Taps (M m³/yr/%)	834	72%	81.9	65%	1826	73%
Total hot water demand at the outlet of taps and showers (M m³/yr)	1161		125.3		2487	
Total demand of water in taps and showers (M m³/yr)	2450		327.3		4313	
Hot water/Total (%)	47		38		58	

The EU-28 non-domestic demand for hot water at the outlet of taps and showers has been estimated as being 1161 million m^3 for 2012. The range of uncertainty regarding these values is between -89% and +53%. For the non-domestic sector, the hot water demand at the outlet of taps and showers would represent 47% of the total water use from these products (variation range 38-58%). Most of hot water is considered to be consumed via taps (72% for the baseline scenario and 65-73% in the two more extreme scenarios).

Considering that the average temperature of inlet water is 15°C, the energy demanded for heating this amount of water would be:

- $6.990 \cdot 10^4$ TJ for taps (69% of the total), with a variation range of -92% to 152%;
- $3.145 \cdot 10^4$ TJ for showers (31% of the total), with a variation range of -88% to +120%.

It must be remarked that these figures do not take into account the energy conversion efficiency of the heating system and other losses of energy due for instance to heat exchange, distribution and temperature control. These will be taken into account in a second step.

3.3 Water heating systems

This section reports information on water heating, i.e. the affected energy system, including:

- definition and types of water heaters, standards and legislation of relevance;
- stock and trends in the EU and techno-economic data.

Detailed information on this field has been produced for VHK's study on "Eco-design of Water Heaters"[156], later referred to as "VHK Lot-2 Ecodesign study". A summary of the key data and findings of this study is provided below.

3.3.1 Definitions and classification, product standards, main legislation

3.3.1.1 Definitions and classification

According to the VHK Lot-2 Ecodesign study, a water heater is defined as an appliance designed to provide hot sanitary water. It may (but does not need to) be designed to provide space heating or other functions as well.

Moreover, a central heating system in this study is considered to provide heat to the whole interior of a building or a portion of a building from one point to multiple rooms.

The performance level of water heaters is assessed based on daily tapping cycles, as defined in EN 13203-2 and prEN 50440. The main performance parameters are:

- specific flow rate (in L/minute), typically for instantaneous types; and
- storage volume (in L) for storage-type water heaters.

Water heaters can be classified based on different criteria:

- fuel type
- heat source
- functionality
- storage configuration and capacity
- condensation
- power class (in kW, residential/commercial)
- boiler water temperature control.

Fuel type:

- Gas (‘gas-fired’) water heaters.
- Electric water heaters (electric resistance water heater, ‘Joule effect’ water heaters).
- Solar-assisted water heaters.
- Heat pump water heaters (Carnot cycle, with an electric compressor used as the driving force, adsorption and absorption with/without pump).

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[156] http://www.ecohotwater.org/

Heat source:

- Ground Source Heat Pump (GSHP or "vertical ground source heat pump"), where the primary heat exchange takes place 30–100 m into the ground.
- Groundwater Heat Pumps (GWHP), which use two groundwater boreholes, one to mine groundwater and one to drain away the cooled groundwater.
- Sole Heat Pump (or "horizontal ground source heat pump"), where the heat exchanger coil is placed a few metres below the surface.
- Outside Air Heat Pump, where a fan passes the ambient air over the heat exchanger.
- Ventilation Air Heat Pump, where a heat pump uses the ventilation air from the house.
- Solar Collector Heat Pump. Heat pump using the water from a collector placed on the roof. Similar in appearance to a solar collector, but the heat is used at much lower temperature levels.
- Other heat sources, such as waste water or waste heat.
- Oil ("oil-fired"). Dedicated oil-fired water heaters are rare, usually it is an oil-fired combi-boiler or a regular oil-fired boiler with an indirect cylinder.
- Coal ("coal-fired"). Almost non-existent and, if they exist, combined with another functionality such as a range cooker or space heating.
- Biomass. Biomass-water heaters can be classified by biomass type (logs, wood pellets, hay, peat, etc.).

Functionality:

- Indirect cylinder or "indirectly heated unvented (closed) storage water heater" (prEN 12897:2004): Vessel complete with heat exchanger (primary heater) for heating and storage of drinking water where the contents are not vented to the atmosphere. Can be defined as a water heater when connected to an external heat source, usually a regular CH (central heating) boiler.
- Regular (or "dedicated") water heater: A water heater which only provides domestic hot water directly (i.e. not a combination boiler or similar), subdivided into
  - instantaneous water heater: a water heater without an internal hot water store, or with an internal hot water store with a capacity of less than 15 litres (for gas- or oil-fired heaters);
  - storage water heater: a water heater with an internal hot water store with a capacity of at least 15 litres.
- Combination ("combi") boiler: A space heating boiler with the capability to provide domestic hot water directly, in some cases containing an internal hot water store. The SEDBUK and EN standards add the following qualifications:
  - Instantaneous combination boiler: a combination boiler without an internal hot water store, or with an internal hot water store with a capacity of less than 15 litres.

  - Storage combination boiler: a combination water heater with an internal hot water store with a capacity at least 15 litres but less than 70 litres, OR a combination water heater with an internal hot water store with a capacity of at least 70 litres, in which the feed to the space heating circuit is not taken directly from the store. Storage combination boilers can be subdivided into:
    - primary, where a primary water store contains mainly water which is common with the space heating circuit, and
    - secondary, in which a secondary water store contains mainly water which is directly usable as domestic hot water.
- Combined Heat and Power combi (CHP combi): A heater which is capable of delivering hot water for space heating and/or hot sanitary water, as well as electricity to the grid or the building installation. CHP water heaters are outside the scope of the Lot-2 ecodesign study.

Storage configuration and capacity:

- Primary store of CH water and the following:
  - No primary store (water content of heat exchanger smaller than ca. 5 litres).
  - No primary water storage tank, but merely a boiler with a high water content and/or mass.
  - Integrated thermal store, designed to store primary hot water, which can be used directly for space heating and indirectly for domestic hot water. The heated primary water is circulated to the space heating (e.g. radiators).
  - Hot-water-only thermal store, designed to provide domestic hot water only and is heated by a boiler. The domestic hot water is heated by transferring the heat from the primary stored water to the domestic hot water flowing through the heat exchanger, the space heating demand being met directly by the boiler.
  - Combined primary storage unit (CPSU): A single appliance designed to provide both space heating and the production of domestic hot water, in which there is a burner that heats a thermal store which contains mainly primary water which is common with the space heating circuit. The store must have a capacity of at least 70 litres and the feed to the space heating circuit must be taken directly from the store.
- Secondary store of sanitary hot water (options for combi-boilers and, for the most part, dedicated water heaters):
  - No secondary store ("instantaneous"). In the instantaneous water heater the sanitary hot water is led through a coil that is heated directly by the burner or electrical element.
  - Keep-hot facility or kitchen water heater. For fossil fuel-fired water heaters and combi-boilers this is a facility in an instantaneous water heater (<15 litres) whereby water within the water heater may be kept hot while there is no demand. The water is kept hot either (i) solely by burning fuel, or (ii) by electricity, or (iii) both by burning fuel and by electricity, though not necessarily simultaneously. For electric water heaters, a storage tank with a

volume < 15 litres only exists with small electrical storage heaters for use in the kitchen and with a power of <2 kW.

- Instantaneous storage water heater or combi. The storage tank of this appliance may be any size. The sensor is placed near the cold water inlet and with (almost) every draw-off results in burner action to keep up with the hot water demand.
- Non-instantaneous storage water heater or combi. The storage tank of this appliance may be any size but is usually above 45 L. This storage water heater or combi is not triggered immediately by the hot water demand, but relies on the stored volume to provide the hot water, whereby the water is heated when it is most convenient/efficient for the heat source.

Condensation (only for gas- or oil-fired water heaters or combis):

- "standard boiler": a boiler for which the average water temperature can be restricted by design;
- "low-temperature boiler": a boiler which can work continuously with a water supply temperature of 35°C to 40°C, possibly producing condensation in certain circumstances, including condensing boilers using liquid fuel;
- "gas condensing boiler": a boiler designed to permanently condense a large part of the water vapour contained in the combustion gases.

This classification depends on the total heat exchanger surface, the resistance to corrosion and the resistance to certain temperatures.

Power class (for residential/commercial gas- or oil-fired boiler-based hot water heating systems):

- The EN standards distinguish between <70 kW; 70-300 kW; 300-1000 kW; and 1-10 MW.
- The Boiler Efficiency Directive distinguishes between a class of 4-400 kW and one above 400 kW.
- Market statistics distinguish between "residential" and "commercial", whereby the exact split varies per country (for instance, in Italy it is at 35 kW and in France at 70 kW).

For central instantaneous water heaters (with or without a storage tank), power levels define the amount of hot water that can be supplied. For instance, assuming, as in the standard, a specific flow rate of 10 L/minute (600 L/h), a cold water temperature of 10°C and a required minimum delivery temperature of 45°C (= 40°C at the tap, after losses in the distribution system), the power required would be 24 kW (35°C x 600 l/h x 1.16 Wh / l °C = 24).

For local instantaneous water heaters, there are hardly any distribution losses and a specific flow rate of 6-9 litres/minute may be acceptable. Hence, a power range of 12 kW to 20 kW may be acceptable.

Boiler water temperature control (only for combi-boilers and regular boilers working with an indirect cylinder and referring to the temperature control of the CH water running through the heating coil in the storage tank):

- Fixed (manual setting at installation): When in water heating mode the boiler is always set at full load, e.g. at a CH water regime of 70/90°C.
- Modulating (also known as systems with "room compensators"): Traditionally the combis and boilers plus indirect cylinders always worked with a fixed, full load. More recently, manufacturers are installing modulating burners in all storage water heaters, which results in a modulating CH water temperature. This is a recognition of the fact that a boiler that is working at lower return water temperatures can reduce its flue-gas losses and is thereby more efficient.

The official Eurostat PRODCOM classification of combi-boilers and regular water heaters is shown in Table 3.15.

Table 3.15 PRODCOM categories for combi-boilers (central heating) and regular water heaters

PRODCOM No.	Description
28.22.12.03	Boilers for central heating using gas
28.22.12.05	Boilers for central heating using fuel (oil)
28.22.12.07	Boilers for central heating using other types of energy
28.22.12.00	Boilers for central heating other than those of HS 8402
29.71.25.30	Electric instantaneous water heaters
29.71.25.50	Electric water heaters (incl. storage water heaters) (excl. instantaneous)
29.71.25.70	Electric immersion heaters (incl. portable immersion heaters for liquids, usually with a handle or a hook)
29.72.12.33	Iron or steel gas domestic appliances with an exhaust outlet (incl. heaters, grates, fires and braziers, for both gas and other fuels; excl. cooking appliances and plate warmers)
29.72.12.35	Iron/steel gas domestic appliances (incl. heaters, grates, fires and braziers, for both gas and other fuels radiators; excl. cooking appliances and plate warmers, those with an exhaust outlet)
29.72.12.53	Iron or steel liquid fuel domestic appliances with an exhaust outlet (incl. heaters, grates, fires and braziers; excl. cooking appliances and plate warmers)
29.72.12.55	Iron or steel liquid fuel domestic appliances (incl. heaters, grates, fires and braziers, radiators; excl. cooking appliances and plate warmers, those with an exhaust outlet)
29.72.11.13	Iron/steel gas domestic cooking appliances and plate warmers, with an oven (incl. those with subsidiary boilers for central heating, separate ovens for both gas and other fuels)
29.72.11.15	Iron or steel gas domestic cooking appliances and plate warmers (incl. those with subsidiary boilers for central heating, for both gas and other fuels; excl. those with ovens)
29.72.11.30	Iron or steel liquid fuel domestic cooking appliances and plate warmers (incl. those with subsidiary boilers for central heating)
29.72.11.70	Domestic cooking or heating apparatus (non-electric) of copper
29.72.14.00	Non-electric instantaneous or storage water heaters

3.3.1.2 Product standards

Relevant EN harmonised product test standards identified for water heaters are shown in Table 3.16.

Table 3.16 Main standards identified for water heating systems

Water heating system	Full title
Gas-fired water heaters, performance assessment	EN 13203-1:2006. Gas-fired domestic appliances producing hot water - Appliances not exceeding 70 kW heat input and 300 litres water storage capacity – Part 1: Assessment of performance of hot water deliveries.
Gas-fired water heaters, energy use assessment	EN 13203-2:2006. Gas-fired domestic appliances producing hot water - Appliances not exceeding 70 kW heat input and 300 litres water storage capacity – Part 2: Assessment of energy consumption. Prepared by CEN/TC 109
Efficiency of electric storage water heater	PrEN 50440:2005 en. Efficiency of domestic electrical storage water heaters. Prepared by CLC/TC 59X
Electric storage water heaters, performance, methods	EN-IEC 60379:2004: Methods for measuring the performance of electric storage water heaters for household purposes. CLC/TC 59X
Indirect cylinders	EN 12897: 2006. Water supply — Specification for indirectly heated unvented (closed) storage water heaters. CEN/TC 164
Indirect cylinders – energetic assessment	prEN 15332:2006. Heating boilers — Energetic assessment of hot water storage tanks. CEN/TC 57
Sanitary hot water heat pumps	EN 255-3:1997 en. Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 3: Testing and requirements for marking for sanitary hot water heat pumps. CEN/TC 113
Gas-fired storage water heaters	EN 89:1999 en. Gas-fired storage water heaters for the production of domestic hot water. CEN/TC 48
Gas-fired instantaneous water heaters	EN 26:1998. Gas-fired instantaneous water heaters for the production of domestic hot water, fitted with atmospheric burners. CEN/TC 48
Electrical instantaneous water heaters, performance	EN 50193:1997. Closed electrical instantaneous water heaters – Methods for measuring performance.
Thermal solar systems, general requirements	EN 12976-1:2001: Thermal solar systems and components – Factory made systems – Part 1: General Requirements.
Thermal solar systems, test methods	EN 12976-2:2001: Thermal solar systems and components – Factory made. systems – Part 2: Test methods
Solar heating – Domestic water heating systems	ISO 9459-3: 1997 Solar heating – Domestic water heating systems- Part 3.
Health Standards	The Drinking Water Directive 98/83/EC states that "water should be safe". The European standard 806-2 is stating "The hot water temperature in the pipe work shall not drop below 50ºC."
EU Building Standards	As prEN 15316-3, parts 1 to 3

3.3.1.3 Legislation

The main legislation and agreements at European Community level on water heating systems are as shown in Table 3.17.

Table 3.17 Legislation and agreements at European Community level on water heating systems

Legislation	Reference
CPR - Construction Products Regulation	305/2011/EU
Drinking Water Directive	98/83/EC
EMC-D - Electromagnetic Compatibility	92/31/EC + 93/68/EC + 2004/108/EC
Energy Labelling Directive	2010/30/EU
EPD - Energy Performance of Buildings Directive	2002/91/EC
Fluorinated gases	EC 2037/2000 + EC 842/2006
GAD - Gas Appliance Directive	2009/142/EC
LVD - Low Voltage Directive	73/23/EEC + 93/68/EC
MD - Machinery Directive	2006/42/EC
Packaging Directive	2004/12/EC
PED - Pressure Equipment Directive	97/23/EEC
RoHS Directive	2011/65/EU
WEEE Directive	2012/19/EU

References to national guidelines for control and prevention of legionnaires disease are also reported in Table 3.18.

Table 3.18 References to national guidelines for control and prevention of legionnaires' disease

Country	Name of document	Year	Publication
Belgium	Relatif aux dangers de et aux mesures préventives contre une contamination par Legionella en Belgique (C.S.H.: 4870)	Sept. 2000	Conseil Supérieur d'Hygiène, Brussels
	Recommendations Pour La Prevention Des Infections A Legionella Dans Les Etablissements De Soins No CSH: 7509	January 2002	As above
Czech Republic	Metodicky navod k zajisteni programu surveillance legioneloz	2000	Ministerstvo Zdravoknictvi Praha
Denmark	Guidelines: Legionella En Vejledning: Legionella i varmt brugsvand. Overvågning, udbredelse og forebyggelse af legionærsygdom. ISBN 87-89148-25-8	1998 2000	Statens Serum Institut, Copenhagen
France	Guide des bonnes pratiques: Legionella et tours aéroréfrigeérantes	June 2001	Directorate-General of Health, Paris
	Gestion du risque lié aux legionelles: Rapport du Conseil Supérieur d'Hygiène Publique de France	July 2001	As above
Germany	Drinking water heating systems and conduits; Technical measures to decrease legionella growth	1993	W 551 DVGW, Bonn
	Drinking water heating systems and conduits; Technical measures to decrease Legionella growth; rehabilitation and operation	1996	W 552 DVGW Bonn
	Protection of Infection Act (IfSG); Act on Prevention and Control of Infectious Diseases in	July 2000	Federal Ministry of Health

Country	Name of document	Year	Publication
	Man		
Ireland	The Management of Legionnaires' Disease in Ireland	2002	National Disease Surveillance Centre, Dublin
Italy	Linee -guida per la prevenzione ed il controllo della legionellosi	May 2000	Gazzetta Ufficiale, serie generale, n.103
Latvia	Epidemiological surveillance of legionellosis	Oct 1998	Ministry of Welfare
Malta	Code of Practice for the Prevention of Legionnaires' Disease in Hotels and Other Establishments	March 1999	Health Division, Malta
Netherlands	Modelbeheersplan Legionellapreventie in Leidingwater Distribution No 16827 Risico analyse, ISSO 55.1	Feb 2002	VROM (The Netherlands Ministry of Housing) ISSO
Norway	Tiltak mot Legionella-bakterier i VVS-installasjoner ("Actions against Legionella-bacteria in water systems") (1993) ISBN 82-7364-069-8.	1993	Statens institutt for folkehelse
	Smittevern 5. Smittevernhåndbok for kommune-helsetjenesten 2002-2003 ("Communicable Disease Control Handbook") (2001) ISBN 82-7364-177-5.	2001	As above
Portugal	Doença dos Legionários. Procedimentos de controlo nos empreendimentos turísticos	July 2001	Direcção Geral de Saúde e Direcção Geral de Turismo
Spain	Recomendaçiones para la prevención y control de la legionelosis	1999	Dirección General de Salud Pública. Ministerio de Sanidad y Consumo
	Guía para la prevención y control de la proliferación y diseminación de legionella en instalaciones	2001	AENOR
	Real Decreto 865/2003, de 4 de julio, por el que se establecen los criterios higiénico-sanitarios para la prevención y control de la legionelosis. Boletin Oficial del Estado nº 171	2003	Ministero de Sanidad y Consumo
Switzerland	Légionelles et légionellose. Particularités bioloqiques, épidémiologie, aspects cliniques, enquêtes environnementales, prévention et mesures de lutte	1999	Office Fédéral de la Santé Publique, Berne
UK	Legionnaires' disease. The control of Legionella bacteria in water systems (L8)	2000 (being updated)	Health and Safety Commission
WHO	Guidelines For Safe Recreational-Water Environments. Vol. 2: Swimming pools, spas and similar recreational-water environments	August 2000	WHO Headquarters Geneva

3.3.2 Analysis of market and stock of heating systems

3.3.2.1 Sales and trade

Key information on the EU-25 market for water heating systems in 2004 is reported in Task 2 of the VHK Lot-2 Ecodesign study. Data on production, imports and exports are shown in Table 3.19, split into:

- electric instantaneous water heaters;
- electric water heaters with storage;
- non-electric instantaneous or storage water heaters,
- boilers (combis and boilers with separate cylinders).

Data were obtained from the PRODCOM and COMEXT databases.

Table 3.19 Overview of the main economic data for water heating systems

PRODCOM category	**29.71.25.30** **Electric, instantaneous**		**29.71.25.50** **Electric, with storage**		**29.72.14.00** **Non-electric, instantaneous with storage**		**28.22.12.00** **Boilers (combis and boilers with separate cylinders)**	
EU-25, 2004	**M units**	**M EUR**	**M units**	**M EUR**	**M units**	**M EUR**	**M units**	**M EUR**
Production	3.8	423	9.8	746	4.8	1368	7.31	4797
Imports	1.9	31	17.3	162	n.a.	99	(1)	838
Exports	0.7	40	6.9	235	n.a.	239	(1)	304
App. consumption	5.0	415	20.1	673	4.8	1230	6.6 (2)	4263
(1): Data not available via Eurostat public domain server.								
(2): VHK estimate, based on EU-25 consumption divided by average boiler value (EU-25 Production value divided by volume = EUR 643/boiler).								

3.3.2.2 Market and stock data, trends and forecasts

Based on the information contained in Task 2 of the VHK Lot-2 Ecodesign study, Table 3.20 and Table 3.21 provide an overview of the installed stock of water heaters in the EU-22 in 2004 and the trends and forecasts of sales. It should be noted that the tables used the following classification:

- primary water heating describes appliances that provide the main supply of sanitary hot water to dwellings;
- secondary water heating describes water heaters that have a supplementary role (usually in supplying hot water to just one room or location in dwellings that already have a primary water heating appliance).

The key findings are the following:

- In 2004/05 there was an installed base ("stock") of 236 million water heaters, of which

  - 2.6 million were based on district heating (1.5% of all primary water heaters),
  - 87 million units were linked to a central heating boiler as a "combi" or with an indirect cylinder (48.9% of all primary water heaters), and
  - 88 million were dedicated water heaters (49.6% of all primary water heaters),
  - 58 million were secondary water heaters (meaning that every 100 primary water heaters there are 32.5 smaller additional water heaters).
- From 1990 to 2005 the annual unit sales of water heaters increased by 25%. This is equivalent on average to a long-term annual growth rate of 1.5%.
- In 2004-2005 the total number of water heaters sold in the EU was 17.2 million, including electric showers, of which
  - 6.8 million units were linked to boilers (39.5%), where
    - 4.5 million were "combi"-boilers (26%) and
    - 2.3 million indirect cylinders (13.5%);
  - 10.4 million were dedicated water heaters (60.5%), where
    - 8.3 million were electric (48.4%) and
    - 2.1 million were gas-fired (12.1%).
- Dedicated electric water heater sales (8.3 million) consisted of:
    - 2.4 million electric instantaneous units, including 1.4 million electric showers in the UK and Ireland (<12 kW);
    - 5.9 million electric storage units.
- The average product lifetime is 15 years for dedicated water heaters, 17 years for boilers and 20 years for indirect cylinders. These values can however vary broadly from case to case.
- Forecasts to 2020 see an increase in sales of water heaters of 2 million. Shares of combi-boilers and indirect cylinders are higher in 2020 compared to 2005 (27.9% and 17.9%, respectively). Electric and gas water heaters shares instead decrease to 45.7% and 8.4%, respectively.

3.3.2.3 Distribution of water heating system by energy consumption

3.3.2.3.1 Residential buildings

Table 3.22 provides the domestic energy consumption for water heating in the EU-25 in 2003, as calculated in Task 3 of the VHK Lot-2 Ecodesign study. It has been reported that district heating, which can generally rely on both renewable and non-renewable sources of energy, can play an important role in some countries (e.g. it supplies 63% of the energy for district heating in Denmark). Nevertheless, the VHK report represents the reference source of information for this preparatory study on taps and showers.

According to the VHK report, the average demand for energy for hot water was 1227 kWh per household per year. This was covered as follows:

- 90.8% by energy from primary water heaters;

- 9.2% by energy from secondary water heaters.

The average energy conversion and exchange efficiencies reported in the study for the year 2005 vary among different systems, for instance:

- 65% and 97% for electric storage and electric instantaneous heaters, respectively;
- 45% for gas storage and gas instantaneous;
- 50-55% for boilers (this would indicatively correspond to a boiler efficiency of 80-85% and a heat exchange and distribution loss of 35%).

More recent data[157] on the stock boilers indicate higher energy efficiencies of conversion (77% for oil, 83% for gas, 65% for coal, 55-67% for biomass). These are supposed to increase progressively until 2030 for oil (84%) and gas (89%), while the average efficiency is not foreseen to increase for coal (64%) and biomass (50-70%). According to recent test results of consumer associations, the conversion efficiency of heating systems could be higher:

- The efficiency for standard combi-boilers can reach about 85% when the boiler is functioning for heating and hot water. For condensation boilers the efficiency can rise up to 96.5%. When operating only for sanitary water (in summer), the efficiency drops to 80% for both types.
- The efficiency of instantaneous gas boilers over 24 hours of use can be up to 85%.
- Solar thermal can provide up to 75% of the annual energy with the remaining being ensured by the secondary system. Considering that only 25% of the energy required is really spent, the yield can reach 400%. The efficiency depends on the location, however, even in colder climates, half of the power can be guaranteed again for free, which would be equivalent to a yield of 200%.

However, these last values consider only the conversion of energy and do not include any loss of energy due to heat exchange, standing heat and distribution. This could be 10% under optimistic conditions. It is considered that values reported in the VHK study refer to real conditions of use, corresponding to total energy losses up to 30-40%.

Considering an average energy conversion and exchange efficiency of 60% for primary water heaters and of 69% for secondary water heaters, the resulting consumption of energy for hot water was 2048 kWh per household per year. This was covered as follows:

- 90.6% by energy from primary water heaters;
- 9.4% by energy from secondary water heaters.

Based on the figures reported in Table 3.22, EU-25 average energy shares of different types of heating systems have been calculated for this study and are reported in Table 3.23.

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[157] http://susproc.jrc.ec.europa.eu/heating/docs/Policy%20Analysis.pdf

Table 3.20 Total EU domestic water heater stock in 2004 (in k units)

	A	B	CZ	DK	EST	SF	F	D***	GR	H	IRL	I	LV	LIT	NL	PL	P	SK	RS	E	S	UK	Total EU-22	% EU-22
PRIMARY																								
District Heating	74	0	189	212	55	152	120	441	0	86	0	0	59	95	32	650	0	100	13	0	329	0	2 606	1,5%
Linked to Boiler, of which	1378	1671	1364	643	41	589	12096	15071	1308	1326	1105	14387	87	155	4899	2427	234	291	295	5619	1717	20598	87 301	48,9%
Combi Boilers	179	749	642	12	9	0	7356	2095	31	519	27	12672	24	48	4230	576	176	181	36	4249	0	7711	41 523	23,3%
Indirect Cylinders Integrated	107	247	0	129	0	377	2353	2248	153	0	0	834	0	0	23	257	23	0	18	640	1150	0	8 558	4,8%
Indirect Cylinders Separate	1052	674	722	478	32	213	2383	10581	1119	807	1077	878	63	107	621	1595	35	110	240	724	560	12886	36 958	20,7%
Solar Thermal (Combined)	40	1	0	24	0	0	4	147	6	0	0	3	0	0	26	0	0	0	0	6	6	0	263	0,1%
Dedicated, of which	1465	1900	1139	591	155	1163	13928	17427	3614	2150	219	11668	357	425	1043	4855	5018	815	362	15241	699	4337	88 572	49,6%
Solar Thermal (WH Only)	159	13	0	36	0	0	36	587	559	0	0	53	0	0	66	0	0	0	0	105	39	7	1 661	0,9%
Electric Instantaneous >12 kW	67	6	50	4	6	11	0	9659	36	0	55	0	9	25	7	572	11	64	1	82	4	2044	12 713	7,1%
Electric Storage >30 litres	1230	1192	958	548	148	1152	11992	4421	3010	1541	113	9198	346	399	672	3985	711	634	358	6120	656	1978	51 360	28,8%
Gas Instantaneous 13+ l/m	0	619	0	0	1	0	1462	1621	6	226	0	1775	0	0	208	0	4276	11	3	8860	0	0	19 069	10,7%
Gas Storage	9	70	131	3	0	0	439	1139	3	383	51	643	2	0	90	299	20	107	0	74	0	307	3 769	2,1%
Total Primary (A)	2917	3571	2692	1446	251	1904	26144	32938	4922	3562	1323	26055	503	674	5974	7933	5252	1207	670	20860	2745	24935	178 479	100%
in % of total	1,6%	2,0%	1,5%	0,8%	0,1%	1,1%	14,6%	18,5%	2,8%	2,0%	0,7%	14,6%	0,3%	0,4%	3,3%	4,4%	2,9%	0,7%	0,4%	11,7%	1,5%	14,0%	100,0%	
SECONDARY																								
Electric Storage, of which	1166	1329	672	204	30	53	1409	15411	379	545	99	6157	51	53	1410	813	101	169	432	1648	18	927	33 077	18,5%
<30 Litres Pressurised	237	1064	429	195	28	53	491	271	38	130	66	6157	35	29	1308	813	101	138	189	1630	18	537	13 958	7,8%
<30 Litres Unpressurised	929	266	242	9	2	0	919	15139	341	415	33	0	15	24	102	0	0	31	243	19	0	390	19 120	10,7%
Electric Instantaneous (<12 kW)	14	23	320	8	15	22	0	941	30	1	999	0	13	55	24	1296	23	131	0	9	2	10145	14 071	7,9%
Gas Instantaneous, of which	186	423	241	6	24	0	843	1073	22	372	7	47	15	43	500	2146	233	64	8	3347	0	1018	10 619	5,9%
5 -<10 Litres/Minute	0	160	0	0	13	0	843	76	5	181	0	47	0	0	256	0	233	50	4	3347	0	0	5 214	2,9%
10 -<13 Litres/Minute *	186	263	241	6	10	0	0	998	17	192	7	0	15	43	245	2146	0	14	5	0	0	1018	5 405	3,0%
Total Secondary (B)	1366	1775	1233	218	68	76	2252	17425	431	919	1105	6204	79	152	1934	4255	358	365	441	5004	20	12090	57 767	32.4%
in % of total	2,4%	3,1%	2,1%	0,4%	0,1%	0,1%	3,9%	30,2%	0,7%	1,6%	1,9%	10,7%	0,1%	0,3%	3,3%	7,4%	0,6%	0,6%	0,8%	8,7%	0,0%	20,9%	100,0%	
Avg Secondary per Dwelling	0.34	0.48	0.31	0.08	0.11	0.03	0.13	0.45	0.08	0.22	0.81	0.22	0.08	0.12	0.28	0.34	0.07	0.19	0.55	0.23	0.00	0.48	0.32	
All Water Heaters (A + B)	4283	5346	3924	1664	319	1980	28397	50363	5353	4481	2428	32259	582	827	7909	12188	5609	1571	1110	25863	2765	37025	236 246	132,4%
All non-integrated **	3923	4350	3093	1311	255	1451	18568	45579	5170	3876	2401	18754	499	683	3624	10705	5411	1290	1043	20975	1286	29313	183 559	102,8%

* For Italy, Portugal and Spain Gas Instantaneous 10 -<13 Litres/Minute are considered as primary ; ** Dedicated Water Heaters plus Separate Indirect Cylinders; *** For Germany, refers to products not dwellings

NB: does not include Cyprus, Luxembourg and Malta

Table 3.21 EU water heater sales by heating technique (in k units and % of total)

year-->	1990	1995	2000	2005	2010*	2020*	% 1990	% 1995	% 2000	% 2005	% 2010*	% 2020*
COMBI BOILERS	**2029**	**2639**	**3774**	**4481**	**4576**	**5379**	**14,8%**	**18,4%**	**23,4%**	**26,0%**	**25,9%**	**27,9%**
Combi Boilers	1988	2533	3537	4233	4311	5086	14,5%	17,7%	21,9%	24,6%	24,4%	26,4%
Combi Boilers (Storage only)	41	105	237	248	265	293	0,3%	0,7%	1,5%	1,4%	1,5%	1,5%
INDIRECT CYLINDERS	**1889**	**2066**	**2156**	**2316**	**2800**	**3444**	**13,8%**	**14,4%**	**13,4%**	**13,5%**	**15,8%**	**17,9%**
Indirect Cylinders Integrated	312	324	351	384	411	472	2,3%	2,3%	2,2%	2,2%	2,3%	2,5%
Indirect Cylinders Separate	1577	1640	1622	1641	1724	1825	11,5%	11,5%	10,0%	9,5%	9,7%	9,5%
Solar Storage Tanks		103	170	249	543	916		0,7%	1,1%	1,4%	3,1%	4,8%
Gas WH: Indirect Cyll. Buffer Storage			13	43	122	231			0,1%	0,2%	0,7%	1,2%
						0						0,0%
60-80L			234	290	402	571			1,4%	1,7%	2,3%	3,0%
80-120L			630	710	982	1335			3,9%	4,1%	5,6%	6,9%
120-200L			603	576	650	697			3,7%	3,3%	3,7%	3,6%
200-500L			345	330	315	286			2,1%	1,9%	1,8%	1,5%
500-1000L			105	112	125	145			0,7%	0,6%	0,7%	0,8%
>1000L			43	66	91	139			0,3%	0,4%	0,5%	0,7%
						0						0,0%
Coil System			1661	1686	1940	2220			10,3%	9,8%	11,0%	11,5%
Plate to Plate System			298	391	605	911			1,8%	2,3%	3,4%	4,7%
ELECTRIC WATER HEATERS	**7248**	**7420**	**7955**	**8335**	**8379**	**8804**	**52,8%**	**51,8%**	**49,3%**	**48,4%**	**47,3%**	**45,7%**
Electric Storage	**5629**	**5450**	**5652**	**5905**	**5973**	**6295**	**41,0%**	**38,1%**	**35,0%**	**34,3%**	**33,8%**	**32,7%**
≤ 30 (Unpressurised)			1264	1034	986	708			7,8%	6,0%	5,6%	3,7%
≤ 30 L (Pressurised)			844	893	873	902			5,2%	5,2%	4,9%	4,7%
> 30 (Pressurised), of which			3544	3978	4115	4685	-	-	22,0%	23,1%	23,2%	24,3%
						0	-	-	-	-	-	-
80L			1699	1785	1701	1704			10,5%	10,4%	9,6%	8,9%
100L			477	542	532	587			3,0%	3,1%	3,0%	3,1%
150L			416	473	502	588			2,6%	2,7%	2,8%	3,1%
200L			742	909	1056	1369			4,6%	5,3%	6,0%	7,1%
400L			210	270	323	436			1,3%	1,6%	1,8%	2,3%
						0						
El. Instantaneous (*excl. showers*)	**1619**	**1970**	**2303**	**2430**	**2406**	**2509**	**11,8%**	**13,8%**	**14,3%**	**14,1%**	**13,6%**	**13,0%**
Electric Showers (IRL and UK only)	739	878	1213	1452	1459	1705	5,4%	6,1%	7,5%	8,4%	8,2%	8,9%
Other instant Elec >12 kW	880	1092	772	705	679	586			4,8%	4,1%	3,8%	3,0%
Other instant Elec <12 kW			318	272	268	218			2,0%	1,6%	1,5%	1,1%
Hydraulic, of which			761	576	482	203	-	-	4,7%	3,3%	2,7%	1,1%
< 12kW			290	224	203	115			1,8%	1,3%	1,1%	0,6%
12kW			80	47	46	12			0,5%	0,3%	0,3%	0,1%
18kW			119	55	53	-13			0,7%	0,3%	0,3%	-0,1%
21kW			163	118	89	15			1,0%	0,7%	0,5%	0,1%
24kW			85	107	75	65			0,5%	0,6%	0,4%	0,3%
27kW			24	25	16	9			0,1%	0,1%	0,1%	0,0%
Electronic, of which			329	401	465	601	-	-	2,0%	2,3%	2,6%	3,1%
< 12kW			27	49	65	103			0,2%	0,3%	0,4%	0,5%
12kW			64	43	49	34			0,4%	0,2%	0,3%	0,2%
18kW			87	41	50	12			0,5%	0,2%	0,3%	0,1%
21kW			96	105	122	148			0,6%	0,6%	0,7%	0,8%
24kW			40	127	141	243			0,2%	0,7%	0,8%	1,3%
27kW			15	36	38	62			0,1%	0,2%	0,2%	0,3%
GAS WATER HEATERS	**2558**	**2190**	**2263**	**2083**	**1942**	**1621**	**18,6%**	**15,3%**	**14,0%**	**12,1%**	**11,0%**	**8,4%**
Gas Instantaneous	**2308**	**1929**	**1972**	**1849**	**1734**	**1495**	**16,8%**	**13,5%**	**12,2%**	**10,7%**	**9,8%**	**7,8%**
13+ Litre/Minute *			295	330					1,8%	1,9%		
10 -<13 Litre/Minute *			1277	1253					7,9%	7,3%		
5 -<10 Litre/Minute *			400	266					2,5%	1,5%		
Gas Storage	**250**	**261**	**291**	**234**	**208**	**126**	**1,8%**	**1,8%**	**1,8%**	**1,4%**	**1,2%**	**0,7%**
Condensing, of which			2	7	15	29	-	-	0,0%	0,0%	0,1%	0,1%
130L			0	0	0	1			0,0%	0,0%	0,0%	0,0%
160L			0	0	0	1			0,0%	0,0%	0,0%	0,0%
190L			0	0	0	0			0,0%	0,0%	0,0%	0,0%
220L			0	0	0	1			0,0%	0,0%	0,0%	0,0%
>220L			2	6	14	26			0,0%	0,0%	0,1%	0,1%
Non Condensing, of which			289	227	193	97	-	-	1,8%	1,3%	1,1%	0,5%
<80L			87	78	70	53			0,5%	0,5%	0,4%	0,3%
80-130L			100	67	50	1			0,6%	0,4%	0,3%	0,0%
160L			53	40	32	10			0,3%	0,2%	0,2%	0,1%
190L			12	11	9	6			0,1%	0,1%	0,1%	0,0%
220L			12	10	10	8			0,1%	0,1%	0,1%	0,0%
>220L			19	17	16	14			0,1%	0,1%	0,1%	0,1%
Open Flue			216	126	69	-78			1,3%	0,7%	0,4%	-0,4%
Fan Flue			69	97	118	168			0,4%	0,6%	0,7%	0,9%
TOTAL *(incl. el. showers)*	**13724**	**14315**	**16147**	**17216**	**17698**	**19248**	**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**

Table 3.22 EU hot water energy consumption in 2003

	Parameter	*unit*	EU-25	AT	BE	CY	CZ	DK	EE	FI	FR	DE	EL	HU	IE	IT	LV	LT	LU	MT	NL	PL	PT	SK	SI	ES	SE	UK
	Base data 2003																											
1	Energy/hh 2003, of which	kWh/hha	17370	24805	26277	13952	16519	20004	18832	25242	17653	20326	15720	16495	22911	13497	15591	11913	36288	7092	17179	14599	9627	**11637**	**21238**	**10736**	**20979**	**19647**
3	Households 2003	mln.	191,4	3,3	4,3	0,2	4,0	2,5	0,6	2,4	26,5	37,7	3,8	4,3	1,4	25,1	0,9	1,4	0,2	0,2	7,1	14,2	3,7	**2,6**	**0,7**	**14,4**	**4,2**	**26,3**
4	Persons/ hh 2003	#	**2,5**	2,4	2,4	3	2,4	2,2	2,4	2,2	2,4	2,1	2,8	2,6	2,9	2,6	2,5	2,6	2,5	3	2,3	2,8	2,8	2,6	2,8	2,9	1,9	2,4
5	Floor area/ dw. 2003	m²	87	94	86	*145*	76	109	60	77	90	90	83	75	104	90	55	61	125	106	98	68	83	56	75	90	92	87
6	Secondary WH per hh.	%	32	34	48	8	31	8	11	3	13	45	8	22	81	22	8	12	48	8	28	34	7	19	55	23	1	48
	Sanitary Hot Water (SHW) demand (litres of 60°C per day)																											
7	Litres/person.day	ltr	24	35	30	25	15	45	10	50	25	25	25	25	25	25	10	10	50	25	31	15	25	15	20	23	50	25
8	Litres/hh.day	ltr	59	84	72	75	36	99	24	110	60	53	70	65	73	65	25	26	125	75	71	42	70	39	56	67	95	60
9	Net SHW energy/ hh.yr	kWh/hha	1246	1778	1524	1588	762	2096	508	2329	1270	1111	1482	1376	1535	1376	529	550	2646	1588	1509	889	1482	826	1186	1412	2011	1270
10	of which																											
11	**Primary WH energy**	kWh/hha	**1114**	**1577**	**1281**	**1545**	**683**	**2040**	**489**	**2305**	**1215**	**945**	**1442**	**1275**	**1121**	**1275**	**515**	**528**	**2223**	**1545**	**1369**	**788**	**1447**	**773**	**968**	**1304**	**2004**	**1067**
12	**Second. WH energy**	kWh/hha	**133**	**201**	**244**	**42**	**79**	**56**	**19**	**23**	**55**	**167**	**39**	**101**	**414**	**101**	**14**	**22**	**423**	**42**	**141**	**101**	**35**	**52**	**217**	**108**	**7**	**203**
	Water Heater Park EU-25, market penetration in %																											
	PRIMARY WATER HEATERS (efficiency)																											
13	**District Heat** (100%)		**1%**	**3%**	**0%**	**0%**	**7%**	**15%**	**22%**	**8%**	**0%**	**1%**	**0%**	**2%**	**0%**	**0%**	**12%**	**14%**	**0%**	**0%**	**1%**	**8%**	**0%**	**8%**	**2%**	**0%**	**12%**	**0%**
14	**Linked to Boiler,** of which		**49%**	**47%**	**47%**	**27%**	**51%**	**44%**	**16%**	**31%**	**46%**	**46%**	**27%**	**37%**	**84%**	**55%**	**17%**	**23%**	**47%**	**27%**	**82%**	**31%**	**4%**	**24%**	**44%**	**27%**	**63%**	**83%**
15	Combi Boilers (55%)		23%	6%	21%	1%	24%	1%	4%	0%	28%	6%	1%	15%	2%	49%	5%	7%	21%	1%	71%	7%	3%	15%	5%	20%	0%	31%
16	Ind. Cylinders Int. (50%)		5%	4%	7%	3%	0%	9%	0%	20%	9%	7%	3%	0%	0%	3%	0%	0%	7%	3%	0%	3%	0%	0%	3%	3%	42%	0%
17	Ind. Cylinders Int. (50%)		21%	36%	19%	23%	27%	33%	13%	11%	9%	32%	23%	23%	81%	3%	13%	16%	19%	23%	10%	20%	1%	9%	36%	3%	20%	52%
18	Solar Thermal (150%)		0%	1%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
19	**Dedicated,** of which		**50%**	**50%**	**53%**	**73%**	**42%**	**41%**	**62%**	**61%**	**53%**	**53%**	**73%**	**60%**	**17%**	**45%**	**71%**	**63%**	**53%**	**73%**	**17%**	**61%**	**96%**	**68%**	**54%**	**73%**	**25%**	**17%**
20	Solar Thermal (150%)		1%	5%	0%	11%	0%	2%	0%	0%	0%	2%	11%	0%	0%	0%	0%	0%	0%	11%	1%	0%	0%	0%	0%	1%	1%	0%
21	Electr. Instant.>12 kW (97%)		7%	2%	0%	1%	2%	0%	2%	1%	0%	29%	1%	0%	4%	0%	2%	4%	0%	1%	0%	7%	0%	5%	0%	0%	0%	8%
22	El. Store >30 ltr. (65%)		29%	42%	33%	61%	36%	38%	59%	61%	46%	13%	61%	43%	9%	35%	69%	59%	33%	61%	11%	50%	14%	53%	53%	29%	24%	8%
23	Gas Instant. 13+ l/m (45%)		11%	0%	17%	0%	0%	0%	0%	0%	6%	5%	0%	6%	0%	7%	0%	0%	17%	0%	3%	0%	81%	1%	0%	42%	0%	0%
24	Gas Storage (45%)		2%	0%	2%	0%	5%	0%	0%	0%	2%	3%	0%	11%	4%	2%	0%	0%	2%	0%	2%	4%	0%	9%	0%	0%	0%	1%
25	*Primary WH avg eff.**		*60%*	*66%*	*56%*	*71%*	*61%*	*67%*	*71%*	*63%*	*58%*	*69%*	*71%*	*58%*	*53%*	*57%*	*67%*	*68%*	*56%*	*71%*	*57%*	*65%*	*48%*	*65%*	*59%*	*54%*	*61%*	*57%*
	SECONDARY WATER HEATERS (efficiency)																											
26	**El. Storage,** of which		**57%**	**85%**	**75%**	**88%**	**55%**	**94%**	**44%**	**70%**	**63%**	**88%**	**88%**	**59%**	**9%**	**99%**	**65%**	**35%**	**75%**	**88%**	**73%**	**19%**	**28%**	**46%**	**98%**	**33%**	**90%**	**8%**
27	<30 Litres Press. (65%),		24%	17%	60%	9%	35%	89%	41%	70%	22%	2%	9%	14%	6%	99%	44%	19%	60%	9%	68%	19%	28%	38%	43%	33%	90%	4%
28	<30 Litres Unpress(65%)		33%	68%	15%	79%	20%	4%	3%	0%	41%	87%	79%	45%	3%	0%	19%	16%	15%	79%	5%	0%	0%	8%	55%	0%	0%	3%
29	**El. Instant<12 kW** (97%)		**24%**	**1%**	**1%**	**7%**	**26%**	**4%**	**22%**	**29%**	**0%**	**5%**	**7%**	**0%**	**90%**	**0%**	**16%**	**36%**	**1%**	**7%**	**1%**	**30%**	**6%**	**36%**	**0%**	**0%**	**10%**	**84%**
30	**Gas Instant.** of which		**18%**	**14%**	**24%**	**5%**	**20%**	**3%**	**35%**	**0%**	**37%**	**6%**	**5%**	**40%**	**1%**	**1%**	**19%**	**28%**	**24%**	**5%**	**26%**	**50%**	**65%**	**18%**	**2%**	**67%**	**0%**	**8%**
31	5 -<10 Litres/min (45%)		9%	0%	9%	1%	0%	0%	19%	0%	37%	0%	1%	20%	0%	1%	0%	0%	9%	1%	13%	0%	65%	14%	1%	67%	0%	0%
32	10 -<13 Litres/min (45%) *		9%	14%	15%	4%	20%	3%	15%	0%	0%	6%	4%	21%	1%	0%	19%	28%	15%	4%	13%	50%	0%	4%	1%	0%	0%	8%
33	*Secondary WH avg eff.**		*69%*	*63%*	*61%*	*66%*	*69%*	*66%*	*65%*	*73%*	*58%*	*65%*	*66%*	*57%*	*94%*	*65%*	*66%*	*70%*	*61%*	*66%*	*60%*	*65%*	*54%*	*73%*	*65%*	*52%*	*68%*	*90%*
										Result: Energy consumption water heaters in kWh/household.year																		
34	**Energy cons. WH**	**kWh/hha**	2048	2719	2706	2240	1240	3115	717	3670	2180	1632	2090	2392	2550	2374	788	808	4698	2240	2641	1365	3067	1266	1971	2624	3281	2112
35	of which electric WH	**kWh/hha**	725	1327	944	1526	474	1278	473	2192	911	717	1424	941	638	847	571	521	1639	1526	398	729	322	724	1125	649	750	420

Table 3.23 **Average energy conversion efficiencies and calculated energy shares of different types of water heating systems in the EU-25**

Type of water-heating system (primary and secondary)	Sub-classification		Average conversion efficiency (%)	Contribution to the energy supplied by primary and secondary heating systems (% by energy)
Electric storage	Primary	Dedicated	65	26
Indirect cylinders	Primary	Boilers	50	24
Combi-boilers	Primary	Boilers	55	21
Gas instantaneous	Primary	Dedicated	45	10
Electric instantaneous >12 kW	Primary	Dedicated	97	6
Electric storage	Secondary	Electric storage	65	5
Electric instantaneous < 12 kW	Secondary	Electric instantaneous < 12 kW	97	2
Gas storage	Primary	dedicated	45	2
Gas instantaneous	Secondary	Gas instantaneous	45	2
District heat	Primary	District heat	100	1
Solar thermal	Primary	Dedicated	150	1
Type of primary water-heating system	**Sub-classification**		**Average conversion efficiency (%)**	**Contribution to the energy supplied by primary heating systems (% by energy)**
Electric store	Primary	Dedicated	65	29
Indirect cylinders	Primary	Boilers	50	26
Combi-boilers	Primary	Boilers	55	23
Gas instantaneous	Primary	Dedicated	45	11
Electric instantaneous >12 kW	Primary	Dedicated	97	7
Gas storage	Primary	Dedicated	45	2
District heat	Primary	District heat	100	1
Solar thermal	Primary	Dedicated	150	1
Type of secondary water-heating system	**Sub-classification**		**Average conversion efficiency (%)**	**Contribution to the energy supplied by secondary heating systems (% by energy)**
Electric storage	Secondary	Electric storage	65	57
Electric instantaneous < 12 kW	Secondary	Electric instantaneous < 12 kW	97	24
Gas instantaneous	Secondary	Gas instantaneous	45	18

The split by energy fuel has also been estimated. Information about the source of energy of combi-boilers and indirect cylinders was not reported in the VHK Lot-2 Ecodesign study. Based on the analysis of background information related to Hydronic Central Heating Generators[158] (water-based heating generators according to the Ecodesign definitions), the following split has been considered for boilers: 51% energy gas, 40% oil, 9% biomass. The results are shown in Table 3.24 and suggest that 40% of the energy produced by water heating systems was from electricity (estimated average total efficiency 72%), 36% from natural gas (estimated average total efficiency 50%), and 18% from oil (estimated average total efficiency 52%).

Other sources/systems seem to play a marginal role (4% biomass, 1% district heating and 1% solar thermal). Shares could change by considering a higher energy contribution from natural gas: 43% from natural gas, 41% from electricity, 9% from oil.

Rescaled to 100%, the shares of the three main heating sources would be:

- 40-41% electricity (estimated average total efficiency 72%);
- 36-43% natural gas (estimated average total efficiency 50%);
- 9-18% oil (estimated average total efficiency 52%).

The estimated values are comparable with the requirements of Commission Regulation (EU) No 814/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water heaters and hot water storage tanks[159].

Table 3.24 Average energy conversion efficiency and energy shares of water-heating systems based on different sources of energy in the EU-25

Source of energy	Average conversion and exchange efficiency (%)	Share of total energy - baseline (% by energy)	Share of total energy – higher share of gas (% by energy)
Electricity	72	40	41
Gas	50	36	43
Oil	52	18	9
Biomass	52	4	4
District heat	100	1	1
Solar thermal	150	1	1

3.3.2.3.2 Non-residential buildings

The VHK Lot-2 Ecodesign study emphasises that the description of water heating in the non-residential sector is very complicated and unclear. Indicative figures for energy consumption

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[158] http://susproc.jrc.ec.europa.eu/heating/docs/Policy%20Analysis.pdf

[159] http://www.eup-network.de/fileadmin/user_upload/Water_heaters_Ecodesign_Reg_814_2013.pdf

for space heating and hot water from 1995 to 1999 in some Member States are reported there. A breakdown of the total sector by source of energy has been calculated for this study and is shown in Table 3.25. It is worth noting that percentages estimated for non-residential buildings are comparable with those of the domestic sector. Based on this, it is proposed that information for residential buildings are applied to the non-domestic sector, for the purposes of this study.

Table 3.25 Indication of energy consumption by energy source for space heating and water heating in non-residential buildings in some Member States

	France	Germany	Italy	Variation range
Oil	23%	37%	8%	8-37%
Gas	31%	29%	41%	29-41%
LPG	0%	1%	3%	0-3%
Solid	0%	2%	0%	0-2%
Electricity	38%	30%	36%	30-38%
District heating	0%	0%	10%	0-10%
Others	8%	0%	3%	0-8%

3.3.3 Technical description of water heating systems

Water heaters can be simplified in three main elements: a heating source, a heat exchanger and a water storage and circulation system. Different concepts and layouts have been developed so far. A summary of the main technical systems for water heating is presented here. A more detailed dissertation on this topic is provided in the VHK Lot-2 Ecodesign study.

3.3.3.1 Heating source and heat exchange

Water is heated up through the production and transport of heat. This can be provided from different sources such as the combustion of fuels, the energy that dissipates in electrical resistances, the radiative energy of sunlight, and exchange of heat from a warmer to a colder body.

In case of combustion, fuel is burned with air in a controlled manner. The majority of gas- and oil-fired boilers and water heaters are based on surface or jet burners, which can be fan-assisted (pre-mix) or not. Over the last two decades there has been a shift from the traditional atmospheric burners towards Low-NO_X pre-mix burners, typically with lower combustion temperatures.

Energy must be transferred from the source of heat to water. Heat exchange can be:

- recuperative: heat is transferred by convection and conduction between two separate media;
- direct: heat is transferred through direct contact between two media (e.g. steam or flame with water);
- regenerative: heat is transferred through an intermediate material (e.g. electric resistances).

The recuperative heat exchanger is predominantly used in boiler and water heater applications based on combustion. However, direct contact heat exchangers are also technically feasible. An overview of the types of heat exchanger in gas-/oil-fired water heaters, including combi-boilers can be structured as follows:

- heat transfer media (flue-gas, central heating water, domestic hot water, combustion air);
- material/shape combination (e.g. cast iron tubes);
- application (e.g. heating only boilers, instantaneous combis).

3.3.3.2 Electric storage water heater

Electric storage water heaters are relatively easily installed (no flues, combustion air or fuel supply needed, just electricity and hot/cold water piping, possibly a drain) and offer relatively high water comfort (depending on the recovery rate).

The design principle is a storage tank with one (or more) electric immersion heater(s). The size of the storage tank may vary from just a few litres (for single point use) to several hundred litres (for multi-point use). The power of the electric immersion heater increases as the size of the storage increases but electric power exceeding 6 kW is rare, given the average maximum size of a household fuse box (20 A).

Electric storage heaters may be pressurised (with the storage at mains pressure) or unpressurised. The latter is either an open vented storage or cistern (more common in the UK) or a vented tap (more common in Germany, in small storage heaters (maximum 5 l) placed above a washbasin). Such unpressurised heaters can be equipped with plastic tanks, whereas pressurised heaters are made of metal (enamelled steel, copper or stainless steel). There are versions with an electrically heated primary store, producing domestic hot water (DHW) through a (plate) heat exchanger. A special group of electric storage water heaters are the boiling water heaters, intended to supply (almost) boiling water for consumption (tea, soup, etc.).

The electric heater applied in electric storage water heaters is a tubular heater which consists of a spiral-wound resistive wire perfectly centred in a tubular metal sheath filled with a powdery insulator (electro-fused magnesium oxide (MgO)). The type of metal sheath (or its surface finishing) is optimised for the working conditions. The magnesium powder is compacted by a laminate, also necessary to obtain good thermal conductivity and good mechanical and dielectric strength. The extremities are sealed with a resin (silicon, epoxy, polyurethane, etc.., according to the application) and terminated by a ceramic plug. The electric connections and the mechanical attachment accessories required can be specified by the manufacturer.

Most electric storage water heaters allow the storage temperature to be set from approximately 40-50°C to 80-90°C. User manuals warn against the risk of scalding when using higher temperatures. In case of thermostat failure the heaters have a thermal sensor/switch to prevent overheating. Usually at temperatures of 95°C or above the sensor switches off the electric supply, which can only be turned on again through manual intervention. Some heaters have frost protection. They switch on if the storage temperature drops below 7°C. Fittings and piping leading to and from the heater need frost protection too. Boiling water heaters are designed to produce water up to boiling point.

The performance of electric storage water heaters is best expressed through their recovery rates: the amount of hot water the device can produce in a specified period of time and a with specified temperature rise. The main parameter for determining the (continuous) recovery rate is the capacity of the electric heaters. For smaller water heaters, the reheat time and standing losses are often indicated.

Another aspect defining the performance of a storage water heater is its useful volume, which is indicated by the mixing efficiency factor V40 and which depends on the placement and shape of the sensor and heater in the storage tank. A better mixing efficiency increases the nominal capacity with the same storage volume, or enables the same nominal capacity with a smaller storage at the same temperature or a similar sized storage with a lower temperature.

The immersed electric heater element transfers virtually all energy to the storage content: the transfer efficiency therefore reaches 100%. The primary efficiency depends on grid characteristics. Standing (off-mode) losses are more important for overall energetic performance.

Standing losses are an important energetic loss of electric storage water heaters and are determined by the temperature difference between the water and the surroundings and the insulation level. This can be roughly estimated as 31-37% of the total energy consumption. An indication of the standing losses of modern electric storage water heaters is provided in Table 3.26. Isolation and optimisation of the storage temperature are important factors for reducing standing losses.

Table 3.26 Standing losses of modern electric storage water heaters

Storage volume (l)	Standing losses		Remarks
	(kWh/24 hr at 60°C)	(kWh/year)	
5	0,25	91	0.05 kWh/24hr*ltr or 10 Watt continuously
10	0,35	128	
15	0,40	146	
30	0,49	179	
50	0,54	197	at 65°C
80	0,66	241	at 65°C
100	0,79	288	at 65°C
120	0,92	336	at 65°C
150	1,07	391	at 65°C
200	1,8	657	
300	2,2	803	
400	2,6	949	0,0065 kWh/24hr*ltr or 108 Watt continuously

Start-stop losses of the electric storage water heater are not a significant source of losses: The thermal mass of the electric element is minimal and preheated by the volume of DHW in which it is immersed. Start-stops are regulated by a sensor switch. The hysteresis of the sensor switch determines the deviation from the set temperatures (overshoot, responsiveness). The better this control the less energy is consumed unnecessarily.

The simplest electric storage water heaters do not use auxiliary electrical energy. The temperature sensors are capillary tubes operating the on/off switches of the heating element. However, more sophisticated models may be equipped with a control panel with signal lights or an electronic (LCD) display indicating the settings and temperature. These added functions require some power (generally < 1 watt).

3.3.3.3 Separate cylinders

Separate cylinders (or external storage tanks) lack an internal heat generator and thus cannot function as an independent water heater. The heat source of external DHW storage tanks or cylinders (also referred to as calorifiers) is the CH system water. The heat input is via a heat exchanger, sometimes in combination with an electric heater. Features characterising external storage tanks are: the heat exchanger, tank material, and insulation (plus jacket/casing).

Most cylinders in mainland Europe are pressurised (under water pressure). In the UK many external cylinders are "unpressurised" but fed by a feed tank located above the cylinder. Unpressurised storage cylinders can also be applied as a primary store with the DHW heat exchanger under mains pressure.

The heat exchanger generally applied in external storage tanks is a system of coil heat exchangers, usually of the same material as the cylinder itself. The diameter, length and surface features of the coil determine the heat transfer surface and are designed for the desired performance.

The tank-in-tank heat exchanger is characterised by the low pressure drop and relatively large water content of the heat exchanger. At 1000 l/hour the coil HE has a pressure loss of 10-17 kPa, the tank-in-tank (double mantle) has a pressure loss of around 0.2-0.3 kPa. Extra-large heat exchanger versions are available to minimise the boiler cycles and are recommended for heat pumps. The water content of the enlarged version is triple the amount of a standard version: 66 l versus 22 l for a 200 litre storage tank).

The heat generator is by definition an external (heating only) boiler and does not form part of the product. In some applications external storage cylinders are fed directly with heated DHW (possibly by instantaneous combi-boilers) and thus do not require a heat exchanger. In such cases they are practically no more than a thermal DHW store.

On-mode efficiency is defined by the external boiler. Part of the efficiency is however influenced by the external storage tank design and especially the heat exchanger. Energy losses in off-mode (standing losses) are the main source of losses for external storage tanks. A few examples of standing losses:

- 150 litre tank (120mm insulation): 65-70W, 600 kWh/year;
- 350 litre solar tank (110mm insulation): 100 W, 870 kWh/year.

Some auxiliary energy consumption occurs in the boiler to operate the circulator, three-way valve (to send primary CH water over the coil), fans and gas valves for the combustion process and some electronic controls (that monitor the need for burner action). This energy consumption depends on the type and make of the boiler that supplies the heat and cannot be influenced by the manufacturer of the cylinder itself.

3.3.3.4 Gas/Oil-fired instantaneous combis

The gas- or oil-fired instantaneous combi-boiler is one of the most successful water heater products in Europe today. It combines production of space heating and DHW in one relatively small package. Gas-fired wall-hung models are the most popular. Oil-fired instantaneous combis do exist but are rare. The instantaneous combi is a boiler with an internal DHW storage of zero to maximum 15 L. Gas-fired combis are available in an immense variety of designs, shapes, features and specifications. The gas burners are either free flame, radiation or flameless burners. Oil burners (not really applicable) are jet burners (atomising).

Primary CH heat exchangers applied in instantaneous combis are of the (improved) fin-tube type (e.g. Nefit), bare tube (no fins) or aluminium die-cast (e.g. Weishaupt). Secondary circuit DHW heat exchangers are either of the plate heat exchanger type or submerged coil.

Most combis are factory-set to a DHW outlet temperature of 60°C (to avoid risk of scalding and legionella propagation). In order to maintain a constant 60°C at the outlet, the combi has to be able to adjust the burner output in accordance with the flow rate (and temperature of the incoming water). The minimum flow rate is related to the modulation range of the burner and heat exchange characteristics. If the boiler operates below the minimum flow rate, "boiler cycling" will occur. Boiler cycling occurs when an oversized boiler quickly satisfies process or space heating demands, and then shuts down until heat is required again. Operating at low firing rates provokes an efficiency decrease[160].

Lower flow rates are becoming a necessity with the advent of low-flow water-saving showerheads, thermostatic mixing valves and, recently, waste water heat recovery. For example, a water-saving showerhead pinches the flow to approximately 5.5 l/minute. If the temperature of the shower is 40°C and water inlet temperature is 15°C, then the boiler must deliver a flow of 3 l/minute of 60°C (9.6 kW). This is close to the minimum flow rate of many boilers. A solution to reduce minimum flow rates to "zero" is the application of a (small) DHW storage tank.

The energy performance of combi-boilers for DHW production is assessed through test standard EN 13203 (limited to combis of maximum 70kW and 300 l storage). The energy assessment covers a period of 24 hours per tapping cycle of which at least two must be executed. The result thus includes losses in on-mode, off-mode and start-stop. Some aspects that influence the energy efficiency in on-mode are:

- the surface area of the primary heat exchanger and associated condensing operation;
- the outlet temperature: many countries require an minimum outlet temperature of 60°C;
- minimum modulation / flow rate.

Condensing combis with integrated DHW heat exchangers (exposed to the burner) are able to (partly) operate in condensing mode since incoming water of 10-15°C is well below the dew point (around 57°C for natural gas). Total recovery of latent heat is not possible with outlet temperatures of minimum 60°C. Most combis however avoid such thermal stress at the primary heat exchanger and use a secondary DHW heat exchanger.

The preferred position is close to the main tapping point (for instance the kitchen or the bathroom) but national building regulations do not always allow this and lead to combis being tucked away in corners of the dwelling or even outside the insulated/heated perimeter of the building.

The steady-state efficiency is an important parameter for larger tappings (shower, bath) and many national (building) standards use default values for on-mode efficiency. Energy losses in off-mode (standing losses) are mainly envelope losses and flue duct losses if no flue damper is used. Some combis still use pilot flames for ignition that also contribute to off-mode losses. The envelope losses depend on the placement of combis and the ambient temperature. Most combis are wall-hung and installed within the insulated perimeter of the dwelling. A small DHW tank of 5 litres has standing losses varying from 0.2 to 0.4 kWh/day

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[160] http://www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/steam16_cycling_losses.pdf

(or 75-150 kWh/year). The "keep-hot facility" or "comfort switch" makes the boiler periodically send some heated CH water over the DHW heat exchanger. This adds some 50 to 100 kWh annually to the overall energy consumption. The pilot flame is believed to consume some 75 to 125 m^3 of natural gas per year (or 750-1212 kWh/year). However, not all the heat from the pilot flame should be treated as a loss, since some of it preheats the appliance (reducing start-stop losses).

Instantaneous production of DHW means many boiler cycles (start-stops) per day. A 40 kg instantaneous combi loses about 0.53 kWh per cool-down cycle. Depending on the number of cycles and the thermal characteristics of the appliance the annual loss could be 1865 kWh (for seven draw-offs per day and with no benefit from CH operations included). In wintertime the combi is often already heated up for central heating operation and the annual start-stop losses for DHW operation may be reduced by 40-50%. In general, electricity consumption of combi-boilers (in space heating, not DHW, operation) is split as follows: pump 57%, fan 34%, control 9%.

3.3.3.5 Gas/Oil-fired integrated storage combis

Gas/oil-fired integrated storage combis offer DHW storage of more than 15 litres. "Integrated" in this context means that the heat generator and storage tank are sold as one unit. In practice the unit can be also delivered in two parts (boiler and storage tank) and assembled on site. The group comprises wall-hung combi-boilers (with the heat generator hung above or beside the DHW storage) as well as floor standing models (with the heat generator placed on top or beside the DHW storage).

Storage combis provide high DHW performance, although many variants exist in terms of how the storage is charged. The traditional combi with integrated storage is based on a heating only boiler with a matched storage cylinder equipped with a DHW coil heat exchanger. More recent storage combis use an external (plate) heat exchanger to produce DHW and inject this directly into the top half of the storage. This type of storage is called "Schichtenspeicher" (thermal layer storage) and offers faster reheat times and eliminates the "empty boiler" effect. DHW injected can be extracted immediately, giving instantaneous combi-like operation. Another type of integrated storage combi is based on gas storage heaters that are equipped with a heat exchanger for space heating operations.

The storage component offers very high initial flow rates in the range of 12 to 30 l/minute or more. The question is however how long the desired flow rate can be maintained at a given temperature difference. In other words: what is the recovery rate (in l/hour at a given temperature rise.

Most storage combis are heated by conventional burners and heat exchangers (spiral in storage). The average efficiency lies in the range of that of instantaneous combis.

During off-mode, the storage combi loses energy through the envelope (mainly through the thermal DHW storage), flue duct and pilot flame (if present). The standing losses of the storage tank are significant and may vary from 0.96 kWh/day for a 30 litre storage tank to 2.65 kWh/day for a 300 litre storage tank. Standing losses can be significant, for instance 20% of the total usable energy content of the DHW water for a 75 litre storage combi.

An important factor for determining standing losses through the envelope is the ambient temperature of the appliance. Many boilers will be placed within the insulated perimeter of the dwelling or building, whereas others are placed in unheated areas. Pilot flame losses (if applicable) are in the range of 75 to 125 m^3 of natural gas per year (or 750 to 1212 kWh/year). However, not all the heat from the pilot flame should be treated as a loss, since some of it preheats the appliance (reducing start-stop losses).

The storage combi consumes electricity when on standby and in operation. The standby power consumption is often 10 Watts or less for normal sized boilers (below 35 kW). The power consumption when in operation depends to a large extent on the power output of the burner and ranges from 100 to 200 W. Some models employ a dedicated DHW feed pump instead of a three-way valve plus a double duty (CH plus DHW) circulator. In general, the electricity consumption of boilers (in space heating, not DHW, operation) is split as follows: pump 57%, fan 34%, control 9%

3.3.3.6 Gas/Oil instantaneous water heater

Gas- and oil-fired instantaneous water heaters are available in a wide capacity range, varying from 10 kW smaller heaters for kitchens, to 40 kW bath water heaters and to 1000 kW industrial heaters for non-domestic applications. Most instantaneous water heaters on the market today are gas-fired. Oil-fired instantaneous water heaters do exist but are rare in Europe.

The maximum flow rate of DHW by instantaneous water heaters depends foremost on the capacity (and efficiency) of the burner. The amount of power to produce 1 litre per minute however remains fairly constant over the range (some 3.4 to 3.5 kW per l/minute).

Temperature stability partly depends on the minimum flow rate. Below the minimum flow rate the appliance will start to "cycle". The minimum flow rate for the smaller water heaters (up to 30 kW or so) is in the range of 2.4-2.5 l/minute (at ΔT 50°C). For the larger models (40-60 kW) it can be 3.5 l/minute. Temperature accuracy can be up to 0.5-1°C.

The heat generator is in most cases a burner with a fin-tube heat exchanger arrangement. Net efficiency is in the range of 85-90%, although condensing water heaters with higher efficiency are available. In off-mode, envelope losses also occur, especially if a pilot flame is present. Another factor is the placement of the appliance (several manufacturers offer models in both indoor and outdoor versions). Appliances without a pilot flame may be equipped with a flue damper to prohibit downdraughts of cold outside air. Additional losses can occur in case of connection to a DHW circulation loop and extra system losses are introduced (heat losses and power needed for circulation). Start-stop losses are mainly due to pre- and post-purging (heating/cooling of thermal mass, unburnt fuel losses). If the flow is below the minimum flow rate, frequent start-stops occur (even within a tapping cycle). However, it has been reported by some stakeholders that appliances with a permanent pilot flame can be found less and less on the market.

The simplest gas-fired water heaters do not use auxiliary energy (apart from the pilot flame). More advanced water heaters use electronic ignition systems and require electric mains connection or batteries. Fan-assisted water heaters are always connected to the electric mains. A survey of 20 mains-powered gas water heaters in Australia gives the following values:

- on-mode: 40-120W;
- cool-down mode: 10-40W;

- passive standby mode (off-mode): 4.5-12W (average 10W and 6-8 W for new models);
- frost protection mode: either zero (drain down type) or 50-120W.

3.3.3.7 Electric instantaneous water heaters

Electric instantaneous water heaters (or "inline" water heaters) are very versatile in installation and mostly used as point-of-use water heaters. The main determinant for their application is the flow rate at a certain outlet temperature. Flows of 2 and 6 l/minute at 40°C are satisfactory for washbasin taps and showers, respectively. A temperature of up to 60°C is instead favourable for kitchen use. The flow rate that can be achieved at a certain temperature rise is determined by the electric power of the electric heating element. Besides electric power there are also differences in type of electric heating element (coil immersion or bar-wire), temperature/flow rate control (hydraulically or electronically) and whether the heat exchanger is "pressurised" or "unpressurised". Versions that are designed for use as electric showers often include a matching showerhead and hose.

The temperature rise is linked to the flow rate and the electric power of the heater. Table 3.27 gives the maximum flow rate produced at a certain electrical power and two temperature rises (assuming 100% efficient heat transfer at all flow rates).

Table 3.27 Flow rate for different powers and temperatures rises

kW	l/min at delta_T 45ºC	l/min at delta_T 25ºC
1,5	0,5	0,9
2	0,6	1,1
3	1,0	1,7
4	1,3	2,3
6	1,9	3,4
8	2,6	4,6
10	3,2	5,7
12	3,8	6,9
16	5,1	9,2
18	5,7	10,3
21	6,7	12,1
24	7,7	13,8
27	8,6	15,5
30	9,6	17,2

Two temperature control mechanisms are applied in electric instantaneous water heaters: hydraulic and electronic.

The conventional hydraulically controlled water heater simply turns on/off heating elements depending on the flow rate (or the water pressure to be more exact). Below a certain pressure the device does not actuate the heating elements and the water stays cold. Above this pressure point the heating element will be activated and the water is heated. The outlet temperature then depends on the flow rate The dependence of outlet temperature on flow rate / water pressure also means that if elsewhere in the house a tap is turned on or a toilet is flushed the available pressure and flow rate drops, leading to an increase in outlet temperature (and vice versa if a running tap is turned off).

The electronically controlled electric instantaneous water heater is able to maintain a set temperature throughout a certain range in flow rate and, in addition to this, offers the possibility of temperature presets and flow rate presets (depending on the actual model). The temperature is maintained constant by powering the electric heating elements (bar-wire type) in steps of approximately 100 Watts. If the flow rate increases to beyond the point where the water heaters is using its maximum power the outlet temperature will drop just like for hydraulically controlled water heaters.

Both hydraulically and electronically controlled appliances need a minimum flow rate before the heating elements are activated. This helps to protect the heating elements and ensures that enough heat is transferred for safe operation. The electronically controlled water heater with bar-wire heating elements is a much faster responding device and can thus operate from lower minimum flow rates. Minimum flow rates before the appliance switches on can be 2.5-3 l/minute.

In hydraulically controlled water heaters if the water becomes too hot, the desired outlet temperature is realised by mixing in cold water. In electronically controlled water heaters the temperature can be set with 0.5-1°C accuracy, displayed on the appliance user interface.

Assuming a flow rate of 3 l/minute, the water content of a conventional hydraulic/coil immersion heater is replaced in 12 seconds (0.6 l) during which the heater also heats up. The electronic/bar-wire heat exchanger has its contents replaced in 6 seconds (0.3 l) during which the heating elements reach its operating temperature. At "stop" the residual heat is lost to the environment (also depending on the tapping pattern). A temperature difference of 25°C (from 40°C to 15°C) causes losses of some 3.70-3.87 kJ/Wh.

Hydraulically operated electric instantaneous water heaters can operate without auxiliary power. Electronically controlled heaters use auxiliary power for the controller and the user interface display (if applicable). The power consumption is rarely documented but this is probably in the range of 1 Watt or less.

3.3.3.8 Gas/Oil storage water heater

This group comprises gas-/oil-fired water heaters with integrated DHW storage. The difference with storage combis is that these are dedicated water heaters, not designed to supply heat for space heating although in practice some construction similarities may exist. Storage water heaters offer high DHW performance (l/minute) and recovery rates (l/hour at a given temperature difference). Most storage water heaters are essentially storage cylinders with a burner/heat exchanger built into the appliance. The basic principle is fairly simple and robust and the product may last for decades with adequate maintenance (i.e. corrosion protection for storage tank). Gas- and oil-fired storage water heaters are produced with atmospheric or fan-assisted burners, in open or closed configurations and a wide range of burner output power (from < 5 kW to > 180kW) and storage volumes.

The performance of storage water heaters is primarily determined by the storage capacity, which ranges from approximately 40 l to over 500 l. Another performance parameter for gas storage water heaters is the recovery rate which links storage capacity and the power of the heat generator. The recovery rate is defined as the amount of hot water the device can produce in a specified period and with a specified temperature raise. A large storage capacity with a relatively modest burner may achieve similar recovery rates (for a specific time period, not continuously) as a smaller storage with larger capacity burner. The efficiency of the heat transfer is also a factor in this. Recovery rates of gas-fired storage water heaters can indicatively vary from 140 to almost 1800 l/hour (temperature difference 50°C). Oil-fired storage water heaters even produce up to almost 2800 l/hour (temperature difference 50°C). The average recommended storage temperature is 60°C, although higher temperatures can be supported. Generally manufacturers advise not to keep temperatures higher than 80°C due to risk of scalding.

A typical low-cost gas storage water heater uses a sensor as the temperature control – at a preset temperature the sensor switches the burner on and off. The simplest form requires a pilot flame so the burner ignites automatically as the gas valve is opened. The burners are atmospheric burners with an "open" combustion air supply. More sophisticated gas storage water heaters are equipped with an ionisation control module and self-ignition and those equipped with fans usually employ a boiler-like gas control unit (also controlled through ionisation). These gas storage water heaters can be "room sealed" although non-fan-assisted heaters are also available.

Historically the heat generator is placed inside the storage tank, with the burner chamber and flue-gas duct surfaces functioning as heat exchangers. Burners range in capacity from 5 kW to over 180kW. The trend towards a condensing operation can also be seen in gas storage water heaters and several models are now available. Condensing heat transfer is achieved by enlarging the heat exchange surface, preferably combined with burner modulation. The efficiency for conventional heaters is 85% and may reach 95-96% for condensing models.

Standby losses are the thermal losses from the storage tank. In fact these losses occur continuously and not only when the water heater is on standby (burner not ignited), therefore "standing losses" is a better description. The losses depend on the storage temperature, the insulation applied and edge losses like standing feet or connections to the rest of the DHW system. Gas- and oil-fired water heaters also have a flue-gas system and air supply that may contribute to standing losses

Simple gas storage water heaters equipped with a pilot flame (ignited manually) and a gas valve operated by the thermostat require no electrical power. The burner is atmospheric and the construction is open. The power consumption of this set-up (5 kW heat input for 75 or 110 l storage) is 26 W, of which 10 W are requested by the gas valve and 16 W by the fan. Fan-assisted gas water heaters with more capacity (190 l) may use up to ten times more energy (e.g. 236 W for 190 l storage). The higher consumption can partly be explained by a more powerful fan. More advanced models can also consume up to 236W. Higher electricity consumption is observed for condensing boilers (e.g. 170-710 W for 30-100 kW models).

3.3.3.9 Other systems (district heating, solar systems, heat pumps)

3.3.3.9.1 District heating

District heating networks rely on substations to distribute DHW to dwellings. Substations transfer heat from a collective hot water circulation loop to a DHW circuit and/or the space heating circuit of a dwelling or building. The collective loop can be part of a district heating circuit or the central heating circulation loop from a collective boiler in a multi-family building.

The water heater function is always indirect, producing DHW on demand from mains cold water. It is possible to connect the substation to a storage tank which is referred to as a semi-instantaneous system. In combi-substations the DHW overrules the space heating function.

As a result various types of substations exist, but the main components are more or less the same:

- heat exchanger (water-to-water);
- regulating valves (thermostatic, pressure-regulated or motorised).

3.3.3.9.2 Solar system

In many parts of Europe, solar thermal systems are applied as DHW preheaters or as stand-alone DHW systems. Literature regarding solar DHW systems often makes the distinction between split (pumped) systems, thermosiphon systems and Integrated Collector Storage (ICS) systems. Another categorisation can be made by the application: DHW only or combined with heating systems. A third categorisation could be on the basis of components, of which a vast array has been developed that differ in the techniques applied to collect, transport, store and heat the collected solar energy.

When looking at components only, a solar DHW system basically consists of three main parts: the collector that collects solar thermal energy, a thermal storage unit that transfers and stores solar heat to DHW and a heat generator that heats up the DHW to the required outlet temperatures. In some parts of Europe the heat generator is omitted and DHW outlet temperatures of 60°C cannot be guaranteed.

3.3.3.9.3 Heat pump systems

Heat pumps for water heating extract heat from either outside air or air extracted from the house (usually ventilation air). Heat pumps using other heat sources (soil, rock or groundwater/surface water) and heat pumps providing space heating as well (sometimes combined in one appliance, but mostly a solo boiler with indirect storage) are not addressed here. Heat pumps are considered very efficient electric storage water heaters: one unit of electrical energy is converted into 3 or 4 units of useable heat. The storage volume is in the range of 150 to 300 l. The average heat pump is electric compressor-driven.

Heat pumps are storage DHW systems hence the flow rate and temperature stability of the heat pump are identical to those of any DHW storage system. A major difference however can be the reheat time since the heating power is often limited, especially at lower source temperatures, and dependent on heat sink conditions. To boost charging times, most electric heat pumps have an electric back-up heating element on board, usually in the range of 1.5 to 3 kW.

The efficiency of a heat pump (in steady-state conditions) is indicated by its Coefficient of Performance (COP), which indicates the ratio of electric power input and thermal output. For most DHW heat pumps the COP is in the range of 2.5 to 4. A heat pump with a 350 W compressor and a COP of 3.5 thus produces 1.2 kW of heat.

3.4 Local infra-structure: water supply and waste water treatment

As taps and showers are embedded in a larger context of infrastructure, a further issue of relevance for this study is the analysis of water supply chains and the subsequent collection and treatment of waste water. The aim of this section is to gather information on the energy demanded and the water lost in water-related infrastructures:

a) water abstraction, impoundment, storage, treatment and distribution of surface water or groundwater;

b) water supply and control at the user location;

c) water heating;

d) waste water collection and treatment which subsequently discharges into surface water.

Water supply and control at the user location has been analysed in Section 3.1, and water heating in Section 3.2.

3.4.1 Water abstraction, impoundment, storage, treatment and distribution of surface water or groundwater

Abstraction refers to the volume of water taken from a natural or modified (e.g. reservoirs) resource over a certain period of time. Sources of fresh water include: natural water bodies, i.e. surface water (rivers and lakes) and groundwater, production by desalination, collected rainwater and reused waste water. According to EEA, 2009[161], surface water is the predominant source of fresh water across Europe (81% of the total abstracted). Groundwater is the main source for public water supply (about 55%) due to its generally higher quality than surface water (see Figure 3.4).

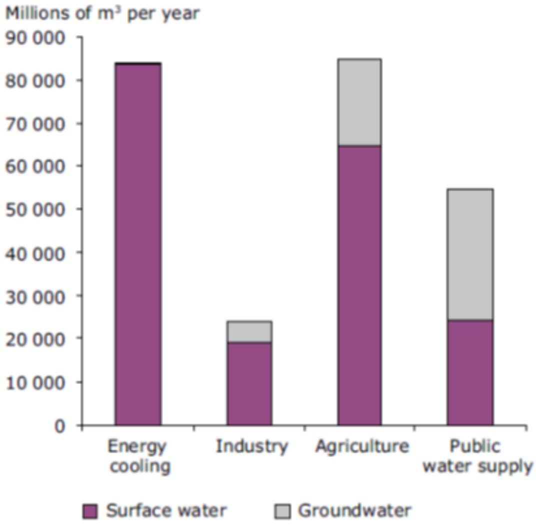

Figure 3.4 Sources of fresh water abstraction by sector[162]

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[161] http://www.eea.europa.eu/publications/water-resources-across-europe

[162] http://www.eea.europa.eu/publications/water-resources-across-europe

Water supply includes abstraction, treatment and distribution via the network for use in domestic and non-domestic applications. These upstream activities require energy in amounts that vary depending on raw water quality and geographical and hydrogeological conditions. The energy required per m^3 of water supplied is very site-specific. For instance, water can be transported from mountains to urban areas by gravity, abstracted from deep aquifers by pumping or taken from rivers. Depending on the source, contamination and the characteristics of water could deviate from water quality standards and more advanced treatments may thus be required.

The most cost-effective and energy-saving solution would be to obtain clean fresh water from a nearby source. If nearby sources are contaminated (e.g. by nitrates and pesticides from agricultural activities or by chemicals from the industrial sector), options are:

- sourcing good quality water from further away (e.g. mountains when possible), which would imply higher costs and energy demands for transport;
- applying an energy-intensive purification treatment (e.g. ion exchange to remove nitrates and activated carbon to remove pesticides);
- desalination of sea water, although this would require the highest amount of energy.

Data on energy consumption for abstraction, impoundment, storage, treatment and distribution of surface water or groundwater in different countries is reported in Table 3.28, taking into consideration data from literature and stakeholders' feedback. Estimations of average data are provided in Table 3.29, together with a range of variability. The most robust estimation of the average energy consumption for the EU is 0.63 kWh/m^3, which is comparable with the value obtainable considering US data too. Extremes vary from 0.47 (-25%) to 0.9 (+43%) kWh/m^3. Within the different phases of water supply, most of the energy seems to be required by abstraction (51% on average). The average demand for water treatment and distribution is lower (24% and 25% respectively). For the purposes of this study, this energy demand is considered to be covered entirely by electricity.

Table 3.28 **Energy consumption for water supply (water abstraction, impoundment, storage, treatment and distribution of surface water or groundwater)**

Supply phases	Country	Energy consumption (kWh/m^3)	GHG emissions (kg CO_2 eq/ m^3)	Source
Abstraction (average data on 40 utilities, mainly in Europe, with different water source and supply conditions)	EU	0.56 (from 0.30 at the 10th percentile to 0.90 at the 90th percentile)		EBC, 2011[163]
Abstraction, treatment and distribution of drinking water to about 22 million people in the EU	EU	0.64		Suez Environnement, 2012 – data provided in EEA 2012[164]
Production of drinking water with seawater desalination by reverse osmosis	EU	4		
Abstraction, impoundment, storage, treatment and distribution in a typical medium system	Portugal	0.84		ANQIP feedback
Abstraction, storage and transport to waterworks	Sweden	0.24		Jacobsen, 2012[165] according to Olsson, 2012 (in press)
Treatment of drinking water	Sweden	0.13		
Distribution of drinking water	Sweden	0.11		
Abstraction, impoundment, storage, treatment and distribution	UK	0.47	0.209	IPPR, 2006[166]
Abstraction (pumping)	UK	0.56		EA, 2009[167]
Abstraction (from 37 m)	US	0.14		U.S. Department of Energy, 2006[168]
Abstraction (from 122 m)	US	0.53		
Abstraction, impoundment, storage and conveyance	US	0-4.2		
Treatment of drinking water	US	0.03-0.40		
Distribution of drinking water	US	0.18-0.32		

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[163] EBC, 2011, *European Benchmarking Co-operation — Learning from international best practices*, 2010 Water and Wastewater Benchmark www.waterbenchmark.org

[164] http://www.eea.europa.eu/publications/towards-efficient-use-of-water

[165] http://projects.eionet.europa.eu/wise-tg/library/thematic-issues/water-utilities-resource-efficiency/european-water-utility-expert-meeting-13-14.12.2012-copenhagen/background-documents/energy-use-water-utilities-eea-presentation-green-week-2012

[166] http://www.ippr.org/publication/55/1535/every-drop-countsachieving-greater-water-efficiency

[167] Quantifying the energy and carbon effects of water saving full technical report, Environmental Agency, 2009

[168] http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf

Table 3.29 Average energy consumption and range of variability estimated for water supply (water abstraction, impoundment, storage, treatment and distribution of surface water or groundwater

Water supply phase	Average energy consumption (kWh/m³)		
	Baseline	Best scenario	Worst scenario
Abstraction (4 sources)	0.37 (51%)	0.14 (37%)	0.56 (46%)
Treatment (2 sources)	0.17 (24%)	0.13 (34%)	0.40 (33%)
Distribution (2 sources)	0.18 (25%)	0.11 (29%)	0.25 (21%)
Total	0.72 (100%)	0.38 (-47%)	1.21 (+68%)
Abstraction, impoundment, storage, treatment and distribution (excluding data for USA) (4 sources)	0.63	0.47 (-25%)	0.90 (+43%)
Abstraction, impoundment, storage, treatment and distribution (including data for USA) (5 sources)	0.66	0.47 (-29%)	4.20 (+634%)

3.4.2 Waste water collection and treatment which subsequently discharges into surface water

Waste water treatment is the process of removing contaminants from domestic, industrial and commercial waste water[169]. Waste water treatment can, generally, involve the following stages:

- Waste water collection.
- Primary treatment, typically involving screening, grit and grease removal and sedimentation of suspended solid materials. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.
- Secondary treatment, to remove dissolved and suspended biological matter including organic matter.
- Tertiary treatment, including pathogens, nitrogen and phosphorus removal through both biological and chemical processes. Tertiary treatment may require a separation process to remove the microorganisms from the treated water prior to discharge or additional treatment.
- Additional treatments are employed when primary, secondary and tertiary treatments cannot accomplish all that is required. The purpose of the additional treatment is, in most cases, to remove additional nitrogen or phosphorus or, where required, pathogens and/or specific hazardous substances.

Data on energy consumption of waste water treatment plants are collected in Table 3.30. Values varying from 20 to 40 kWh per equivalent person per year have been proposed in 2012 within the GPP Criteria for Waste Water Infrastructure for well-operated waste water treatment plants. Values depend on many factors such as type of treatment, technology, size

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[169] http://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm

of plant, and composition of input waste water. Comparable data are provided in different studies, varying from 32 to 75 kWh per equivalent person per year[170] [171] [172] [173].

Referring to specific treatment operations, indications of typical energy/power consumption figures are for instance the following[174]:

- 4-4.5 W per m^3/hour and per m head for waste water pumps with an efficiency of 60-70%.
- 2-3 W per m^3 for mixing large water volumes in process tanks or digesters.
- 40-60 kWh/t of dissolved solids for sludge dewatering with centrifuges. Other sludge dewatering equipment can have lower energy consumption. For sludge drying and sludge incineration, the energy consumption depends on the type and equipment.

Tab. 3.30 Data on the energy consumption of the waste water system (waste water collection and treatment which subsequently discharges into surface water)

Supply phases	Country	Energy consumption (kWh/pe/y)	Source
Waste water treatment	EU	20-40	GPP Criteria for Waste Water Infrastructure, 2012[175]
Waste water treatment (based on 18 million people served in the EU)	EU	47	Suez Environnement, 2012 – data provided in EEA 2012[176]
Waste water treatment (review of some 40 utilities using different forms of waste water treatment, mainly in Europe)	EU	33	EBC, 2011[177]
Urban waste water treatment (plants serving populations ranging from less than 1 000 persons to more than 100 000)	Germany	32–75	EEA 2012[178]
Urban waste water treatment (analyses for 645 urban waste water treatment plants in North Rhine-Westphalia, Germany. 35 million pe served; 18 million inhabitants. Corresponding to 67 kWh/y/p)	Germany	34	Jacobsen, 2012[179] according to Olsson, 2012 (in press)

The German Federal Ministry for the Environment[180] has indicated that in 2007 almost 10,000 municipal waste water treatment plants were located in Germany, managed by more than 6,900 municipal waste water disposal companies. 10.1 billion m^3 of waste water were

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[170] http://www.eea.europa.eu/publications/towards-efficient-use-of-water

[171] http://www.eea.europa.eu/publications/towards-efficient-use-of-water

[172] EBC, 2011, *European Benchmarking Co-operation — Learning from international best practices*, 2010 Water and Wastewater Benchmark www.waterbenchmark.org

[173] http://projects.eionet.europa.eu/wise-tg/library/thematic-issues/water-utilities-resource-efficiency/european-water-utility-expert-meeting-13-14.12.2012-copenhagen/background-documents/energy-use-water-utilities-eea-presentation-green-week-2012

[174] http://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm

[175] http://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm

[176] http://www.eea.europa.eu/publications/towards-efficient-use-of-water

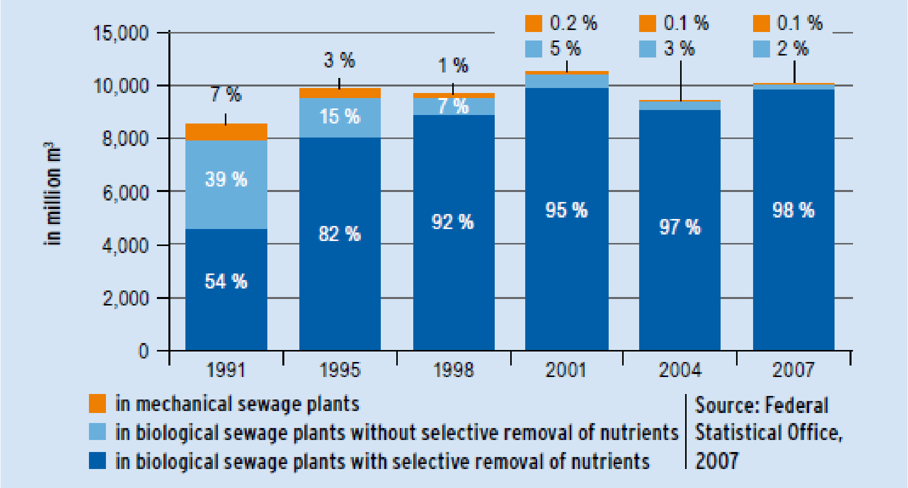
[177] EBC, 2011, *European Benchmarking Co-operation — Learning from international best practices*, 2010 Water and Wastewater Benchmark www.waterbenchmark.org

[178] http://www.eea.europa.eu/publications/towards-efficient-use-of-water

[179] http://projects.eionet.europa.eu/wise-tg/library/thematic-issues/water-utilities-resource-efficiency/european-water-utility-expert-meeting-13-14.12.2012-copenhagen/background-documents/energy-use-water-utilities-eea-presentation-green-week-2012

[180] http://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/faltblatt_wasserwirtschaft_en_bf.pdf

treated almost exclusively through biological waste water treatment, as shown in Figure 3.5. The volume of waste water is composed of sewage water, rainwater and infiltration water in almost equal parts. The length of the public sewage network was of approximately 540,000 km. Waste water plants are one of the biggest consumers of electricity in Germany, using around 4,400 GWh/y. The specific electricity consumption depends on the capacity of the sewage plant. As indicated in Figure 3.6, the specific electricity consumption of categories 4 and 5 plants is significantly lower than in smaller plants. In Germany there are around 2,200 category 4 and 5 sewage treatment plants (about one third of the total number of plants), but together they treat over 90% of the population equivalent and account for around 87% of total electricity consumption (see Figure 3.6). Based on these considerations, the distribution of energy consumption in Germany seems consistent with the average figure reported by EBC[181] (33 kWh per equivalent person per year in 2011), as indicated in Table 3.30.



Source: Federal Statistical Office, 2007

Fig. 3.5 Waste water volumes treated in public sewage plants in Germany

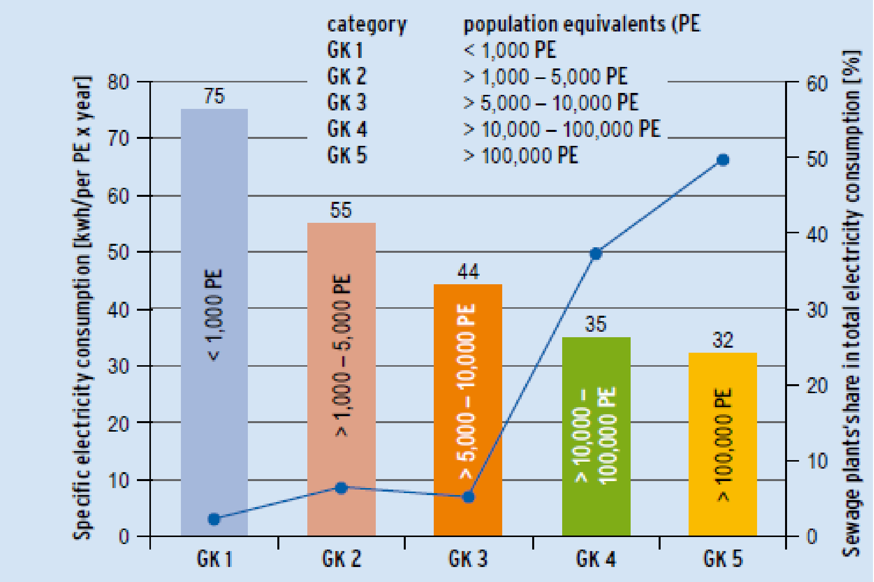


Fig. 3.6 Electricity consumption of municipal sewage plants in Germany

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[181] EBC, 2011, *European Benchmarking Co-operation — Learning from international best practices*, 2010 Water and Wastewater Benchmark www.waterbenchmark.org

Information so far collected refers to the population equivalents from different domestic and non-domestic activities. Estimation of the total consumption of energy per volume of waste water treated would only be possible after quantifying that parameter.

Data on energy consumption for waste water collection and treatment in different countries have been gathered through literature survey and stakeholder consultation and reported in Table 3.31. Average data are provided in Table 3.32, together with indications on the range of variability. The energy consumption for waste water collection, treatment and discharge into water basins has been estimated to be 1.97 kWh/m^3, on average. However, this can vary from 0.29 (-85%) to 10.27 (+422%) kWh/m^3. The breakdown between different stages is: 89% waste water treatment, 8% waste water collection, 3% effluent discharge into water basins.

The amount of energy for the downstream management of the waste water is 3.13 times the amount of energy required for the upstream water supply. For the purposes of this study, this energy demand is considered to be covered entirely with electricity.

Table 3.31 Energy consumption for waste water treatment (waste water collection and treatment which subsequently discharges into surface water)

Waste water phase	Country	Energy consumption (kWh/m^3)	GHG emissions (kg CO_2 eq/ m^3)	Source
Collection and treatment of sewage water in a typical medium city in Portugal	Portugal	0.82		ANQIP feedback
Collection and transport of sewage water	Sweden	0.16		Jacobsen, 2012[182] according to Olsson, 2012 (in press)
Treatment	Sweden	0.9-10		
Collection and treatment	UK	0.44	0.195	IPPR, 2006[183]
Collection and treatment	US	0.29-1.25		U.S. Department of Energy, 2006[184]
Waste water discharge	US	0-0.11		
Post-treatment: recycled water treatment and distribution for non-potable uses	US	0.11-0.32		

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[182] http://projects.eionet.europa.eu/wise-tg/library/thematic-issues/water-utilities-resource-efficiency/european-water-utility-expert-meeting-13-14.12.2012-copenhagen/background-documents/energy-use-water-utilities-eea-presentation-green-week-2012

[183] http://www.ippr.org/publication/55/1535/every-drop-countsachieving-greater-water-efficiency

[184] http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf

Table 3.32 Average energy consumption and range of variability for waste water treatment (waste water collection and treatment which subsequently discharges into surface water)

Waste water phase	Average energy consumption (kWh/m³)		
	Baseline	Best scenario	Worst scenario
Collection and transport	0.16 (8%)	Not Available	Not Available
Collection and treatment	1.87 (78%)	0.29	10.16
Waste water discharge	0.06 (3%))	0	0.11
Post-treatment: recycled water treatment and distribution for non-potable uses	0.22 (11%)	0.11	0.32
Total for water discharge	1.97	0.29 (-85%)	10.27 (+422%)
Total for water reuse	2.13	0.40 (-71%%)	10.48 (+393%)

In case of reuse of the effluent, the average figure has been estimated to increase to 2.13 kWh/m^3, the specific contribution due to the treatment of recycled water and the further distribution for non-potable uses being higher than that due to effluent discharge into water basins (on average 0.22 versus 0.06 kWh/m^3).

According to Jacobsen, 2012[185], energy savings of about 30% could be possible, most commonly by:

- electricity and heat production from the digester gas,
- utilising the heat energy contained in the sewage,
- in some cases by the use of hydropower from the slope of the waste water plants.

Based on a review of some 40 utilities using different forms of waste water treatment, mainly in Europe, EBC[186] has calculated a median energy recovery of around 7.5 kWh/pe/year (23%). Sewage treatment plants also have the possibility to be net suppliers of energy by producing biogas, which could be used for instance for domestic heating and public transport.

3.4.3 Water losses and saving in the water supply system

Considerable "loss" of water can occur in public distribution and supply networks:

- leakage from transmission and (or) distribution mains,
- leakage from utility's storage tanks, and
- leakage from service connections up to point of customer.

Leakage in water supply systems results in the loss of purified drinking water but also means wasting the energy and material resources used in abstraction and treatment. In cases where the supply pressure drops, the potential risk of bacterial contamination from the ground nearby can also occur.

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[185] http://projects.eionet.europa.eu/wise-tg/library/thematic-issues/water-utilities-resource-efficiency/european-water-utility-expert-meeting-13-14.12.2012-copenhagen/background-documents/energy-use-water-utilities-eea-presentation-green-week-2012

[186] EBC, 2011, *European Benchmarking Co-operation — Learning from international best practices*, 2010 Water and Wastewater Benchmark www.waterbenchmark.org

Distribution losses vary considerably across the EU. For example, EBC[187] reports distribution losses of about 5 m^3/day/km of mains in the supply network. According to the feedback from ANQIP, water losses are estimated to be 25% of the total supply in Portugal. Oakdene Hollins[188] has estimated that in England and Wales 22% of the water supplied in 2007-08 was lost through supply pipe or distribution leakage. Similar figures are provided for the USA by EPA[189] and for Australia[190]. In the USA, drinking water system losses are estimated as being as much as 20% of treated drinking water due to leaks in the pipe networks. In Australia, leakages in office and public building hydraulic systems and equipment are estimated to be 10-30%. Examples of leakage estimates for different EU countries are provided within the EU water-saving potential project developed by the Ecologic Institute in 2007[191] and listed in Section 3.2. Average losses of water in the EU-28 water distribution network have been estimated to be 24% of the water delivered to the final users.

In some European countries there has been a recent focus on saving water and decreasing leakage. In Denmark, for example, losses were reduced to 6-7 % from more than 10 % in 1996, and in England and Wales a programme of leakage reduction decreased network losses from 29% to 22% of the total distribution input between 1992/3 and 2000/1[192].

According to IWA[193], water loss management consists of the following:

- Pipeline and assets management, since preventive maintenance and network renewal are the main factors affecting leakage of a network.
- Pressure management. The most important aspect of pressure management is the control of surges and rapidly fluctuating pressures.
- Speed and quality of repairs.
- Active leakage location and control. Modern and in some cases emerging technologies can detect leaks, significantly reducing the time taken to discover and locate a leakage. They include sensors that use the noise generated by a leak to locate it, radars that can identify disturbed ground or cavities around a pipe, tracer gases and devices that use radio signals to detect the presence of flowing water.

Besides leakage reduction, additional water-saving methods in the distribution network include rainwater collection, reuse of grey water (household waste water except that from toilets) and waste water and efficient use of water in gardens and parks[194].

Rainwater harvesting could be one measure to reduce fresh water abstraction needs. Rainwater can be used for non-potable purposes inside the home for toilets and washing machines.

Grey water refers to all household waste water other than that from toilets, i.e. waste water from baths, showers, washbasins and the kitchen. In the most simple reuse systems grey water is stored and subsequently used, untreated, for flushing toilets and watering gardens (other than edible plants). Grey water from baths, showers and washbasins is generally

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[187] EBC, 2011, *European Benchmarking Co-operation — Learning from international best practices*, 2010 Water and Wastewater Benchmark www.waterbenchmark.org

[188] The Further Benefits of Business Resource Efficiency Oakdene Hollins A research report completed for DEFRA March 2011 – Final report

[189] Water Efficiency Saves Energy: Reducing Global Warming Pollution Through Water Use Strategies - March 2009 NRDC

[190] http://www.environment.gov.au/sustainability/government/publications/water-efficiency-guide.html

[191] http://ec.europa.eu/environment/water/quantity/pdf/water_saving_1.pdf

[192] http://ec.europa.eu/environment/water/quantity/pdf/water_saving_1.pdf

[193] IWA (2007): Water loss task force, Leak Location and Repair, Guidance notes, March 2007

[194] http://www.eea.europa.eu/publications/water-resources-across-europe

preferred to that from kitchen sinks and dishwashers since it is less contaminated. The reuse of grey water raises some public health concerns related to its microbiological quality. Its immediate use would be preferable, although approaches also exist that minimise the contamination of stored water. These include electronically controlled dump valves and use of chemical disinfectants such as chlorine.

Effluents from waste water treatment plants also represent a potential source of water supply. In Europe only 2.4% of the total waste water volume treated is reused (964 Mm^3/y)[195]. In areas where water is scarce, treated waste water provides an alternative source of water for irrigating crops. The practice is growing within Europe and it is particularly well established in Mediterranean countries as Cyprus, Greece, Italy and Spain.

3.4.4 Impacts on supply and sewage systems due to a decreased consumption of water

There is some concern about the fact that reduced flow rates could affect the normal functioning of water supplies and waste water management networks.

A significant decrease in water consumption could lead to the under-utilisation of water supply infrastructures and the prolongation of the stagnation time of water inside the distribution network.

Increasing the stagnation time of water inside the distribution network could have negative effects on the microbiological quality of drinking water. This risk could be managed though by diminishing key design parameters of pipelines[196]. However, it was pointed out by stakeholders that piping design should also take into account phenomena such as extreme weather events with high precipitation levels or peak drinking water demands in summertime.

In some countries like Germany, it was indicated that water companies are obliged to ensure a minimum flow of water in their pipes in order to ensure the drinkability of drinking water. In extreme cases, additional water abstraction may be necessary for flushing the pipelines. Moreover, it was reported by stakeholders that in Eastern Germany there are regions where the groundwater level is rising and this is requiring major investments to avoid damage to infrastructure and buildings.

A decrease in water consumption would also be associated with a decrease in the amount of waste water produced. Failure to reach the minimum flow rate in the sewage system could lead to stagnation and the formation of sedimentation zones as well as to long retention times. The risk is higher for large diameter pipelines. Long retention times could result in bacterial growth and, where oxygen content is low, in the formation of H_2S, HS-, S^2. Sulphate reductions could corrode concrete elements of the pipeline and produce a higher rate of leakage.

The UK Environment Agency[197] developed a study to examine the impact of increased efficiency of water-using appliances on waste water flow, waste water collection systems (drains and sewers) and waste water treatment. The study highlighted that:

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[195] Mediterranean EUWI Wastewater Reuse Working Group, 2007. *Mediterranean Wastewater Reuse Report*. Available at: http://www.emwis.net/topics/WaterReuse

[196] Inkinen, J.; Kaunisto, T.; Pursiainen, A.; Miettinen, I.T.; Kusnetsov, J.; Riihinen, K.; Keinanen-Toivola, M.M. (2014) Drinking water quality and formation of biofilms in an office building during its first year of operation, a full scale study. Water Research 49, 83-91

[197] Less water to waste Impact of reductions in water demand on wastewater collection and treatment Systems Science project SC060066 http://www.environment-agency.gov.uk/research/library/publications/33993.aspx

- reduced WC flush volumes offer the greatest water-saving opportunities,
- the most significant waste water discharges to drains/sewers are from the bathroom, with the WC providing the main force for moving sewer solids.

The results of the study indicate that, under some circumstances, reduced water consumption could result in poorer removal of solids. The problem would be more apparent in drains characterised by limited flows, such as those serving either a single property or a few single occupancy properties. WC flushes are the most important element for moving solids through drains. Other waste water discharges (e.g. from baths and showers) can also be significant in amount but their potential reduction is not considered to adversely affect the movement of solids. Thus, whilst the overall levels of water efficiency are unlikely to cause a problem for the operation of drains and sewers, it is the reduction in WC flush volumes that may be an issue. New technologies could help to reduce WC flush volumes without causing problems in the drainage system (for example, toilets using water and air to move solids).

Moreover, the likelihood of blockages and other operational problems caused by reduced waste water flows could be reduced by changing the design standards for drainage systems. However, because of the nature of infrastructures, the practical implementation of such measures would require some time (even decades) and investment of money. These modifications could include the use of smaller diameter pipes (even if subject to certain practical limitations due to the risk of obstruction), the use of pipelines with steeper gradients and the design of pipeline layouts where fewer pipes take very little flow. The study recommends a revision of existing drainage design standards to take planned flow reductions into account. In existing properties, the drainage layout should be taken into account before deciding whether to replace an old WC with a new lower flush model. Properties with higher risk of blockage are those in which drains serve a single property or a few single occupancy properties.

The study also considered the impact on treatment of a reduction in waste water discharged from houses. There is some uncertainty regarding the likely overall impact, as effluent concentration depends on both the volume and characteristics of the water discharged and on infiltration into the sewer system. However, a number of key factors may need to be addressed in the design of future plants or operational procedures in order to ensure appropriate treatment and operational efficiencies.

The study conclusions are that, while the full impact of demand reductions on waste water flows is not fully understood, it may result in increased sewer blockages and other operational problems such as odour complaints and sewer flooding. However, this would be mainly related to WC use and other issues can also contribute to the above-mentioned problems, such as:

- inappropriate use of sewers to dispose of food residues and solid material such as wipes;
- the poor condition of some drainage systems;
- reuse of rain water.

Therefore, the implications of reduced water demand must be seen in a larger context and a wider perspective. Investigations should be undertaken to better understand the interplay of waste saving with the correct operation of the water supply and waste water management network.

A study of the Plumbing Efficiency Research Coalition in 2012[198] also evaluated the influence of water-saving devices on the efficiency of the drainage system. In particular, the study is focused on toilets with a maximum average flush volume of 6.0 litres. It is reported that many plumbing experts have questioned whether these reduced flush volumes are approaching a tipping point where some sanitary waste systems would be unable to function properly. Of particular concern are larger commercial systems that have long horizontal runs to the sewer. Reduced consumption from toilets is one contributor to the decrease in liquids discharged to building drainlines. This change is the consequence of reduced indoor water use by many water-consuming devices and equipment. Given these changes, and ongoing efforts to further reduce water consumption, the need to better understand the function of drainlines, as currently constructed, is highlighted within the study.

The major finding of the study is that pipe slope, toilet paper, and flush volume are all significant factors for drainline performance while other characteristics of toilet flush discharge (e.g. the flush rate) are not. In particular, a key role is played by the wet tensile strength of toilet paper. The use of toilet paper with a lower wet tensile strength could effectively reduce the frequency of blockages. This possible remedy to chronic drainline blockages may be a first step towards the definition of a series of best management practices. Furthermore, a test has been developed to assess waste transport, which is significantly affected by pipe diameter. The results of the study indicate that 3 litres per flush volume may be problematic in commercial installations that have long horizontal drains and little or no additional long duration flows available to assist the toilet in providing drainline transport of solids. The study suggests that toilet paper selection also has the potential to be a very significant variable for the transport of solid waste in building drainlines. Experiments should be designed to determine how other materials, such as moisturised non-woven “wipes”, paper toilet seat covers, and other "flushable" consumer products impact drainline performance.

Finally, a study [199] has also been found that investigates the characteristics of waste water reused in situ as well as the impacts of waste water reuse on the functioning of the drainage system. It was found that both the flow rate and the speed of the waste water in the drainage network decrease. Flow rates registered in scenarios where there is an in situ reuse of water present an 8% maximum decrease. This reduction appears compatible with the existing network, according to the Portuguese regulations on minimum flow speed and shear stress. Reducing the diameter of the pipes would make the network more economical. According to the case study, even the pollutant load that is discharged into the public sewer can decrease with the reuse of water if a treatment is carried out within the building. In conclusion, the study shows that the water-saving measures can be compatible with the existing public networks without the need for adaptation.

The assessment of the potential impacts of water-saving measures on water supply and sewage systems is a topic that deserves attention and investigation. Based on the information collected, there does not seem to be enough evidence that a reduced consumption of water in taps and showers would be critical for the functioning of the water distribution and waste water management networks. Concerning the water distribution network, negative potential effects may be controllable through technological amendments to the design and management of sewage systems. If any, negative effects on the waste water

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[198] http://www.plumbingefficiencyresearchcoalition.org/projects/drainline-transport-of-solid-waste-in-buildings/

[199] Monteiro A.M., Matos C., Silva- Afonso A., Bentes I. " Study of the impact caused in sewerage networks by the “in situ” reuse of greywater" (personal communication)

management network seem to be associated to other factors such as toilet flushing and disposal of toilet paper and other materials in toilets. These effects however seem to be controllable through technological modifications to toilets and through technical actions aimed at improving the design and management of sewage systems. It should also be pointed out that the information available does not allow quantification of the level of water-saving that could be considered "critical". It could be assumed that the problems mentioned would only occur in case of extensive saving. Indications provided by stakeholders, for instance, indicate that problems in the draining system may occur further to a decrease in water consumption of 30-50%[200], which seems considerably higher than the potential saving achievable for this product group within this context.

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[200] Määttä, J. (1999). How saving of water will influence to the drainage system. VTT study (In Finnish)

3.5 System evaluation of water and energy consumption

Water and energy consumption from taps and showers has been calculated taking into account:

- the water loss and energy demand for the water supply system;
- the energy losses in the water heating system;
- the energy demand in the waste water treatment system.

Based on the information collected in the previous sections, the following assumptions have been made:

- EU average water losses in the water distribution system: 24%.
- Energy demand for water supply: 0.63 kWh per m^3 (variation range: -25% to +43%), considered to be electricity.
- Energy mix: 40% of hot water at the point of use from electricity (EU average total system efficiency 72%); 40% of hot water at the point of use from natural gas (EU average total system efficiency 50%); 20% of hot water at the point of use from oil (EU average total system efficiency 52%). Total average efficiency is considered to take into account any energy losses from energy conversion, heat exchange, standing losses and distribution. A total energy efficiency equal to 75% has been considered instead for the best scenario.
- Energy demand for waste water collection and treatment: 1.97 kWh per m^3 (variation range: -85% to +422%), considered to be electricity.
- To express results in terms of primary energy, 1 energy unit of electricity is considered equivalent to 2.5 units of primary energy from fossil fuels (equivalent to a conversion efficiency of 40%)[201].
- Data are considered to refer to the EU-28 average and the year 2012.

3.5.1 Total water abstraction

Total water abstraction considering losses of 24% in the water distribution network is presented in Table 3.33.

Total water abstraction for use in taps and showers in the EU-28 domestic sector is 21,637 million m^3/year (49% taps and 51% showers). The variation range over this value is -27% to +37%.

Total water abstraction for use in taps and showers in the EU-28 non-domestic sector is 3,224 million m^3/year (85% taps and 15% showers). The variation range over this value is -87% to +76%.

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[201] Cordella, M.; Stramigioli, C.; Santarelli, F. (2013) A Set of Coherent Indicators for the Assessment of the Energy Profitability of Energy Systems. Journal of Sustainable Bioenergy Systems, 2013, 3, 40-47, http://dx.doi.org/10.4236/jsbs.2013.31005

Total water abstraction for use in taps and showers in the EU-28 is 24,861 million m^3/year (87% domestic sector and 13% non-domestic sector). The variation range over this value is -35% to +42%.

Table 3.33 Total water abstraction per unit of taps and showers

	Taps			Shower		
	Baseline	Variation range		Baseline	Variation range	
Water consumption - domestic (M m^3/yr)	8060	-35%	49%	8384	-19%	25%
Water consumption - non-domestic (M m^3/yr)	2087	-87%	75%	363	-85%	82%
Water abstraction - domestic (M m^3/yr)	10605	-35%	49%	11032	-19%	25%
Water abstraction - non-domestic (M m^3/yr)	2746	-87%	75%	478	-85%	82%

3.5.2 Total demand of energy carriers for the product system

In the present study, the total demand of energy carriers has been defined as the sum of energy units (e.g. MJ) of electricity, natural gas and oil requested for:

- water supply and waste water management (assumed to be electricity);
- production and delivery of hot water, including energy losses in the heating system.

With respect to water heating, four energy scenarios have been modelled, based on the assumption reported above:

- water heating based on the average energy mix;
- water heating through use of electricity;
- water heating through use of natural gas;
- water heating through use of oil.

The total demand of energy carriers has also been expressed in terms of primary energy by converting 1 energy unit of electricity into 2.5 units of primary energy from fossil fuels (equivalent to a conversion efficiency of 40%). The conversion factor for both natural gas and oil has been considered equal to 1, which is equivalent to neglecting distribution losses of energy along the fuel production and supply chain[202].

Results for the average energy mix are reported in Table 3.34. The average total demand of energy carriers (electricity and fossil fuels) in the domestic sector is as follows:

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[202] Cordella, M.; Stramigioli, C.; Santarelli, F. (2013) A Set of Coherent Indicators for the Assessment of the Energy Profitability of Energy Systems. Journal of Sustainable Bioenergy Systems, 2013, 3, 40-47, http://dx.doi.org/10.4236/jsbs.2013.31005

- 380 PJ/year for taps (variation range: -64% to +70%), which is 2.16 times the theoretical demand for hot water only. In terms of primary energy, the energy demand would be 1.74 times higher (variation range: -64% / +289%).
- 1310 PJ/year for showers (variation range: -37% to +46%), which is 1.81 times the theoretical demand for hot water only. In terms of primary energy, the energy demand would be 1.59 times higher (variation range: -48% to +107%).

The average total demand of energy carriers (electricity and fossil fuels) associated to the use of water in taps and showers in the EU-28 domestic sector is thus equal to 1693 PJ/year (22% taps and 78% showers). The variation range over this value is -43% to +118%. In terms of primary energy, the energy demand would be 1.62 times higher (variation range: -52% to +151%).

The average total demand of energy carriers (electricity and fossil fuels) in the non-domestic sector is as follows:

- 139 PJ/year for taps (variation range: -92% to +72%), which is 1.99 times the theoretical demand for hot water only. In terms of primary energy, the energy demand would be 1.67 times higher (variation range: -94% to +317%);
- 57 PJ/year for showers (variation range: -88% to +63%), which is 1.81 times the theoretical demand for hot water only. In terms of primary energy, the energy demand would be 1.59 times higher (variation range: -90% to +201%).

The average total demand of energy carriers (electricity and fossil fuels) associated to the use of water in taps and showers in the EU-28 non-domestic sector is thus equal to 196 PJ/year (71% taps and 29% showers). The variation range over this value is -91% to +236%. In terms of primary energy, the energy demand would be 1.65 times higher (variation range: -52% to +151%).

The average total demand of energy carriers (electricity and fossil fuels) associated to the use of water in taps and showers is thus 1890 PJ/year (90% domestic sector and 10% non-domestic sector). The variation range over this value is -48% to +131%. In terms of primary energy, the energy demand would be 1.62 times higher (variation range: -57% to +165%).

In terms of energy contributions:

- the energy contained in the hot water accounts for 46% to 55% (27-35% considering the demand for primary energy);
- the energy losses in the water heating systems account for 32% to 38% (42-55% considering the demand for primary energy);
- the waste water treatment accounts for 5% to 15% (7-22% considering the demand for primary energy);
- the water abstraction and delivery counts from 2% to 7% (3-10% considering the demand for primary energy).

Considering CO_2 emissions as an indirect measure of energy consumption, the resulting breakdown is comparable with a study of the UK Environment Agency[203], which estimates that 89% of carbon emissions in the water supply - use - disposal system are attributed to "water in the home", including energy for heating water (excludes space heating). The

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[203] Greenhouse gas emissions of water supply and demand management options Science Report – SC070010, 2008

contribution of public water supply and treatment emissions to the total is instead equal to 11%.

Calculations for the other energy scenarios are reported in Table 3.35 (electricity), Table 3.36 (gas) and Table 3.37 (oil). A comparison of the different scenarios is shown in Table 3.38.

Table 3.34 Average total demand of energy carriers associated to the use of water in taps and showers considering an average energy mix for heating water

	Domestic		Non-domestic	
	Taps	**Showers**	**Taps**	**Showers**
A. Energy demand for hot water (PJ/yr)	176	727	69.9	31.5
B. Total demand of energy carriers (PJ/yr)	380 (2.16 times A)	1310 (1.81 times A)	139 (1.99 times A)	56.8 (1.81 times A)
- *Water abstraction and delivery*	*7%*	*2%*	*5%*	*2%*
- *Water heating with energy mix*	*78%*	*93%*	*84%*	*93%*
- *Waste water treatment*	*15%*	*5%*	*11%*	*5%*
C. Primary energy demand (PJ/yr)	660 (3.74 times A)	2080 (2.87 times A)	233 (3.34 times A)	90.2 (2.87 times A)
- *Water abstraction and delivery*	*10%*	*3%*	*7%*	*3%*
- *Water heating with energy mix*	*68%*	*90%*	*77%*	*90%*
- *Waste water treatment*	*22%*	*7%*	*16%*	*7%*
Note: Total energy = electricity + heat				

Table 3.35 Average total demand of energy carriers associated to the use of water in taps and showers considering electricity for heating

	Domestic		Non-domestic	
	Taps	**Showers**	**Taps**	**Showers**
A. Energy demand for hot water (PJ/yr)	176	727	69.9	31.5
B. Total demand of energy carriers (PJ/yr)	327 (1.86 times A)	1090 (1.51 times A)	118 (1.69 times A)	47.4 (1.81 times A)
- *Water abstraction and delivery*	*8%*	*2%*	*6%*	*2%*
- *Water heating with energy mix*	*75%*	*93%*	*82%*	*93%*
- *Waste water treatment*	*17%*	*5%*	*12%*	*5%*
C. Primary energy demand (PJ/yr)	818 (4.64 times A)	2740 (3.77 times A)	296 (3.34 times A)	118 (3.77 times A)
- *Water abstraction and delivery*	*8%*	*2%*	*6%*	*2%*
- *Water heating with energy mix*	*75%*	*93%*	*82%*	*93%*
- *Waste water treatment*	*17%*	*5%*	*12%*	*5%*
Note: Total demand of energy carriers = electricity + heat				

Table 3.36 **Average total demand of energy carriers associated to the use of water in taps and showers considering gas for heating**

	Domestic		Non-domestic	
	Taps	**Showers**	**Taps**	**Showers**
A. Energy demand for hot water (PJ/yr)	176	727	69.9	31.5
B. Total demand of energy carriers (PJ/yr)	435 (2.47 times A)	1540 (2.12 times A)	161 (2.31 times A)	66.6 (2.12 times A)
- Water abstraction and delivery	*6%*	*2%*	*4%*	*2%*
- Water heating with energy mix	*81%*	*94%*	*87%*	*94%*
- Waste water treatment	*13%*	*4%*	*9%*	*4%*
C. Primary energy demand (PJ/yr)	595 (3.17 times A)	1670 (2.29 times A)	193 (2.76 times A)	72.2 (2.29 times A)
- Water abstraction and delivery	*11%*	*4%*	*8%*	*4%*
- Water heating with energy mix	*63%*	*87%*	*73%*	*87%*
- Waste water treatment	*26%*	*9%*	*19%*	*9%*
Note: Total demand of energy carriers = electricity + heat				

Table 3.37 **Average total demand of energy carriers associated to the use of water in taps and showers considering oil for heating**

	Domestic		Non-domestic	
	Taps	**Showers**	**Taps**	**Showers**
A. Energy demand for hot water (PJ/yr)	176	727	69.9	31.5
B. Total demand of energy carriers (PJ/yr)	421 (2.39 times A)	1480 (2.04 times A)	156 (2.23 times A)	64.2 (2.04 times A)
- Water abstraction and delivery	*6%*	*2%*	*4%*	*2%*
- Water heating with energy mix	*80%*	*94%*	*86%*	*94%*
- Waste water treatment	*14%*	*4%*	*10%*	*4%*
C. Primary energy demand (PJ/yr)	545 (3.09 times A)	2080 (2.87 times A)	233 (3.34 times A)	90.2 (2.87 times A)
- Water abstraction and delivery	*12%*	*4%*	*9%*	*4%*
- Water heating with energy mix	*62%*	*87%*	*71%*	*87%*
- Waste water treatment	*26%*	*9%*	*20%*	*9%*
Note: Total demand of energy carriers = electricity + heat				

Table 3.38 Variation range for the results obtained with the different energy scenarios

Energy scenario	Domestic						Non-domestic					
	Taps			Showers			Taps			Showers		
	Baseline	Variation range		Baseline	Variation range		Baseline	Variation range		Baseline	Variation range	
Energy mix (PJ/yr)												
- total demand of energy carriers	380	-64%	+70%	1310	-37%	+46%	139	-92%	+72%	56.8	-88%	+63%
- primary energy	660	-64%	+289%	2080	-48%	+109%	233	-94%	+317%	90.2	-90%	+201%
Electricity (PJ/yr)												
- total demand of energy carriers	327	-58%	+71%	1090	-40%	+48%	118	-93%	+74%	47.4	-89%	+65%
- primary energy	818	-58%	+251%	2740	-40%	+94%	296	-93%	+282%	118	-89%	+182%
Gas (PJ/yr)												
- total demand of energy carriers	435	-68%	+68%	1540	-57%	+45%	161	-95%	+71%	66.6	-92%	+62%
- primary energy	559	-71%	+325%	1670	-59%	+121%	193	-95%	+351%	72.2	-92%	+222%
Oil (PJ/yr)												
- total demand of energy carriers	421	-67%	+68%	1480	-56%	+45%	156	-94%	+71%	64.2	-92%	+62%
- primary energy	545	-70%	+331%	1610	-57%	+123%	188	-95%	+357%	69.8	-92%	+225%
Overall variation range (PJ/yr)												
- total demand of energy carriers	138-1350			658-2790			8.67-559			5.26-176		
- primary energy	163-2870			692-5300			10-1130			5.53-334		
Note: Total demand of energy carriers = electricity + heat												

3.6 Analysis of user behaviour and estimation of savings potential

As is generally the case for each product, the use of taps and showers is efficient if the product is used adequately. This is even the case for water/energy-saving technologies. Key factors influencing the performance of taps and showers include, for instance:

- market preference in terms of product and flow rate;
- user behaviour practices (e.g. frequency and length of use, wastage of water flow);
- influence of technology on user behaviour.

In addition, consumer education, potential targets and regulations can also play a significant role in addressing user behaviour and the usage pattern of the product.

Consultation of stakeholders and screening of the literature have provided information on the variation of flow rates and frequency of use of products. The elements collected in this section can also inform the rough estimation of the variation of impacts associated to changes in technology and user behaviour practices.

Information on the typical use of taps and showers is reported in Table 3.39. Three scenarios have also been defined for the water consumption in taps and showers (baseline scenario, best scenario and worst scenario), as shown in Table 3.40.

Table 3.39 Indicative information gathered from stakeholders on the average individual use of taps and showers

	Daily frequency per user	Volume of water	Wastage of water
Baths	0.2 in the UK, less in Germany and tending to zero in other European countries	155-185 L (40% actual)	0-10%
	Daily frequency per user	**Time of use**	**Wastage of water**
Showers	1 (0.6-1.5)	7 min (2.5-12 min)	10% (0-20%)
Washbasin taps	5 (3-7); at weekends it could be higher, for instance 7 (3-10)	1 min (0.1-2 min)	10% (0-50%)
Kitchen taps	5 (3-7)	1 min (0.5-2.5 min)	10% (0-20%)

Table 3.40 Indicative scenarios defined with stakeholders for the water consumption from taps and showers

	Baseline	Best scenario	Worst scenario
Baths	185 L (50% actual)	155 L (40% actual)	200 L (60% actual)
Showers	10 L/min	6 L/min	14 L/min
Washbasin taps	7 L/min	5 L/min	10 L/min
Kitchen taps	8 L/min	5 L/min	11 L/min
Note: values are considered to express flow of water in normal conditions of use.			

This information has been used to analyse how water performance can be affected by user behaviour practices and a change in the flow rate of the products. Additional information on water- and energy-saving technologies is reported in Section 4. Uncertainty associated to the analysis of user behaviour practices is also discussed.

3.6.1 Showering

The average time spent using a shower can vary from 2.5 to 12 minutes and the wastage of water associated with an inefficient use is 0-20%. An average usage time of 7 minutes has been identified. This value is supported by studies available in the literature that analysed in detail conditions of use of shower in Portugal[204] and the UK[205].

Three scenarios have been modelled, based on the information reported in Table 3.39 and in Table 3.40. The consumption of water associated with the use of a shower is:

- 77.8 L/use in the baseline scenario;
- 15 L/use in the best scenario (-81%);
- 210 L/use in the worst scenario (+170%).

The savings potential associated with the transition from typical conditions of shower use to the improved technological and behavioural level set with the best scenario is estimated to be 81%. Inefficiency in the selection and use of the product can otherwise worsen the water performance of the product (+170%).

Compared to the baseline scenario, it is considered that the water consumption can vary from -40% to +40% by changing the water flow only, and from -68% to +93% by changing other user habits.

In general, there seems to be some concern that a decrease in water flow rates may slightly prolong the use of products. The quantification of such an effect for different products and activities is difficult, due to the lack of studies. A study[206] has highlighted that the use of lower flow rates could lengthen the use of showers so that the actual savings potential would in reality decrease by about 15%. Although referring to specific product characteristics and conditions of use, in the absence of more specific information, it was considered relevant to take this effect into account by introducing an average compensation factor equal to 85%. This can be considered a conservative factor.

Based on the information collected, the theoretical water-saving potential that could be achieved by using a lower flow rate could thus be 34% (85% of 40%), with reference to the baseline. This would increase to 69% (85% of 81%) in the more optimistic scenario that also considers a behavioural change in the user.

Frequency of use can have an additional influence (-40%/+50%) but this could be associated to specific needs of the user and it also affects the use of water in other appliances. This element has thus been decoupled from the previous considerations on the water-saving potential of the product.

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[204] C. Pimentel-Rodrigues, A. Silva-Afonso (2012) "Water efficiency of products. Comfort limits". Proceedings of the CIBW062 Symposium 2012

[205] http://www.energysavingtrust.org.uk/About-us/The-Foundation/At-Home-with-Water

[206] C. Pimentel-Rodrigues, A. Silva-Afonso (2012) "Water efficiency of products. Comfort limits". Proceedings of the CIBW062 Symposium 2012

3.6.2 Bathing

Three scenarios have been modelled for bathing, based on the information reported in Table 3.38 and Table 3.39. The consumption of water associated with the use of a bathtub is:

- 92.5 L/use in the baseline scenario;
- 62 L/use in the best scenario (-20%);
- 133.3 L/use in the worst scenario (+71%).

The savings potential associated with the transition from typical conditions of bathtub use to the improved conditions set with the best scenario is estimated to be 20%. Inefficiency in the selection and use of the product can otherwise worsen the water performance of the product (+71%).

Based on the information collected, the theoretical water-saving potential that could be achieved by more efficient use of the bathtub is 20%.

In the event that the use of the bathtub is replaced by showering and that conditions of use are kept fixed, the resulting theoretical improvement potential could vary from 17% (85% of 20%) for a shower water flow rate of 10 L/minute to 44% (85% of 52%) for a shower water flow rate of 6 L/minute.

3.6.3 Washbasin taps

Excluding applications in which a volume has to be filled, where volume and not time is the critical factor, the time of use of washbasin taps can vary from 0.1 to 2 minutes and the wastage of water associated with an inefficient use is 0-50%.

Three scenarios have been modelled, based on the information reported in Table 3.39 and in Table 3.40. The consumption of water associated with the use of a washbasin tap is:

- 7.8 L/use in the baseline scenario;
- 0.5 L/use in the best scenario (-94%);
- 40 L/use in the worst scenario (+414%).

The savings potential associated with the transition from typical conditions of washbasin tap use, in applications requiring a "free" flow of water, to the improved technological and behavioural level set with the best scenario is estimated to be 94%. Inefficiency in the selection and use of the product can otherwise worsen the water performance of the product (+414%).

Compared to the baseline scenario, it is considered that the water consumption can vary from -29% to +43% by changing the water flow only, and from -91% to +260% by changing other user habits.

In general, there seems to be some concern that a decrease in water flow rates may slightly prolong the use of products. The quantification of such an effect for different products and activities is difficult, due to the lack of studies. A study[207] has highlighted that the use of lower flow rates could lengthen the use of showers so that the actual savings potential would

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[207] C. Pimentel-Rodrigues, A. Silva-Afonso (2012) "Water efficiency of products. Comfort limits". Proceedings of the CIBW062 Symposium 2012

in reality decrease by about 15%. Although referring to specific product characteristics and conditions of use, in the absence of more specific information, it was considered relevant to take this effect into account also for washbasin taps by introducing an average compensation factor equal to 85%. This can be considered a conservative factor.

Based on the information collected, the theoretical water-saving potential that could be achieved by using a lower flow rate could thus be 24% (85% of 29%), with reference to the baseline. This would increase to 80% (85% of 94%) in the more optimistic scenario that also considers a behavioural change in the user.

The savings potential described could be achieved in almost all the bathroom applications involving the use of washbasin taps.

Frequency of use can have an additional influence (+/- 40%) but this could be associated to specific needs of the user and it also affects the use of water in other appliances. This element has thus been decoupled from the previous considerations on the water-saving potential of the product.

3.6.4 Other taps

Excluding applications in which a volume has to be filled, where volume and not time is the critical factor, the time of use of kitchen taps can vary from 0.5 to 2.5 minutes and the wastage of water associated with an inefficient use of the product is 0-20%.

Three scenarios have been modelled, based on the information reported in Table 3.39 and in Table 3.40. The consumption of water associated with the use of a kitchen tap is:

- 8.9 L/use in the baseline scenario;
- 2.5 L/use in the best scenario (-72%);
- 34.4 L/use in the worst scenario (+287%).

The savings potential associated with the transition from typical conditions of kitchen tap use, in applications requiring a "free" flow of water, to the improved technological and behavioural level set with the best scenario is estimated to be 72%. Inefficiency in the selection and use of the product can otherwise worsen the water performance of the product (+287%).

Compared to the baseline scenario, it is considered that the water consumption can vary from -38% to +38% by changing the water flow only, and from -55% to +181% by changing other user habits.

In general, there seems to be some concern that a decrease of water flow rates may slightly prolong the use of products. The quantification of such an effect for different products and activities is difficult, due to the lack of studies. A study[208] has highlighted that the use of lower flow rates could lengthen the use of showers so that the actual savings potential would in reality decrease by about 15%. Although referring to specific product characteristics and conditions of use, in the absence of more specific information, it was considered relevant to take this effect into account also for kitchen taps by introducing an average compensation factor equal to 85%. This can be considered a conservative factor.

Based on the information collected, the theoretical water-saving potential that could be achieved by using a lower flow rate could thus be 32% (85% of 38%), with reference to the

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[208] C. Pimentel-Rodrigues, A. Silva-Afonso (2012) "Water efficiency of products. Comfort limits". Proceedings of the CIBW062 Symposium 2012

baseline. This would increase to 61% (85% of 72%) in the more optimistic scenario that also considers a behavioural change in the user.

Dish washing could be an example of application where the savings potential described could be achieved. No other significant uses can be identified.

Frequency of use can have an additional influence (+/- 40%) but this could be associated to specific needs of the user and it also affects the use of water in other appliances. This element has thus been decoupled from the previous considerations on the water-saving potential of the product.

3.6.5 Preliminary assessment of water- and energy-saving potential

Water consumption from taps and showers is a function, among others, of technology and user behaviour. A significant use of energy is also associated with the use of water in taps and showers, as shown in this section. It is thus evident that both water and energy savings can be achieved by acting on both technology and user behaviour.

The influence of behaviour on the use of water in taps and showers has been analysed in this section, showing that practice of use can dramatically affect the total water consumption from the products. Any attempts to estimate such an influence at EU level would be characterised by some uncertainty. The savings potential associated with a change in user habits could be significant, as shown in Sections 3.6.1 to 3.6.4 (69% for showers, 80% for washbasin taps, 61% for other taps).

Some influence on the user behaviour could be achieved through the monitoring of water consumption with water meters. Water meters can potentially be installed at the entrance of whole apartments/houses (central water meters) or on individual products. According to the Energy Saving Trust[209], central water meters are installed in 43% of the UK's houses. This device is considered to help reduce water consumption at home by 3%.

Some stakeholders, however, pointed out that key issues for saving water are education of users and financial pressure of the water bill. However, the focus of this section is on the estimation of the savings potential achievable through a change of technology, for instance through the promotion of water- and energy-saving products.

User behaviour is a key element for determining the actual consumption of water and energy. This underlines the importance of the culture and education of users. However, since the main focus of this study is at the product level, the savings potential achievable through a change of product design characteristics has been estimated in this section. The savings potential has been modelled as the result of: a) reduction of water flow; and b) improved control of temperature and water flow.

Without including any other behavioural factors and in accordance with the analysis presented above, the theoretical maximum water-saving potential associated to the use of lower flow rates would be:

- 29% for washbasin taps and 38% for other taps, and
- 40% for showers.

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[209] http://www.energysavingtrust.org.uk/About-us/The-Foundation/At-Home-with-Water

With regard to taps, washbasin taps have been taken as a reference product because they are considered to provide a more representative and conservative theoretical maximum water-saving potential. The switch from bathing to showering could lead to an additional saving of 20-44%.

Information on different water- and energy-saving technologies are included in Section 4, where it is interesting to observe that the technologies available on the market can offer the possibility to achieve the overall savings potential indicated here.

The distribution of the products in terms of their average maximum flow rate has also been estimated based on consultation with stakeholders. This has been reported in Table 3.41.

Table 3.41 Estimated average maximum water flow rate of taps and showers at EU-28 level based on information from stakeholders

	2013[a]	Short term[a]	Medium-long term[a]	Baseline[b] (L/min)	Theoretical limit[b] (L/min)
	Average (L/min)	Average (L/min)	Average (L/min)		
Taps[c]	8.0	6.0	5.3	7	5
Showers[d]	11.3	9.7	8.0	10	6

(a) Maximum flow rates.
(b) Real flow.
(c) Washbasin taps considered as reference product for taps.
(d) 6 L/min may be needed to ensure operation, 8 L/min may be the technical limit to avoid the risk of scalding.

Considering the baseline as a reference and the values reported in Table 3.41 as the target, it is estimated that the theoretical maximum water-saving potential achievable in the medium-long term through a decrease in the average flow rate could be 29% for taps and 20% for showers.

Intervals of variation of the theoretical maximum water-saving potential have been built based on the results from the two estimation procedures:

- 24-29% for taps,
- 20-40% for showers.

Introducing a conservative factor equal to 85% to take into account that reduced flow rates could increase the usage time of taps and showers, the corrected theoretical maximum water savings potential would be:

- 20-24% for taps (22% as average),
- 17-34% for showers (25.5% as average).

These are considered to be the savings that would be achieved if taps and showers were replaced by products which would decrease the flow rate from 7 L/minute for taps to 5-5.3 L/minute and from 10 L/minute for showers to 6-8 L/minute. Nevertheless, based on a simulation performed in a domestic water network, it was observed that pressure regulating valves and pipe sizing may also have a significant influence on water consumption[210].

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[210] M. Peltonen (2012). Simulating a domestic water network inside a building with a hydraulic model. Final dissertation for defending the Master's Degree in Engineering at the Aalto University

Direct energy saving is associated to the reduction of water consumption. In the French scheme for the calculation of the energetic performance of new buildings[211], default hot water-saving values are assigned to different valves:

- "normal" tap or mixer: no saving potential;
- "C3 valve" (single control valve with mechanical brake and cold water middle position): 5% saving per tap in households;
- "CH3 valve" (single control valve with flow regulation at 6L/minute and cold water in middle position): 5% saving per tap in households;
- thermostatic valves: 5% saving per tap in households;
- self-closing valves (push button or electronic): 7% saving per tap in households.

An additional savings factor has been assigned to some technologies which are considered to provide some added value in terms of water and energy control (e.g. thermostatic valves; two-stage valves; self-closing valves). In accordance with input received from stakeholders, push taps have been "penalised" (0-5% bonus) compared to sensor taps (0-7% bonus), the latter being considered to provide a better control of the water flow. Based on this, the revised theoretical maximum savings for different technologies would be:

- 20-24% (22%) for taps with aerators and flow regulators;
- 20-29% (24.5%) for taps with mechanical brakes (e.g. two-stages cartridge taps, flow boosters);
- 20-29% (24.5%) for push taps;
- 20-31% (25.5%) for sensor taps;
- 17-39% (28%) for shower systems based on thermostatic valves, mechanical brakes, automatic valves;
- 17-34% (25.5%) for other shower systems.

Although only explicit for the technology (taps with aerators and flow regulators), such devices and others for the control of flow rates can be integrated into all the other options. In fact, these saving technologies have already been commonly used in the last decade. Without integrating such devices, the savings potential of single technologies could be lower, the savings potential being modelled as the result of: a) reduction of water flow (considered the same for all design options applying a technologically neutral approach); and b) improved action and control on temperature and water flow

Focusing on products at the point of use, energy saving can be considered to be associated with saving water and the control of temperature. Without considering variations of the temperatures set by users, the reported savings have been assumed to also be representative in terms of energy.

Assuming that 40% of the showers and taps installed in the domestic and non-domestic sectors have one of these technologies implemented, the theoretical maximum water/energy savings potential has been corrected with an additional saving factor of 0-3% (1.5% average):

- 20-27% for taps (23.5% average);

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[211] http://rt2012.senova.fr/telechargements/Annexe-arrete-methode-de-calcul-TH-B-C-E-2012-CSTB.pdf

- 17-37% for shower systems (27% average).

These savings are considered to be effectively achieved in the short-medium term (10 years, indicatively):

- for 21% of the water consumed in taps (corresponding to the use of water in 60% of washbasin taps and 60% of kitchen taps used for dish washing, which together make up 35% of water use from taps);
- for 60% of the water consumed in shower systems.

The following assumptions have been considered for roughly estimating the actual water- and energy-saving potential of the stock of taps and showers in the short-medium term:

- No switch from bathing to showering.
- Water-saving potential of taps is 23.5% on average (variation range: from 20% to 27%).
- Water-saving potential of shower systems is 27% on average (variation range: from 17% to 37%)
- The above-mentioned water saving can be effectively achieved in 21% of taps (variation range: from 20% to 35%) and 60% of showers (variation range: from 45% to 100%) in the short-medium term.
- Water and energy savings potential is the same.
- Effects due to the parallel implementation of policy tools have been ignored.

Based on these assumptions, the resulting water- and energy-saving potential which could be on average achievable in the EU in the short-medium term is:

- 5% for water used in taps (variation range: from 4% to 9%);
- 16% for water used in showers (variation range: from 8% to 37%).

However, it has to be pointed out that consumer behaviour could have a dramatic influence on the results, which could also deviate from these general indications for specific product designs/markets.

The estimations are aligned with the indications provided by stakeholders involved in the project, suggesting that the water-saving potential can be 20-50% and achievable for 20% of taps (4-10%) and 45% of showers (9-22.5%). Figures are also compatible with information provided for public buildings in Loire Bretagne (France)[212], indicating that water savings can be between 0% and 30%.

Estimated values have been used for quantifying the overall water-saving potential at EU-28 level. Results are shown in Table 3.42. The energy-saving potential associated with saving water has also been calculated and reported in Table 3.42.

The total EU-28 water saving from taps and showers, which could be achieved through a change of products and technology in the short-medium term, has been estimated to be

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[212] http://ec.europa.eu/environment/water/quantity/pdf/water_saving_1.pdf

2520 million m^3/year, distributed 92% in the domestic sector and the other 8% in the non-domestic sector. This saving would represent:

- 11% of the total water abstraction for taps and showers in the EU-28, and
- 5% of the total water abstraction for urban use in the EU-28.

Considering the uncertainty regarding the use of water in taps and showers, the savings potential could vary from -61% to +192% of the values reported.

The energy saving from taps and showers in the EU-28 which could be achieved through a change of products and technology in the short-medium term has been estimated to be 386 PJ of primary energy per year (131 PJ/year without considering system aspects), distributed 96% in the domestic sector and the other 4% in the non-domestic sector. This saving would represent 13% of the total system demand for primary energy for taps and water in the EU-28.

Considering the uncertainty regarding the demand for energy in taps and showers, the savings potential could vary from -74% to +426% of the values reported.

In practical terms, comparing estimated values with those of ecodesign measures already implemented for other product groups[213], it is considered that the energy-saving potential associated to taps and showers can be extremely high, as highlighted in Table 3.43.

Table 3.42 Estimated water- and energy-saving potential from taps and showers at EU-28 level

	Domestic		Non-domestic		Total
	Taps	Showers	Taps	Showers	(variation)
Water saving (M m^3/yr)	525	1790	136	77	2520 (-61%/+192%)
Energy saving in terms of demand for hot water (PJ/yr)	8.72	118	3.46	1.56	131 (-69%/+265%)
Energy saving in terms of system energy demand					
- total demand of energy carriers (PJ/yr)	18.8	213	6.89	2.81	241 (-72%/+236%)
- primary energy (PJ/yr)	32.6	338	11.5	4.46	386 (-76%/+426%)
- primary energy	27.3	846	163	187	NA

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[213] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/files/brochure_ecodesign_en.pdf

Table 3.43 Ranking of energy-saving potential for different product groups

Product group	Estimated savings in terms of primary energy[a, b] (PJ/yr)	% normalised to total without considering taps and showers
Energy saving from taps and showers in terms of system energy demand – upper limit	**2032**	**62%**
Electric motors	1215	37%
Energy saving from taps and showers in terms of system energy demand – average	**386**	**12%**
Domestic lighting	351	11%
Street and office lighting	342	10%
Standby	315	10%
Fans	306	9%
Televisions	252	8%
Circulators	207	6%
System energy demand for taps and showers – lower limit	**93**	**3%**
Air conditioners and comfort fans	99	3%
External power supplies	81	2%
Simple set top boxes	54	2%
Domestic refrigerators	36	1%
Domestic dishwashers	18	1%
Domestic washing machines	14	0%
Total without considering taps and showers	3294	

(a) In-house calculation based on the values reported in http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/files/brochure_ecodesign_en.pdf (1 PJ of power considered equivalent to 2.5 PJ of primary energy).
(b) Estimated at 2020 for product groups other than taps and showers / theoretical savings potential in the short-medium term for taps and showers.

3.7 Product use, maintenance and end-of-life

The environmental and economic performance of taps and showers is inherently influenced by the time after which the product is replaced with a new one. Taps and showers are often changed before they fail, due to personal preferences and fashion. Information on typical lifespans is reported in Section 2.

The use phase of taps and showerheads will, in addition to water and energy, require maintenance and repair during their lifetime. This may include replacement valves and washers. The frequency of the replacement of parts for taps and showerheads is considered to be limited. Section 2 includes information on the costs of the product and on installation, repair/maintenance and utilities prices (e.g. water and electricity).

Feedback from stakeholders indicates that taps are generally recycled at the end of their lifespan, due to their metal content which has value. Taps and showers that need to be disposed of are handled by professionals (plumbers or builders). These usually give products to recyclers. In case of disposal of the product by the user, a large proportion is still considered to be recycled due to the increasing pressure of public authorities to recycle household waste and the consequent availability of facilities where these products can be disposed of.

4 ANALYSIS OF TECHNOLOGIES

4.1 Introduction

This section aims at analysing technical aspects related to taps and shower systems. Typical products on the market and alternative design options are described including indications on the use of materials, product performance and costs. Additionally, information on product manufacturing, distribution, durability and end-of-life is reported. The best available technologies and technological trends are also analysed as far as possible.

Background information on technologies was gathered before the development of the EU Ecolabel and GPP criteria for sanitary tapware[214,215]. This has been revised based on updated information collected during the development of this study.

4.2 Technical description of products

Taps and showers for the domestic and non-domestic sectors are produced in a variety of designs, using a range of different materials and varying functionality depending on their intended use. This section provides an overview of the key common elements of these products.

The mains water pressure across Europe varies considerably. Taps and showers are designed to work optimally either in high-pressure or low-pressure systems, depending on whether the water pressure is above or below 1 bar.

The type of water supply system is the first parameter to consider when selecting a product in order to ensure it is suitable for use with the system in which it will be used.

In continental Europe the mains water pressure tends to be above 1 bar, 3 bars in general. This is the pressure at which high-pressure system products are typically tested.

Gravity-fed low-pressure systems are generally characterised by the presence of a water tank in the loft and a separate hot-water cylinder in the airing cupboard[216]. The typical pressure of low-pressure systems is between 0.1 and 0.4 bar. At these pressures the design imperative is to gain as much flow as possible (e.g. a shower at 0.1 bar may only be capable of delivering 3 or 4 litres per minute). According to stakeholders, low-pressure systems constitute around 50% of the market in the UK, Ireland and some Eastern countries.

Different types of taps and showers have been introduced in Section 1 on the scope (technical definition and classification) and in Section 2 on market analysis (elements on costs). Additional technical details on key components and mechanisms used in taps and showers are reported here.

4.2.1 Taps

Taps control the release of water through two main types of mechanisms:

- spindles (original mechanism);
- ceramic discs (modern mechanism).

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[214] http://susproc.jrc.ec.europa.eu/ecotapware/docs/Task%204_Report_Base_Case_Assessment%20Final_Sept.2011.pdf

[215] http://susproc.jrc.ec.europa.eu/ecotapware/docs/BAT%20Report%20Final_Sept%202011.pdf

[216] http://www.bathroom-association.org/pdf/10steps-c-guide.pdf

4.2.1.1 Spindle taps

Spindle taps were, in the past, the only type of mechanism available for supplying water. They are still used across the EU since they can be used in both high- and low-pressure systems. The principle on which they operate is simple, the flow rate being controlled by turning the tap head.

Spindle taps are typically composed of several components, as shown in Figure 4.1. The tap consists of a spindle with a valve seat placed at the bottom of the spindle. A washer is attached to the end of the spindle and it is positioned over the hole through which water flows. As the handle is turned it moves the washer up or down to adjust the flow.

The various parts of the tap are generally robust and hard-wearing. During the lifetime of a spindle tap, the key components likely to require replacing are tap washers, O-rings or regrinding of the valve seat where this has been eroded[217].

This mechanism is typically used in pillar taps, which are mainly used in the UK. According to some stakeholders, in the UK the "traditional" look in the bathroom with pillar taps is still desirable. However, other countries also have a significant pillar tap market.

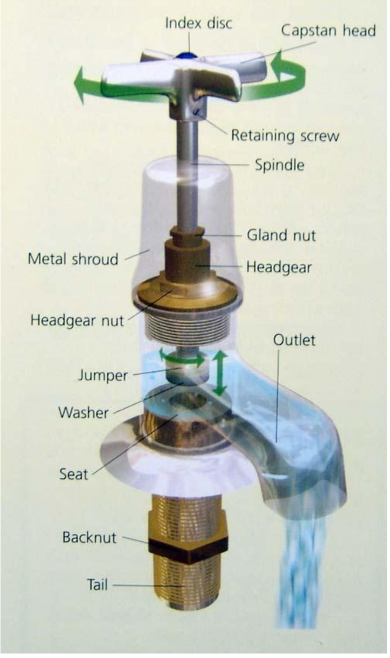

Figure 4.1 Spindle tap mechanism and components[218]

4.2.1.2 Ceramic disc taps

Taps based on ceramic discs operate differently to spindle taps. In this case, water flow is controlled through two ceramic discs in the tap body that are separated when the handle is turned or lifted. As illustrated in Figure 4.2 for a single-lever mixer tap, some components of a ceramic disc tap are the same as those of a spindle tap but the mechanism differs.

The main components of a ceramic disc tap are (see photo 1 in Figure 4.2):

- spout (A);
- tap cartridge (B);
- handle (C);
- retaining screw (D);
- screw cover / hot-cold indicator (E).

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[217] http://www.diydoctor.org.uk/projects/dripping_tap.htm

[218] http://www.upperplumbers.co.uk/plumbing/Plumbing_principles/taps.html

The main element of this type of tap is the cartridge, which consists of a number of parts itself (see photo 2 in Figure 4.2):

- disc-retaining washer (A);
- ceramic discs (B);
- O-ring which stops any water seepage up to the head of the tap (C);
- valve retaining nut (D);
- spindle on which the handle sits (E).

As with spindle taps, ceramic disc taps are designed to be hard-wearing. Ceramic discs are the key component and they are designed to be durable and it is unusual for them to wear out completely. However, if new discs are needed, the whole tap cartridge is usually replaced.

Figure 4.2 Components of a ceramic disc tap (Photo 1) and of the tap cartridge (Photo 2)[219]

In general, ceramic disc taps require a certain pressure at which to operate in order to provide an acceptable flow rate. However, the design of the tap (e.g. the size and alignment of the discs, the diameter of the opening which water can pass through and the resistance provided) can be adapted to the pressure at which they will operate, from 0.1 bar to higher pressures (e.g. 0.5 bar, 1.0 bar and above). However, given the fact that low-pressure systems in Europe can be mainly found in the UK, Ireland and some Eastern countries, the majority of ceramic disc taps are designed for higher pressure systems. In order to ensure that an acceptable flow rate is achieved, it is important that taps are properly designed for the pressure system with which they are intended to be used and that the minimum/maximum pressure of use are clearly communicated.

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[219] http://www.diydoctor.org.uk/projects/ceramic_disc_taps.htm

4.2.1.3 Evolution of the control technology

In terms of technology evolution, the first taps/valves had two handles. These are still used mainly for high-end decorative products and for thermostatic mixers.

Single-lever taps/valves were invented in 1937 and became popular in the 1990s thanks to ceramic disc cartridge improvement in terms of performance and reliability. This gave increased possibilities to manufacturers for researching and developing product design lines. The market for this type of products is very mature and many tap manufacturers produce their own cartridges.

In the late 1980s-1990's, the market saw the introduction of thermostatic valves. The reliability of components has improved since the 1990s for the benefit of comfort and security. The trend is now towards downsizing, inclusion of water-saving features and further penetration of thermostatic valves, at least in the shower valve sector for the domestic market.

4.2.2 Showers

Showers are systems composed of one or more outlets (e.g. showerheads and/or a hand showers) and interrelated control valves and/or devices for regulating water flow and temperature (e.g. through a mixer/thermostatic element).

The shower outlet delivers water to the end-user and it is usually connected to the valve via a hose or, if it is wall-mounted, via a shower arm. The showerhead is a typical outlet and its design and components can vary depending on the type and complexity of the product. For instance, some showerheads have aerators or built-in flow regulators. Some examples of outlets are provided in Figure 4.3 together with an indication of the main components. Shower outlets can consist of:

- a body;
- a spray disc/plate;
- seals (e.g. nitrile rubber seals);
- a flow regulator / aerator mechanisms (depending on the product design).

A built-in water heater is present in electric instantaneous showers. Safety aspects are of key importance for this specific product group, which was included in the preparatory study for "Eco-design of Water Heaters"[220],

Elements presented in Section 4.2.1 for taps can also be applied to valves used in shower systems. Further description of thermostatic mechanisms is provided in Section 4.3.5.

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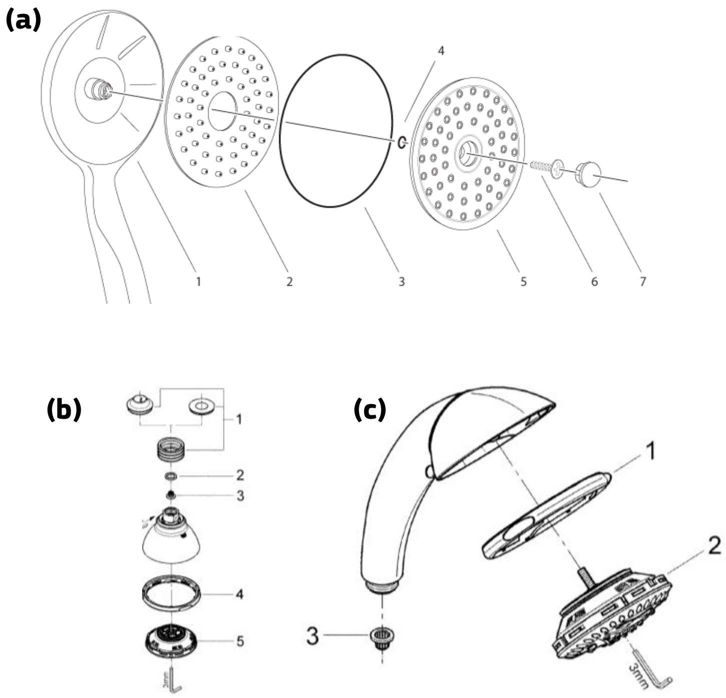
[220] http://www.ecohotwater.org/



(a) Single spray showerhead[221].
(b) "Champagne" showerhead[222].
(1 – Bellow, 2 – sealing washer, 3 – strainer, 4 – adjusting ring 5 – spray faceplate).
(c) Massage hand shower[223] (1 – adjusting ring, 2 – spray faceplate, 3 – strainer).

Figure 4.3 Examples of shower outlets

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[221] http://www.wayneansell.com/portfolio/hh-336n_diagram_lrg.png

[222] http://www.showerdoc.com/shower-spares/grohe/GROHE-PARENT-37-Grohe- movario-Head-Shower-Champagne-1-2in-28-396

[223] http://www.showerdoc.com/shower-spares/grohe/GROHE-PARENT-32-Grohe-Movario-Handshower-Massage-28-391

4.3 Technologies, design cycles, trends and examples of products

In recent years there has been increasing interest in improving resource efficiency in different industry sectors. This is also the case concerning the use of hot and cold water in taps and showers, both in terms of product system performance and user behaviour.

The increased focus on water efficiency generally results from a number of key drivers:

- The cost of supplying water is increasing and these costs are passed on to consumers in the form of higher water bills. In response to this, consumers and businesses are keen to identify and implement measures that enable them to reduce their water bills.
- Other utility costs are also increasing, for example gas and electricity. The energy consumption associated to heating water is recognised by both businesses and consumers as a potential area for cost savings.
- Consumer awareness of the environment and the impact they have on it, including their water use, is increasing. This has resulted in many consumers sourcing products that help them to achieve a more sustainable lifestyle.
- Increased provision of information increases awareness and consumer/business understanding of the differences in products.
- Businesses are increasingly aware of their environmental impacts and profile and the commercial benefits from improved reputation through increased Corporate Social Responsibility.
- Businesses are increasingly recognising the risk posed by water scarcity to their operations, especially those that utilise large volumes or where water is integral to or the limiting factor in their processes. More sustainable water use will help reduce overall water consumption and minimise exposure to such risks.
- Regulations, government policies and public support to promote product innovation and development in the area of water efficiency.
- Identification of business opportunities by front-runners, for example in the development of particular technologies to give them a competitive advantage.

In addition to water efficiency, other drivers will also influence the innovation and design of tap and showerhead products:

- Consumers have increasingly busier lifestyles and like products that are easy to install and use, offering high levels of convenience.
- Consumers have expectations of product performance, for example comfort levels when showering, which if not met will result in them looking at alternative products that meet their requirements.
- Products may be required to undertake different types of functions, for example hand washing or vessel filling leading to products that offer consumers increased flexibility in how the product can be used.
- User behaviour is an important aspect of improving the water efficiency of taps and showers. The products need to be installed correctly, used in the correct way and for their intended design purpose to operate at their optimum. Additional features may be included within the design of the product to help direct consumer behaviour or information provided with the product itself.

- Health and safety issues need to be considered, in particular when dealing with the delivery of hot water, with the need to take issues such as scalding and legionnaires' disease into account.

Several technologies and features for saving water and energy have been developed over the years and new innovations are expected to enter the market in the future.

The water- and energy-saving technologies identified so far are reported in Table 4.1. Further description is provided in the following sections. A combination of two or more technologies is commonly applied to products to save water and energy while fulfilling safety and comfort requirements.

Table 4.1 Water- and energy-saving technologies identified in this study

Technology	Primary saving potential
1. Flow and spray pattern design, aerators and flow regulators	Water (and energy through hot water saving)
2. Flow booster	Water (and energy through hot water saving)
3. Two-stage cartridge taps	Water and/or energy (and energy through hot water saving)
4. Sensor taps	Water directly (and energy through hot water saving and temperature setting)
5. Push taps	Water directly (and energy through hot water saving and temperature setting)
6. Thermostatic valves	Water and energy
7. Hot-water limiters	(Potential relevance for energy saving if low maximum temperatures are set)
8. Water meters	Water indirectly, through user's awareness (and energy through hot water saving)

4.3.1 Flow and spray pattern design, aerators and flow regulators

4.3.1.1 Flow and spray design patterns

One of the first actions to improve the efficiency of taps and showers was to add a flow restrictor, to increase the speed of water, and to design improved spray patterns. Already in the 1970s, this allowed the introduction of showerheads delivering 16% less water than "conventional" models and performing the same (15-16 L/minute versus 18.5 L/minute at 2 bar). New models were designed in the 1990s that delivered 27% less water (13.5 L/minute against 18.5 L/minute at the same pressure).

Meanwhile, it has been reported by some stakeholders that the design for low-pressure showering solutions in the UK has traditionally centred on maximising the available flow rate through the shower valve and showerhead to provide an adequate showering experience. A high-performance luxury product designed for low-pressure applications may be able to deliver around 7 L/minute at 0.1 bar. The majority of products are likely to deliver flow in the 2 to 5 L/minute range at 0.1 bar.

Conventional showerhead sprays emit water in many (often more than 20) small continuous jets producing a narrow needle-like spray. The water jets are usually set in a circular pattern to balance coverage area and comfort. Showerhead designs can employ different spray types which can result in greater consumer satisfaction and water savings. However, it must be observed that this is an area characterised by a significant level of subjectivity.

For example, the Methven Satinjet showers[224] use twin jets of water that collide and turn the water stream into thousands of tiny droplets. These are also fitted with a flow restrictor, with flow rates of 9 and 14 L/minute, and can also be retrofitted easily. The manufacturer website indicates that assuming a conventional shower flows at 20 L/minute and that four showers of 10 minutes are on average taken in a household every day, a reduction of the water flow to 14 L/minute could allow savings of up to 27% in hot water energy costs and up to 30% in the water costs. Cost savings would be 50% for energy and 55% for water with a further reduction of the water flow to 9 L/minute. Considering 12 L/minute as the updated reference, the revised savings in case of 9 L/minute would be about 25%. Relatively short payback times (a few months) are reported for this product by the manufacturer.

Another design concept developed by Nordic ECO[225] is based on a screw-like turbine device. When the water reaches the showerhead it rebounds from the underside of the “screw” and is retained in an expansion chamber, where pressure increases. Once a certain level of pressure is reached, the water bounces back and out of the chamber many times per second. This pattern uniquely manipulates the surface tension of water. Without choking the water flow, this action maximises the effect of every drop, maintaining pressure and temperature whilst consuming much less water but achieving the performance of a much greater flow. There is no attempt to give the feeling of having more water by filling water droplets with air but to deliver fuller droplets with propulsion and impact. Nordic ECO's showers can deliver a flow rate of 6-9 L/minute, depending on the model. It is declared that the 9 L/minute model is considered as effective as a conventional shower with a flow of 19 L/minute. The showerheads are available at about EUR 60 (June 2013). No information on the payback period has been gathered but the website of the manufacturer provides a tool to calculate the savings associated with individual circumstances[226].

4.3.1.2 Aerators

An aerator is a device that entrains air into the water stream through the Venturi effect. This breaks the water stream into many small droplets providing an effective cleansing function with less water. The resulting water stream is softer to touch and non-splashing.

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[224] http://www.methven.com/nz/innovations/satinjet/

[225] http://www.nordiceco.com/index.php?option=com_content&view=article&id=90&Itemid=24

[226] http://www.nordiceco.com/index.php?option=com_content&view=article&id=105&Itemid=30

Standard aerators do not allow the flow rate to be controlled independently from the pressure: the flow will increase as the pressure increases. However, aerators are commonly combined with a flow regulator producing a constant flow rate regardless of pressure fluctuations (see Figure 4.4 and Section 4.3.1.3).

Aerators are integrated into the tap spout or into the shower outlet (with or without a flow regulator) and when used in low-pressure water supply systems they allow an increase in the perceived water pressure and provide a flow-straightening function. In Europe they can be found in most of the products designed for domestic and non-domestic applications. Aerating shower handsets often need a minimum maintained pressure of 1.0 bar to allow them to actually aerate. This is thus not a technology that is suitable for all installations.

With respect to the reference flows of 12 L/minute for showers and 9 L/minute for taps, the water-saving potential of aerators is considered to vary between 5% and 50%, depending on whether a flow regulator for the reduction of the water flow rate is installed, or less. There is no particular obstacle to the diffusion of this technology. The typical cost of aerators could be up to EUR 10. However, consumers must be informed that the flow indicated by the manufacturers depends on the pressure of the system and may have consequences for the comfort. As aerators are a technology commonly implemented in taps and showers, the advantages due to this technology can only be considered to be generally exploited.

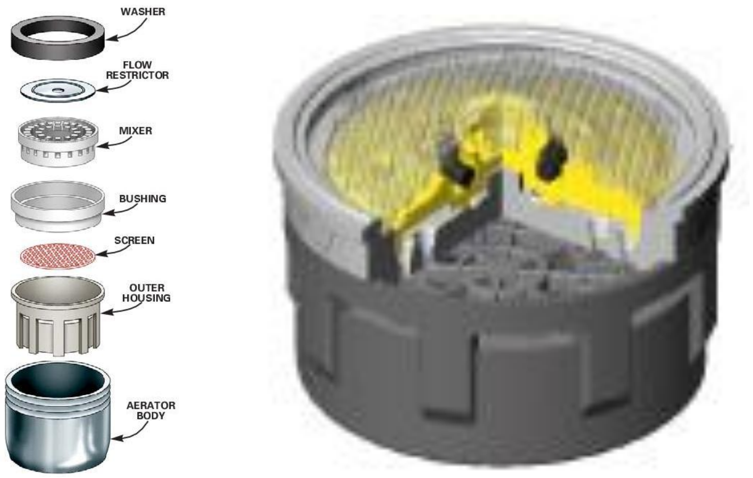

Figure 4.4 Example of a restricted aerator for taps (on the left)[227] and of an aerator with an integrated flow regulator (on the right)[228]

4.3.1.3 Flow regulators

Aerators are often used in conjunction with a flow regulator to compensate pressure variations. Flow regulators maintain a constant flow rate regardless of pressure ensuring comfort for the end-user at low pressures and water saving at high pressures.

The flow regulator is composed of a specifically designed profiled body and a dynamic O-ring. The O-ring reacts to the pressure changes and adjusts its shape to decrease the amount of water going through while the flow rate remains constant (see Figure 4.5). In the event of no flow or low pressure, the elastomer is relaxed (position 1 in Figure 4.5). As the pressure increases the elastomer is compressed into the seating area reducing the water passage (positions 2 and 3 in Figure 4.5). As the pressure decreases the elastomer relaxes and reopens the water passage (returning to positions 2 and 1).

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[227] http://www.askmehelpdesk.com/plumbing/there-no-water-coming-out-hot-water-tap-what-can-431402.html

[228] http://www.neoperl.net/en/oem/products/flowregulators/design.html

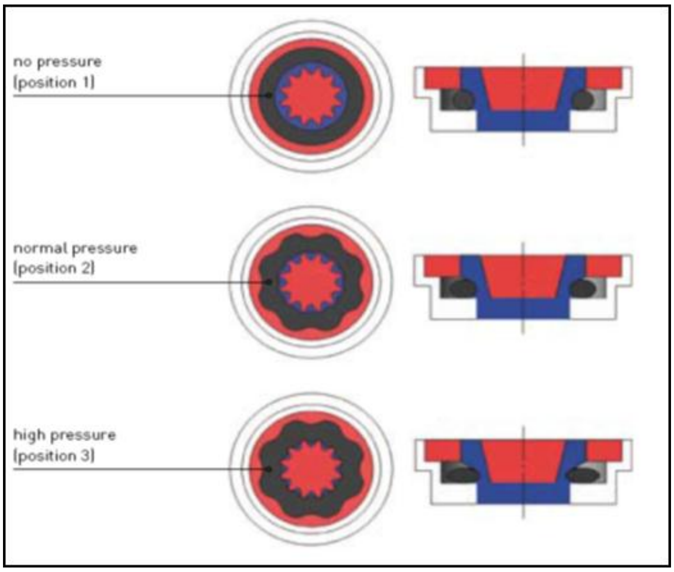

Figure 4.5 Flow regulator mechanism[229]

Flow regulators are designed and manufactured to operate at different flow rates and to provide control over a range of pressure conditions (see Figure 4.6). They are available in standardised dimensions and designs to meet different water-saving specifications. Installers and end-users must select the most suitable product for the intended used (e.g. high- or low-pressure system). Standard regulators control the flow rate between 0.8 and 10 bar.

Special models developed for low-pressure installations are typical for the UK and Ireland. The flow control function of these special regulators can be initiated significantly earlier, for instance when pressure is about 0.25 bar.

Dual-flow regulators are also available which allow the users to select between two possible flow rates or between two different pressure modes (e.g. requiring maximum flow at low pressures or compensating flow rate at standard pressure ranges).

Flow regulators are technologically different from flow restrictors. Flow restrictors are mechanical restrictions which reduce the water flow. These can be, for instance, orifice discs or limited cross-section areas, and they are designed to provide a certain flow rate at a given pressure. However, restrictor-driven flows depend on the pressure: if the pressure rises or drops, the flow rate increases or decreases as well. Ensuring a minimum flow rate is critical in terms of hygiene, safety and comfort. It was also reported that flow restrictors are usually not applied or are removed from products used in low-pressure systems since they restrict the size of the water pathways thus simply reducing the efficiency of the product while not regulating flow rate.

Compared to flow restrictors, flow regulators represent a superior solution since they can provide a constant flow, independently from the pressure. In addition, flow regulators can even provide more water at low pressure. This adds more comfort and user satisfaction in parallel to saving water.

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[229] Neoperl products brochure – flow regulators (supplied by manufacturer)

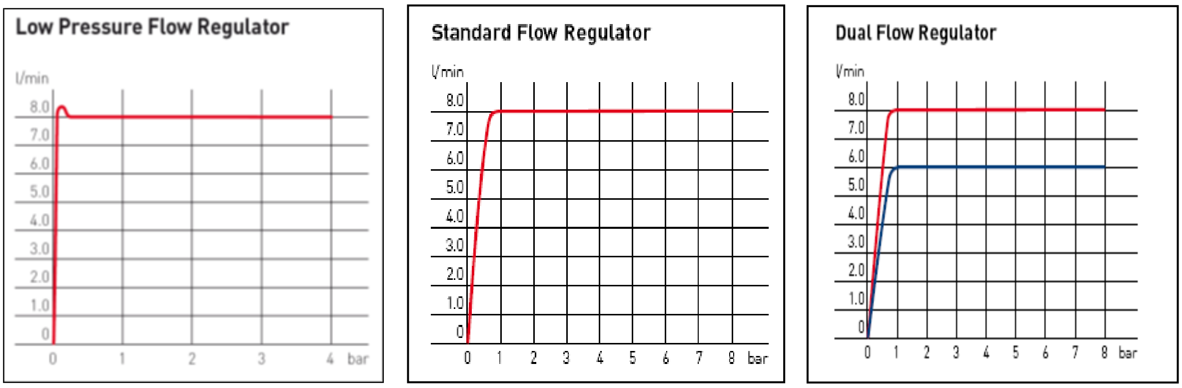

Figure 4.6 Performance of different flow regulator types for up to 8 bar pressure[230]

Flow regulators are commonly integrated in taps and showers, for instance accommodated in the inlet/outlet connections of a valve. Flow regulators can be easily installed, even for retrofitting, removed for maintenance, replaced or upgraded, thus minimising the cost and therefore barriers to the use of this technology.

Flow regulators are suitable in standardised dimensions for both domestic and commercial applications. In commercial and institutional installations where multiple taps are supplied by a single hot/cold water system, flow regulators can also help to improve the distribution and save water.

Flow regulators play a prominent role in the design of water-efficient taps and showers. They are manufactured by specialised companies and supplied to the producers of taps and showers. Although the technology is not new, this is likely to continue being one of the main technical solutions used in the coming years for reducing water consumption.

The water-saving potential of this technology is considered to be 15-50%. The typical cost of the technology could be up to EUR 10, which can be compensated relatively quickly when compared to the lifetime of the product.

4.3.1.4 Combination of these features in commercial products

The design of taps and shower outlets can have an influence on water consumption by controlling the flow and spray pattern and therefore the amount of water used. The water flow can be further reduced by entraining air into the water and including a flow regulator (see Figure 4.7 for a showerhead). This has for instance allowed a reduction of the water flow of some showerhead models from 18.5 to 8 L/minute (56% decrease), which also results in energy savings due to reduced hot water use. Retrofitting a tap with an aerator and a flow regulator could cost from less than EUR 5.5 to EUR 20, thus representing a minor contribution to the overall product cost.

This design strategy has been implemented in both taps and showers, as done in the Ecosmart product line. To use water in showerheads more efficiently, about 3 L of air per L of water is drawn in through the entire spray disc and mixed together with inflowing water, which results in the water drops becoming more voluminous, lighter and softer. The combination of the flow limitation, special spray jets and the mixing of water with air can reduce water consumption down to 6-9 L/minute.

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[230] Neoperl products brochure – flow regulators (supplied by manufacturer)

Figure 4.7 Example of a showerhead with an aerator and a flow regulator[231]

Low-flow showers however are not always suitable for low-pressure water supply systems because they may not fulfil the expectations of users and for electric showers because of the risk of scalding. A lower flow rate means the water will stay in contact with the heating element for longer, resulting in overheating. Some products include safety features to prevent this by switching off the heating elements when the flow is too low or the water gets too hot. Based on information from manufacturers, the typical water and energy savings that can be achieved with this technology are shown in Table 4.2.

Table 4.2: Indicative water and energy savings and payback periods for specific types of showerheads with aerators and flow regulators[232]

Parameter	RaindanceEcoSmart*	Crometta 10 Ecosmart0	Crometta 85 Ecosmart
Water savings (L per year)	24024	41000	43680
CO_2 emission savings (kg per year)	180	310	326
Water and energy cost savings (EUR per year)	181	312	329
Product payback period (months)	6	2	1
*Compared to the same product without the same technology for a family of four in Germany in 2009.			

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[231] https://pro.hansgrohe-int.com/assets/global/ecosmart_en.pdf

[232] https://pro.hansgrohe-int.com/assets/global/ecosmart_en.pdf

It is worth noting that product payback times are relatively short. Although these can change depending on the end-user behaviour, this indicates that the product price should not be prohibitive if life cycle cost considerations are taken into account.

The same technology can be applied to taps. The water and energy savings potential for an example product on the market with an integrated aerator and flow regulator is shown in Table 4.3. In particular, payback periods indicate that the initial investment is returned after 7-20 months, which is significantly shorter than the typical lifetime of a tap. However, it must be noted that actual savings depend on user behaviour, the pressure of the system, price of water and electricity and the fact that the potential savings may not be achieved with low-pressure systems.

Table 4.3 Potential savings from specific types of washbasin mixers fitted with an integrated aerator and flow regulator[a]

Parameter	Conventional tap	EcoSmart tap	EcoSmart tap with electronic mixer
Water flow (L/min)	13.5	5	5
Estimated annual savings of water costs (EUR) for a family of 4 persons living in Germany [b]	-	204	204
Estimated annual savings of energy costs (EUR) for a family of 4 persons living in Germany [c]	-	67	67
Total annual savings (EUR)	-	271	271
Maximum product payback period (months)	-	7	20
Maximum overcharge for the water-saving product (EUR)	-	160	450

(a) Figures provided by the manufacturer.

(b) Considering water consumption equal to 3 L/day and EUR 5.50 per 1000 litres of water.

(c) Considering 0.029 kWh to warm a litre of water from 10 °C (cold tap water) to 35 °C (warm water temperature).

4.3.2 Flow boosters

Flow boosters are features that allow users to select the desired water flow mode. They have been introduced over the last couple of years and their use could spread significantly onto the market.

Flow boosters must not be confused with diverters, often used as indicating devices for switching the water flow between bathtub taps and shower outlets, and with flow switchers, for instance often used as indicating devices for switching from rain to massage modes in showerheads.

Flow boosters can be implemented in taps and showers as "eco-buttons". These allow the user to intentionally override default flow limitation(s) or water-saving position(s) to get full flow on demand for a specific purpose.

The flow rate is controlled by an integrated flow regulator. The water-saving position is usually set as the default mode. By pressing the button, the user can switch from water-saving to boost modes and vice versa (see Figure 4.9). This provides flexibility of use, for instance when sinks or vessels must be filled.

These control devices are easy to install and could decrease water use by 10-50%, with respect to the reference flows of 12 L/minute for showers and 9 L/minute for taps, depending on the conditions of use and on the default water flows. Thus, it is important to inform users about the different modes they can operate in order to gain maximum benefits.

An example of a product on the market is the Neoperl Ecobooster[233]. Flow rates of showers and taps can be switched from 11 to 20 L/minute and from 7 to 17 L/minute, respectively. The Ecobooster costs approximately EUR 25. The payback period will depend on how much the default water saving position is used.

The average increase in cost associated to this technology is considered to be about EUR 20.

Figure 4.9 Examples of applications for flow boosters in taps and showers [234]

4.3.3 Two-stage cartridge taps

Two-stage cartridge taps are increasingly included by manufacturers in their product ranges as an incentive to operate with reduced flow rates and/or cold water.

Two main design concepts can be used:

- devices for the automatic return to a "middle" position;
- brakes (commonly known as a "click" cartridge) for limiting movements from a "middle" position.

Setting cold water in the middle position is an emerging feature installed on single-lever taps. During "normal" conditions, these taps deliver cold water. Hot water flows only when the lever is intentionally moved to the left, in some cases requiring an additional pressure from the user. The mixer lever can be easily turned back to the water- and energy-saving position.

With respect to the reference flows of 12 L/minute for showers and 9 L/minute for taps, the energy saving achievable with this system can be 5-30%. However, the actual saving potential strongly depends on the user behaviour. The benefits of having such a system installed in bath taps for instance could be offset for users who prefer to use warm water. Additionally, it must be noted that not all taps permit the implementation of this feature.

In the case of brakes, full flow rates and/or consumption of hot water are only possible after the user overcomes a mechanical resistance. In theory, water brakes can be fitted to all taps though they are typically fitted to single-lever mixer taps. For instance, the lever can be easily raised until the "middle" flow position. This is usually set at 50% of maximum flow; however the break could also be set to a different point. At this point the user will feel a resistance to

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[233] http://www.neoperl.ch/en/retail/products/watersavers/linesfeatures/ECOBOOSTER.html

[234] http://www.neoperl.ch/en/retail/products/watersavers/linesfeatures/ECOBOOSTER.html

movement, and opening the tap any further requires additional force to overcome the brake. Once overcome, the lever will move as easily as before towards full flow, as shown in Figure 4.10. As for flow boosters, the performance of the product may vary depending on the default water flow rate.

Figure 4.10 Example of tap with a water brake installed

With respect to the reference flows of 12 L/minute for showers and 9 L/minute for taps, the water-saving potential of brakes is estimated to be between 5% and 30%. The average increase in cost associated to this technology could be estimated to be about EUR 15. However, the payback period will depend on the conditions of use of the product.

Some taps directly integrate both water- and energy-saving features into their designs. An example is the Ceramix Blue taps[235]. The manufacturer's suggested retail price for this model is approximately EUR 235. In addition, the manufacturer has estimated that for a family of four people, the installation of this model of taps could lead up to a saving of up to EUR 207 per year (considering an exchange rate of 1.19 between GBP and EUR), including both water and energy savings. A breakdown of water and energy savings are shown in Figure 4.11. The average water and energy (by gas) prices have been considered as EUR 2.1 per m^3 and EUR 0.08 per kWh, respectively. Based on the above data, the payback time for this product would be about one year.

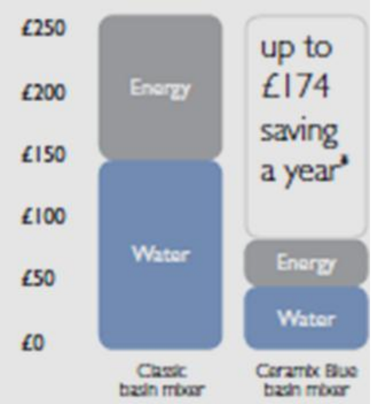

Figure 4.11 Potential savings from CeraMix Blue Eco tap[236]

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[235] http://www.reuter-shop.com/ideal-standard-ceramix-blue-basin-mixer-with-flow-rate-limiter-p308504.php

[236] http://www.ideal-standard.co.uk/fileadmin/templates/main/res/material/gb/help_support/brochures/IS_Multisuite_Multiproduct_Bro_GB_Taps-Mixers-2012.pdf

A similar system for saving water and energy is to force the lever to return automatically to a position with lower water temperature and flow when unnecessary. Conventional mixers could be cheaper to buy but more expensive when costs for use are considered, as shown in Figure 4.12[237].

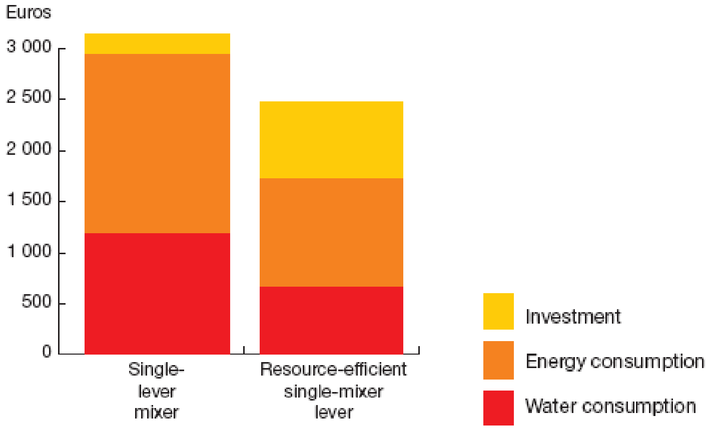

Figure 4.12 Estimated savings from a mixer tap with automatic repositioning of the single lever[238]

Three conventional mixers for kitchen sinks, washbasins and showers together could cost between EUR 170 and EUR 280, including VAT. The overall cost for purchasing and using these three conventional taps for 15 years could be estimated to be EUR 3225. In contrast, the more efficient mixers could cost between EUR 450 and EUR 550, including VAT, and could allow a saving of EUR 725 over 15 years. The price difference is thus earned back in a few years (1-3) via reduced energy and water costs.

4.3.4 Automatic taps

4.3.4.1 Push taps (automatic shut-off taps)

Push taps, or automatic shut-off taps, are valves that deliver water after a mechanical operation from the user and that stop by themselves. As with sensor taps, automatic shut-off/push taps are typically used in the non-domestic sector, which is why they are often designed to be tamper-proof and vandal-resistant. They typically do not allow user-adjustable flow control. As well as being water-efficient (up to 50-60% of water with respect to the reference flows of 12 L/minute for showers and 9 L/minute for taps), push taps offer a good level of hygiene. The average increase in cost associated to this technology could be about EUR 20. Retrofitting to this type of taps is also possible[239] [240]

Automatic shut-off taps can be designed to be activated with hands, elbows, knees or feet, depending on the end-users' requirements. Once activated, they cannot be left running indefinitely but they are set to automatically stop flowing after a certain time (e.g. 1-30 seconds). In order to maximise the potential water saving offered by push taps, the use of the tap needs to be considered carefully in order to optimise the settings, in particular the flow rate and the run time.

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[237] Swedish Energy Agency Informs: Save Energy with efficient tapware(article supplied by stakeholder)

[238] Swedish Energy Agency Informs: Save Energy with efficient tapware (article supplied by stakeholder)

4.3.4.2 Sensor taps

Sensor taps are devices that start delivering water when a movement is detected and that terminate with a set delay time.

These are typically used in non-domestic applications even though they are also suitable for households. Sensor taps are well suited for use within public washrooms since they operate without the user having to touch a button, tap or handle. They are also suitable for use within kitchens, restaurants, schools, hospitals and offices and have been available on the market for a number of years. It is possible that their use could be expanded in the domestic market in the future, depending on the application.

Sensor taps generally consist of four key components: an electromechanically operated valve (also known as a solenoid valve), an infrared sensor, a power source, and a tap unit (see Figure 4.13). When the infrared sensor (2) detects the presence of the user's hands in front of the tap (1) it sends an electronic signal to the solenoid valve (5) inside the control box. This initiates the flow of water (6), which is fed to the user (8) via the flexible hose (7) connected to the tap. When the detected object is no longer present, the infrared unit sends a new signal to the solenoid valve to terminate the flow of water. This usually occurs after a few seconds. The solenoid valve transforms electrical energy into motion, and physically starts and stops the water flow.

The power consumption of these taps is minimal, for example from 0.5 mW (DC) in static conditions to 2 W (AC) in dynamic conditions[241]. Some models are able to operate with AA batteries, which could last up to two years depending on the level of use[242]. The trend is to improve the battery life up to 10 years.

It is estimated that 15-20% of new commercial buildings adopt this technology. With respect to the reference flows of 12 L/minute for showers and 9 L/minute for taps, the water-saving potential of sensor taps is considered to be up to 50-60%, depending on the conditions of use and set delay time. Since taps are activated or deactivated within a few seconds they do not drip (a common problem with manual taps). Sensor taps require specific knowledge in design, manufacturing, installation and maintenance. The average cost increase associated to this technology is considered to be EUR 150.

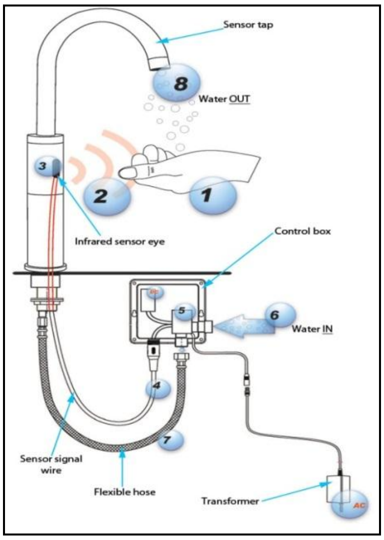

Figure 4.13 Sensor tap operation[243]

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[241] http://cmr.org.in/sensor_tap.html

[242] http://www.autotaps.com/atx-8205-technical-details.html

[243] http://www.autotaps.com/how-automatic-tap-work.html

4.3.5 Thermostatic mixing valves

Thermostatic mixing valves are mixers that, if properly designed, allow the delivery of water at a stable and controllable temperature and flow. Two cartridges are currently included in the design of this product, one for regulating the water flow and another one for temperature control, as shown in Figure 4.14. The time to find and reach a desired temperature is much shorter than in single-lever and double-handle mixers, with direct implications for water and energy savings, estimated being up to 10-15%.

Mechanical stop positions can be applied even to the thermostatic valves of showers, as in the case of Ecostop[244]. Full flow and hot temperatures can be set only after pushing a safety button. According to the producer, water consumption can be reduced by up to 50% with this function, with respect to the reference flows of 12 L/minute for showers and 9 L/minute for taps.

Figure 4.14 Example of thermostatic mixing valve for showers[245]

The use in Europe typically concerns showering, for which they could represent up to half of the market with an increasing sales trend, but further applications could be foreseen in the future (e.g. in kitchens).

The key component of this technology is the thermostatic element, which regulates and controls the outlet temperature in the event of variations in the hot and cold water input conditions. This can also limit the risk of scalding in case of low flow rates. Different mechanical and electronic systems have been developed but the most cost-effective ones at the moment are the wax thermostats.

The average cost of cartridges for thermostatic valves can be the double that for single-lever valves. Thermostatic mixers are more expensive than other mixers. A high quality one could cost between EUR 60 and EUR 200 and up to EUR 2000. The average cost increase associated to this technology is considered to be about EUR 70.

The product is designed to mix hot and cold water entering the system from the correct sides (conventionally hot water from the cartridge controlling the temperature and cold water from the opposite side). The installation of the product is extremely important for the correct functioning of the device. In terms of functionality, the thermostatic element can lose some precision with time, but this can be easily compensated by selecting a different temperature of use. Some elements could also need to be replaced after some time if they are not properly designed or installed. There are no particular difficulties for changing cartridges when necessary and the main maintenance intervention against limescale is to flow water at the maximum and minimum temperatures once per week.

Technical problems and possible issues that could be potentially associated to the use of thermostatic mixing valves have been identified by stakeholders and are reported in Table 4.4. This highlights the importance of the quality of the thermostatic valve and correct installation for the satisfactory functioning of the product.

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[244] http://www.hansgrohe.com.sg/assets/global/hg_thermostats_en.pdf

[245] http://www.houzz.com/photos/423099/Bathroom-Thermostatic-Mixer-Valve-Shower-Tap-5592-contemporary-showers-

4.3.6 Hot water limiters

Changes in incoming water pressure or temperature can result in a sudden change in outlet water temperature. The likelihood of exposure to extreme variations in water temperature can increase in the event of lower flows.

In order to decrease the risk of scalding, valves can be equipped with a hot-water limiter. The hot-water limiter is a special ring assembled within the handle or the cartridge which can be adjusted by the installer or the end-user to set the maximum temperature of the hot water delivered. The water will only be delivered at the temperature set if the supply conditions (i.e. the input water temperature and pressure) remain constant. The hot-water limiter is a safety device. Energy savings can result only if a low temperature is set.

Hot-water limiters are included in particular products at the discretion of manufacturers; however they are not included across all product ranges. For instance, this feature is very important in bathrooms and hospitals but may be unnecessary in kitchen taps, where high temperatures may be required for cleaning or hygiene.

4.3.7 Water meters

Some influence on the user behaviour could be achieved through the monitoring of water consumption with water meters. Water meters can potentially be installed at the entrance of whole apartments/houses (central water meters) or on individual products (individual water meters).

According to the Energy Saving Trust[246], central water meters are installed in 43% of the UK's houses. According to this source, implementing this specific type of device is considered to help reduce water consumption at home by 3%. However, stakeholders pointed out that in countries like Germany and Switzerland almost all houses and flats have such a central water meter installed serving as a reference for the water bill and that key issues for saving water are education of users and financial pressure of the water bill itself.

The amount of taps and showers on the market with an individual water meter is practically negligible. Information available for this device is limited, however, it can be expected that the incorporation of this technology would entail additional costs while its effectiveness in terms of savings would rely exclusively on the ability of users to interpret the data provided and the related behavioural changes (no indications on whether water is wasted can be reported). In addition to this, individual water meters would require an important change in design for which the market acceptance is currently unknown, also because of a significant increase in costs (for instance, it may at least double the price of a conventional single-lever mixer). They may also add technical complications in terms of the durability/maintenance of products/components and the related disposal.

The price of individual water meters could vary from EUR 20 to EUR 200. Information on water savings is limited and uncertain as this a technology which is not widespread on the market.

4.3.8 Payback time of water- and energy-saving technologies

Indications about the average time which consumers would need to use a water/energy-saving technology in order to recover the investment made have been estimated for a set of products. The estimation has been calculated on the basis of the information gathered in this and the previous sections.

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[246] http://www.energysavingtrust.org.uk/About-us/The-Foundation/At-Home-with-Water

Indications of typical products' purchase prices were provided in Section 2:

1. conventional tap/valve: EUR 60 (35-85);
2. tap with aerator and flow regulator only: EUR 70 (45-95);
3. tap with flow booster: EUR 80 (50-110);
4. two-stages cartridge taps: EUR 75 (55-95);
5. push tap: EUR 80 (45-110);
6. sensor tap: EUR 210 (185-235);
7. thermostatic valve: EUR 130 (60-200);
8. shower outlet: EUR 70 (40-100).

Additional costs over the life cycle of the products (e.g. installation, maintenance and repair) have also been estimated based on the information of Section 2:

- the average installation cost for taps/valves is EUR 75 and, where applicable, it also covers the shower outlets;
- the maintenance and repair costs (including spare parts) for conventional taps/valves installed in the domestic and non-domestic sectors are EUR 31 and EUR 19, respectively;
- the maintenance and repair costs (including spare parts) for taps/valves implementing additional devices to aerators and flow regulators are EUR 107 for the domestic sector and EUR 143 for the non-domestic sector;
- the maintenance and repair costs (including spare parts) for shower outlets installed in the domestic and non-domestic sectors are EUR 29 and EUR 20, respectively.

Conventional products are considered to be representative of the typical use of the average products installed in domestic and non-domestic sectors. Some of these could include common water-saving devices such as aerators. Products implementing water- and energy-saving technology are considered to present optimised features compared to the average products on the market.

Theoretical maximum savings for different technologies, benchmarked against average water flows of 10 L/minute for shower systems and 7 L/minute for taps, were estimated in Section 3:

- 20-24% (22%) for taps with aerators and flow regulators;
- 20-29% (24.5%) for taps with mechanical brakes (e.g. two-stage cartridge taps, flow boosters);
- 20-29% (24.5%) for push taps;
- 20-31% (25.5%) for sensor taps;
- 17-39% (28%) for shower systems based on thermostatic valves, mechanical brakes, automatic valves;
- 17-34% (25.5%) for other shower systems.

Although only explicit for the first design option (taps with aerators and flow regulators), these and other devices for controlling flow rates can be integrated in all the other options. In fact, these water/energy-saving technologies have already been commonly used in the last decade. Without integrating such devices, the savings potential of single technologies could be lower, the savings potential being modelled as the result of: a) reduction of water flow (considered the same for all design options applying a technologically neutral approach); and b) improved action and control on temperature and water flow.

For individual water meters, for which more limited and uncertain information is available, the additional cost associated to the technology has been estimated to be between EUR 20 and EUR 200 while the savings potential has been conservatively set at 0-3%, as for central water meters.

Payback times and additional assumptions considered for the calculations have been reported in Table 4.4. As can been observed, for most of the products, the payback time is in general significantly shorter, from a consumer perspective, than the expected average time of use. Nevertheless, results for specific product designs/markets could deviate from these general indications. Moreover, as indicated, it is possible that promoting the economic benefits associated to water- and energy-saving technologies may encourage users to consume water more responsibly.

Table 4.4 Indication of possible payback times of technologies on the basis of the information collected in this study

Product	Increase in product's purchase/total costs (EUR)	Water and energy saving	Payback time (years)
Conventional taps – domestic	reference	0%	-
- Taps with aerators and flow regulators only (improved performance)	10 10	20-24%	1.2-1.4 1.2-1.4
- Taps with flow boosters	20 96	20-29%	2-2.9 9.6-13.9
- Two-stage cartridge taps	15 91	20-29%	1.5-2.2 9.1-13.1
- Water meters	20-200 N.A.	0-3%	> 19.2 N.A
Conventional taps – non-domestic	reference	0%	-
- Push tap	20 144	20-29%	0.4-0.6 2.9-4.2
- Sensor tap	150 274	20-31%	2.8-4.4 5.2-8.0
Conventional showers – domestic	reference	0%	-
- Shower systems with thermostatic mixers	70 146	17-39%	1.0-2.2 2.0-4.6
- Water-saving showers based on automatic valves, flow boosters, mechanical brakes	20 96	17-39%	0.3-0.6 1.3-3.1
- Water-saving showers based on flow pattern design, aerators and flow regulators only	20 20	17-34%	0.3-0.6 0.3-0.6
- Water meters	20-200 N.A.	0-3%	> 3.6 N.A.

Key assumptions:

1. Water consumption:

- 6.8 m^3/yr per unit of product for conventional taps used in the domestic sector;
- 29.5 m^3/yr per unit of product for conventional taps used in the non-domestic sector;

- 21.1 m^3/yr per unit of product for conventional showers used in the domestic sector.

2. Electricity consumption:

- 99.6 MJ/yr per unit of product for conventional taps used in the domestic sector;
- 667.1 MJ/yr per unit of product for conventional taps used in the non-domestic sector;
- 1230.5 MJ/yr per unit of product for conventional showers used in the domestic sector.

3. Fuel consumption:

- 149.4 MJ/yr per unit of product for conventional taps used in the domestic sector;
- 1000.6 MJ/yr per unit of product for conventional taps used in the non-domestic sector;
- 1845.8 MJ/yr per unit of product for conventional showers used in the domestic sector.

4. Water and energy price:

- water price (EUR/m^3): 3.89;
- electricity price (EUR/kWh): 0.2;
- fuel price (EUR/GJ): 19.1.

4.3.9 Technology penetration, design cycles, barriers and opportunities

The level of diffusion, advantages and drawbacks of the water- and energy-saving technologies presented in the previous sections are summarised in Table 4.5. The market penetration of products and technologies is, in particular, a fundamental factor for understanding their availability and stage of development.

Table 4.5 **Level of diffusion, advantages and drawbacks of water and energy technologies for taps and showerheads**

Technology	Level of diffusion	Advantages	Disadvantages
Flow and spray pattern design	Common issue for all products	Short payback time	Retrofit not possible
Aerators	Commonly implemented in all taps in high-pressure systems	Short payback time. Possibility of retrofitting.	They do not regulate flow rate independently from pressure, they often need to be integrated with a flow regulator. Since taps are designed to work at a certain pressure, an improper installation could create problems inside the tap (blockage and loss of water and interference between hot and cold water).
Flow regulators	Commonly implemented in high-pressure systems	Short payback time. Possibility of retrofitting.	Available in standardised dimensions and wide range of preset flow rates to meet different water-saving specifications. Retrofitting may require the consultation of a plumber for the correct installation of the proper device to prevent negative impacts in terms of performance, hygiene and temperature variations.
Flow boosters	Available for taps and showers, increased diffusion possible in the future	Flexibility of use	Retrofit theoretically possible but in most cases this would require the intervention of a plumber to dismantle the product. This might be more expensive than buying a completely new product.
Two-stage cartridge taps	Available for taps and showers, increased diffusion possible in the future	Possibility of influencing directly both hot and cold water use	Retrofit theoretically possible but in most cases this would require the intervention of a plumber to dismantle the product. This might be more expensive than buying a completely new product. Generally only suitable for systems with pressure > 1 bar. A few years could be needed to recover the investment.
Sensor taps	Commonly used in non-domestic sector, possible applications in the domestic area	Improved hygiene since taps do not have to be touched. If properly set allows water use only when needed. Most of products are vandal-proof.	Retrofit not possible. Not necessarily suitable for the domestic market. Power supply needed. If sensor is fouled there could be continuous flow but there should be a safety device to close it.
Push taps	Commonly used in non-domestic sector, possible applications in the domestic area	Improved hygiene since taps do not have to be touched to stop the flow. Retrofit possible. If properly set avoids wastage of water. Most products are vandal-proof.	Not necessarily suitable for the domestic market. Depending on user behaviour, advantages of having an automatic device could be offset by wastage of unnecessary water (if not properly set).

Technology	Level of diffusion	Advantages	Disadvantages
Thermostatic valves	Common issue for all products	Short payback time	Retrofit not possible
Hot-water limiters	Common safety device buy not used in all products	-	-
Water meters	Installation of central water meters in EU buildings is common (e.g. in Germany) or not unusual (e.g. 43% in the UK). Presence of individual water meters in products on the market currently negligible.	It would allow users to monitor water consumption	Uncertain saving, depending on influence of technology on user behaviour. Key issues for saving water are education of users and financial pressure of the water bill. The payback time could be high. Acceptability of design change. Technical complications in terms of durability/maintenance of products/components and related disposal.

4.3.9.1 Technology penetration in terms of water control devices

Market penetration and expected trends in terms of different water control devices are provided in Table 4.6.

Table 4.6 Market penetration of different water control devices according to stakeholders

Technology	Segmentation in the valve market		
	France	UK	Other
Pillar taps	0% in France, market penetration decreasing	30% in the UK, -2% expected over next five years	Bulgaria, Czech Republic, Poland and Romania also have significant pillar tap markets
Double-lever taps	10% in France, market penetration decreasing	43% in the UK, -2% expected over next five years	
Single-lever taps	62% in France, market penetration increasing	25% in the UK, +3% expected over next five years	
Thermostatic valves	18% in France, market penetration increasing, they could represent up to 50% of valves installed in showers		
Infrared sensors	1.8% in France and, for the non-domestic sector, market penetration increasing		
Push button and other non-manual mechanical controls	8% in France and, for the non-domestic sector, market stable		10% for industrial kitchen taps in Germany, market stable

4.3.9.2 Technology penetration in terms of flow rate

Knowing the market segmentation in terms of the flow rate of the product is key for understanding the performance of the market and the potential offered by technology.

An indicative picture of the distribution of products in terms of water efficiency can be obtained through the observation of the products that are registered under the European Water Label voluntary scheme[247], as reported in Table 4.7 (figures updated on 27 June 2013).

The Water Label is a voluntary scheme which covers 12 different categories of bathroom products. According to BMA, about 6500 products and 68 companies have been registered across Europe in 2014. The Water Label is currently in the process of adding an "energy consumption" element to the existing version of the label, which displays the water efficiency based on flow rate.

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[247] http://www.europeanwaterlabel.eu/;Update at 27 June 2014

Table 4.7 **Number of taps and showers registered under the European Water Label scheme**

Flow rate (L/min)	Basin taps		Shower controls		Shower handsets		Kitchen taps	
	Number	**%**	**Number**	**%**	**Number**	%	**Number**	**%**
< 6	572	32.6	25	2.5	50	10.9	20	7.9
6-8	309	17.6	216	21,4	42	9.2	6	2.4
8-10	630	35.9	161	15.9	119	26.0	84	33.3
10-13	9	0.5	84	8.3	163	35.6	11	4.4
>13 *	234	13.4	524	51.9	84	18.3	131	52.0
Total	1754	100	1010	100	458	100	252	100
*** Flow rate (L/min)**	**Basin taps**		**Shower controls**		**Shower handsets**		**Kitchen taps**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
13-20	36	15.4	312	59.5	17	20.2	16	12.2
20-30	88	37.6	139	26.6	56	66.7	12	9.2
30-40	48	20.5	21	4.0	6	7.1	42	32.1
>40 (a)	62	26.5	52	9.9	5	6.0	61	46.5
Subtotal	234	100	524	100	84	100	131	100

Notes:
(a) Figures updated in June 2014
(b) For basin taps - Low-pressure product tested at 3 bar and does not reflect how the product will be installed and used.

Some countries, like Portugal, have their own system for certification and labelling the water efficiency of products. The Portuguese system has nearly 500 certified products[248], as shown in Table 4.8.

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[248] http://www.anqip.pt/index.php/en/technical-committees/90-comissao-tecnica-0802

Table 4.8 Number of products registered under the ANQIP labelling scheme[249]

PRODUCT	ANQIP Label						
	A++	**A+**	**A**	**B**	**C**	**D**	**E**
Bathroom taps	0	1	2	4	0	0	0
Kitchen taps	0	0	1	0	0	0	0
Showerheads	0	2	20	24	13	5	1
Showers	0	7	213	0	2	0	0
Flushing cisterns	8	8	118	8	0	0	0
Urinal flushing valves	1	0	0	0	0	0	0
Flow restrictors (aerators, etc.)	53 (only certification, with drawing of graphs pressure/flow, to allow proper selection by the consumer. No class is assigned)						
Compact products for reuse of grey water in buildings	2 (only certification, with verification of sanitary security of compact products with washbasin/toilet. No classs is assigned)						
Note: figures updated in January 2014							

From the analysis of Tables 4.7 and 4.8 it appears that several products that are already on the market can potentially offer high levels of water savings. However, it must be considered that these statistics cover only a part of all the products on the market, due to the voluntary nature of these schemes, which could have a lower appeal for products using more water.

Additional information on market segmentation in terms of maximum flow rates is reported in Table 4.9, while Table 4.10 presents an estimation of the average maximum flow rate of taps and showers in 2013 and of the expected trends in the short/medium and medium/long terms, calculated based on input from stakeholders and considered to be reasonable after compiling Tables 4.7 and 4.8.

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[249] http://www.anqip.pt/index.php/en/technical-committees/90-comissao-tecnica-0802, January 2014

Table 4.9 **Indications of market segmentation by maximum water flow according to stakeholders**

Water flow	Kitchen taps (%)	Bathroom taps (%)	Showers (%)
Max. 4 L/min	No European relevance because it is a very restricted market	10% in Portugal (expected trend to 60%)	
Max. 6 L/min	No European relevance because it is a very restricted market. 10% in Portugal (expected trend to 50%).	29.5% in one global retailer	
Max. 7.2 L/min			10% in Portugal (expected trend to 60%)
Max. 8 L/min		99.5% in one global retailer	
Max. 13 L/min		100% in one global retailer	
Lowest maximum flow rate technically feasible (L/min)	2 L/min at 3 bar is technically feasible but fitness for use could be not fulfilled below 6 L/min. The flow rate has to be higher than washbasin taps because of the need to fill volumes in a relatively short time.	2 L/min at 3 bar might be enough for hand washing but fitness for use for other uses could be not fulfilled below 5 L/min in the domestic sector	4.5 L/min at 3 bar. However, fitness for use of showerheads and hand showers could be not fulfilled below 6 L/min
Highest flow rate known (L/min)	For conventional products: 20L/min at 3 bar. For professional products: 110 L/min in pot- or kettle-filling taps.	20-30 L/min at 3 bar	Up to 45-60 L/min at 3 bar

Table 4.10 **Estimated average maximum water flow rate of taps and showers at EU-28 level based on information from stakeholders (same as Table 3.41)**

	2013[a]	Short term[a]	Medium-long term[a]	Baseline[b] (L/min)	Theoretical limit[b] (L/min)
	Average (L/min)	Average (L/min)	Average (L/min)		
Taps[c]	8.0	6.0	5.3	7	5
Showers[d]	11.3	9.7	8.0	10	6

(a) Maximum flow rates.
(b) Real flow.
(c) Washbasin taps considered as reference product for taps.
(d) 6 L/min may be needed to ensure operation, 8 L/min may be the technical limit to avoid the risk of scalding.

4.3.9.3 Design cycles and future trends

According to the stakeholders of this study, innovations in technology for taps and showers are on average introduced every 2-10 years and stay on the market for 10-40 years. However, manufacturers that operate in different market segments face different demands and different levels of acceptability of the market. For instance, new industrial kitchen technologies are rare. Because of the small volume, producers follow the domestic tap industry and use the technology from this segment. The product design cycles for taps for industrial kitchens are much longer (approximately twice as long) because a longer payback period is needed due to the small volumes.

Technology scenarios have been defined with the input of stakeholders, as shown in Table 4.11. Expected technical innovations and trends for the next years could include:

- reduction of product sizes and increased importance of water- and energy-saving technologies;
- increase in importance of wellness together with saving water;
- increase in penetration of automatic valves in private households, especially in kitchen appliances and extension of the battery life up to 10 years;
- increase in penetration of electronics (e.g. water-saving programmes or data gathering);
- increase in penetration of thermostatic valves;
- integration of a booster in the aerator and improved system for cleaning and change;
- development of specific cartridges and fitting to fulfil the functions expected from the product;
- selection of materials that ensure compliance with hygiene quality standards.

Table 4.11 Technology scenarios according to stakeholders

Product	Scenario description		
	2013	Short-medium term	Medium-long term
Showers, domestic	- Thermostatic valves in 25-50% of showers	- Thermostatic valves in 55-60% of showers - New technologies to increase comfort with less water on the market (increased pressure and breadth of the jet, etc.). - Presence of mixing valves which prevent unnecessary consumption of hot water.	- Thermostatic valves in 60-90% of showers - The scenario will not change considerably - More thermostatic valves will be installed - Devices for real-time monitoring of consumption may be incorporated in some products - Water efficiency will increase because more water-efficient products will have been installed and because of the technology evolution.
Showers non-domestic	- Self-closing valves in 5% of showers	- Self-closing valves in 25% of showers - New technologies to increase comfort with less water on the market (increased pressure and breadth of the jet, etc.) - Presence of mixing valves which prevent unnecessary consumption of hot water.	- Self-closing valves in 50% of showers - The scenario will not change considerably - Penetration of water-efficient devices will depend on the willingness to pay for the replacement of older products and on pressure from water and energy prices.
Taps, domestic	- Self-closing valves in 1% of installations	- Self-closing valves in 2.5-5% of installations - New technologies to increase comfort with less water on the market (increased pressure and breadth of the jet, etc.) - Presence of mixing valves which prevent unnecessary consumption of hot water.	- Self-closing valves in 5-10% of installations - The scenario will not change considerably - Products incorporating automatic-stop devices might appear and expand on the market - Devices for real-time monitoring of consumption may be incorporated in some products - Water efficiency will increase because more water-efficient products will have been installed and because of the technology evolution.
Taps, non-domestic	- Self-closing valves in 5% of installations	- Self-closing valves in 25% of installations - New technologies to increase comfort with less water on the market (increased pressure and breadth of the jet, etc.) - Presence of mixing valves which prevent unnecessary consumption of hot water.	- Self-closing valves in 50% of installations - The scenario will not change considerably - Penetration of water-efficient devices will depend on the willingness to pay for the replacement of older products and on pressure from water and energy prices.

4.4 Production, distribution, installation, maintenance and end-of-life

Additional technical input on taps and showers is reported in the following sections. This comprises the following life cycle phases: production, distribution, use and end-of-life.

4.4.1 Production

Taps and showerheads on the European market come in a variety of designs, using a range of materials.

4.4.1.1 Materials and primary metal scrap production

90-99% of the taps produced in Europe are made mostly of brass, with chrome plating as metal finishing, and this is unlikely to change in the short to medium term. Other materials play a more important role only in countries like Germany (5% of taps based on stainless steel) and the UK (4% of taps based on stainless steel; 1% on plastic and 5% on other materials (e.g. zinc-Al alloys)).

The situation is different for showers, in which plastics are used considerably more. Plastics are the main construction material for showerheads and hand showers (70% in the UK and 89% in France), followed by brass (20% in the UK and 10% in France), stainless steel (4% in the UK and 1% in France) and other materials. Most of the valves used in shower systems are still based on brass (70% in the UK and 90% in France) but the market relevance of plastics is high (25% in the UK and 10% in France).

Scenarios for the coming years should not change significantly, although the use of plastic could increase in the future.

The majority of brass products are either machined from bar or stamped or cast into components. In all cases any "scrap" is recovered and recycled back into the manufacturing of new products.

Many types of plastic materials are used in taps and showers, and information can, in some cases, be commercially sensitive. These are the main types of plastics used in different components:

- spray gun bodies: POM or Grivory;
- aerators: POM;
- rings: POM and PA6;
- cartridges: PSU, POM and PA6;
- thermostatic cartridges: PSU, PEI, PPA;
- parts under extreme conditions of pressure and temperature or requiring special accuracy during manufacture: PPA, PPO, PSU, PEI, ABS;
- wet parts, not pressurised: POM, PP;
- hoses for mixers: inner tube of PEX (with braid of nylon or stainless steel and brass sleeves);
- hoses for showers: ABS, PVC;
- showerheads and hand showers: housing (90%) made of ABS and internal elements made of POM, PPO or PS and others;
- other parts : PA, ABS, POM.

4.4.1.2 Chrome plating

Chrome plating can be based on two substances:

- hexavalent chromium,
- trivalent chromium.

Hexavalent chromium is a known human carcinogen; in Europe its use is restricted in electrical and electronic equipment through the RoHS Directive. An alternative is trivalent chromium, which is not subject to the same restrictions. Chromium trioxide and some other chromium VI compounds are included in REACH Annex XIV[250]. These substances cannot be placed on the market or used after a "sunset date", unless an authorisation is granted for their specific use. Uses are prohibited without an authorisation from 21 September 2017. The last application date for the authorisation is 21 March 2016.

Although no hexavalent chromium is present in the finished product after the plating process, it was indicated that some manufacturers have had to change their chrome plating processes where the WEEE Directive applies, for example for showerheads connected to an electric shower. Those who have made this change tend to use trivalent chromium for all processes to ensure colour tone consistency and benefit from economies of scale.

While trivalent chromium offers lower toxicity and some technical advantages, e.g. higher cathode efficiency and better throwing power, there are some drawbacks. For example, trivalent chromium baths tend to be more sensitive to metallic impurities, although these can be removed. Other issues relating to trivalent chromium include colour differences and inferior corrosion resistance when compared to hexavalent chromium, however processes are now being introduced to address these drawbacks, which mean trivalent systems are a viable option for most, if not all, applications.

In addition to the environmental benefits of alternatives to hexavalent chromium, practical issues such as cost also need to be considered. The literature indicates that trivalent chromium is more expensive than hexavalent chromium, however this would need to be balanced against production rates and waste disposal costs, for example sludge disposal. Section 4.9.8.3 of the BREF for Surface Treatment of Metals and Plastics highlights that the additional initial costs associated with trivalent chrome plating are more than offset by the savings made during operations, for example reduced energy, monitoring, waste disposal and effluent treatment costs.

Additional research and a comparison of hexavalent chromium and trivalent chromium have been undertaken by the Toxic Use Reduction Institute in the USA. Chapter 6 of this research is particularly relevant and provides a summary of the characteristics of hexavalent chromium and the alternatives available, reiterating some of the points highlighted by the references above[251].

4.4.1.3 Resource demand and emissions from the manufacturing stage

The amount of energy demanded (heat and electricity) and the amount of waste produced during the manufacture of a unit of product/component vary too much to give exact figures. Some indications have been provided on water consumption, CO_2 emissions and total waste

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[250] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:108:0001:0005:EN:PDF

[251] http://susproc.jrc.ec.europa.eu/ecotapware/docs/Task%204_Report_Base_Case_Assessment%20Final_Sept.2011.pdf

production in a manufacturing plant in 2010-2012, but it must be noted that figures can vary from year to year and from one production site to another:

- 6.20-7.36 m^3 of water consumed per tonne of product;
- 0.892-1.014 tonnes of CO_2 emitted per tonne of product;
- 0.169-0.208 tonnes of waste produced for tonne of product.

4.4.1.4 Bill of materials (BoM) of example products

Examples of taps and showerheads with different material compositions and weights were provided by manufacturers. Information refers to design options used either for domestic or non-domestic applications. Average bills of materials have been modelled and normalised to the weights considered in Section 2. The resulting models for taps and showers are reported in Table 4.12 and in Table 4.13, respectively. Due to the wide range of materials and designs, the information on composition provided may not cover all products on the market. Nevertheless, this is considered to be representative of typical products available on the market with the exception of sensor taps, for which electronics/batteries have to be added to the bill of materials.

Table 4.12 Selected bill of materials (BoM) for a typical tap

Material / Component	BoM for a typical product (g)	Normalised BoM (g) (variation from the average: -21% to +36%)
Brass (body)	1200	1296.1
Nickel chrome plating	2	2.2
Plastic materials	73.5	79.4
Ceramic discs	21	22.7
Zinc (handle)	216	233.3
Plastic (pressure hoses)	154	166.3
Cardboard (packaging)	562.5	607
TOTAL WITH PACKAGING	**2229**	**2407.6**
TOTAL WITHOUT PACKAGING	**1666.5**	**1800**

Table 4.13 Selected bill of materials (BoM) for a typical shower system

Material / Component	BoM for a typical product (g)	Normalised BoM (g) (variation from the average: -15% to +76%)
Valve		
- Brass (body)	2226.5	2118.1
- Nickel chrome plating	2	1.9
- Plastic materials	257	244.5
- Ceramic discs	31.5	30
- Zinc (handle)	353.5	336.3
Outlet		
- Plastic materials	278	264.5
- Brass	951	904.7
Packaging		
- Cardboard (valve)	568	540.4
- Plastic (outlet)	371	352.9
TOTAL WITH PACKAGING	**5038.5**	**4793.3**
TOTAL WITHOUT PACKAGING	**4099.5**	**3900**

4.4.2 Product distribution

Packaging can vary from a few hundred grams to more than 1 kg depending on the product. Materials used are cardboard, paper and plastic bags.

Cardboard is the main material. Recycled card is typically used for the majority of fitments. Higher quality card is sometimes used for colour printing for consumer products. Plastic materials (e.g. LD-PE) or cloth can be used for bagging the components and to avoid scratching the surfaces during transportation.

The dimensions of the packaging used for taps and showerheads could indicatively be:

- length 15-120 cm
- width 10-50 cm
- height 5-40 cm
- volume: 0.75-240 L.

Products are mainly transported by road and sea but all means of transport can be used (trucks/lorries, trains, boats, planes) depending on the location of suppliers, manufacturing plants, retailers and customers.

The delivery time from the manufacturer's central warehouse to the place of installation can be from 2 to 5 days, depending on the shipment. It may take longer from the factory, especially if overseas transport is needed.

4.4.3 Installation, use, maintenance of the product and durability

Information on the use of taps and showers is provided in Section 2, focused on market analysis. The average time of use of taps and showers is reported in the following table.

Table 4.14 Average lifetime of taps and showers

Product	Average lifetime in years (min.-max.)	
	Domestic sector	Non-domestic sector
Taps	16 (3-50)	10 (5-20)
Showers	10 (2-30)	7 (5-15)

The durability of taps and showers can be affected and reduced significantly by poor installation or maintenance.

Installation varies for all products and should be in full compliance with the manufacturer's requirements (e.g. cleanness, inlet pressures, inlet flow rates and temperatures, lime removal). Installation costs also differ across Europe. Maintenance is also product-specific and it is simple for some products while more complicated for others. User care has a great influence on the durability of the product. Regular cleaning and lime removal will help the product to last longer. In contrast, no cleaning or frequent cleaning with aggressive products can damage the product. During the lifetime of taps and showers there are usually very few replacements of parts. Depending on the quality of water, aerators could be replaced periodically, even by the user. For the change of other parts, the intervention of a plumber could be necessary, as for instance in the case of seals, valves, flow boosters, cartridges. Some producers provide spare parts for repairs.

Information on indicative costs of installation, maintenance and repair have been collected with the support of stakeholders and reported in Section 2, focused on market analysis.

Information on the average use of water and energy associated to taps and showers in the EU-28 has been summarised in Table 4.15 based on the outcomes of Section 2 (analysis of the stock of products) and Section 3 (analysis of water and energy consumption associated to taps and showers).

Table 4.15 Water and energy demand associated to the use of taps and showers in the EU-28

Parameter	Domestic sector		Non-domestic sector	
	Taps	Shower systems	Taps	Shower systems
Water abstraction (m^3/yr per unit of product)	8.860 (-35% to +49%)	27.65 (-19% to +25%)	38.78 (-87% to +75%)	19.98 (-85% to +82%)
Energy carriers for water supply (MJ/yr per unit of product): • electricity	21.05 (-53% to +845%)	65.69 (-42% to +696%)	92.15 (-91% to +1014%)	47.47 (-89% to +1059%)
Energy carriers for water heating (MJ/yr per unit of product)[a]:				
• electricity (40%)	99.55	1230	667.1	889.2
• gas (40%)	99.55	1230	667.1	889.2
• oil (20%)	49.77	615.3	333.5	444.6
	(-59% to +91%)	(-34% to +51%)	(-92% to +152%)	(-88% to +120%)
Energy carriers for waste water collection and treatment (MJ/yr per unit of product): • electricity	47.75 (-90% to +674%)	149.02 (-88% to +552%)	209.03 (-98% to +812%)	107.69 (-98% to +849%)
(a) In case of heating with a single source of energy, total consumption of energy carriers (MJ/year) would be:				
Electricity	204.6	2529	1371	1828
Gas	294.7	3642.3	1974	2632
Oil	282.3	3502	1899	2531

4.4.4 End-of-life practices

At the end of their lives, products are usually collected by installers and recycled in order to recover value from metals. Indicatively, it can be considered that 90-95% of metal-based products are recycled.

Metals and alloys can be extensively recycled via well-established, highly efficient and economically sound markets. There are few technical barriers that include the recycling of nickel-containing stainless steels and copper alloys containing lead and nickel.

The concrete presence in the territory of infrastructures for the separation, collection and recycling of products and components represents another potential barrier. However, recovery of metals should also be efficient if the product is collected and disposed of by municipal services rather than delivered directly to established commercial recycling facilities. In recent years, local authorities have indeed increased the collection of metal waste at the source of production and at the municipal waste sorting sites.

With regards to the disposal of plastic components, it is considered that these are usually disposed of as municipal solid waste. Based on this information, disposal costs, if any, are considered to be minimal and mainly determined by the current demand for metal scraps at the time of disposal.

4.5 Preliminary identification of scenarios for analysis

A series of priority scenarios and technologies of interest for the assessment of environmental and economic impacts have been identified based on the information gathered during the elaboration of the previous sections (see Tables 4.16 and 4.17).

All in all, the available examples of products can potentially allow the assessment of environmental and economic impacts for base case scenarios in domestic and non-domestic sectors and design options made of different types and amounts of materials. An estimation of the influence of water- and energy-saving technologies could be provided by changing data on the consumption of energy and water for base cases.

Additional scenarios of potential interest could for instance involve the analysis of the effects due to durability, change in weight and composition of products, and water heating system used. However, these last scenarios are not considered as having a major impact on the outcome of the study and are thus not considered a priority.

Table 4.16 Priority scenarios for analysis preliminarily identified for the assessment of environmental and economic impacts associated to taps and showers

Scenario	Product design	Sector	Lifespan	Water-Energy consumption (incl. user behaviour)	Energy for heating
Base cases for typical product systems (4)	Average brass tap	Domestic	Average	Baseline	Energy Mix
	Average brass tap	Non-domestic	Average	Baseline	Energy Mix
	Average shower system	Domestic	Average	Baseline	Energy Mix
	Average shower system	Non-domestic	Average	Baseline	Energy Mix
Water/energy consumption (8)	Average brass tap	Domestic	Average	Best/Worst scenario	Energy Mix
	Average brass tap	Non-domestic	Average	Best/Worst scenario	Energy Mix
	Average shower system	Domestic	Average	Best/Worst scenario	Energy Mix
	Average shower system	Non-domestic	Average	Best/Worst scenario	Energy Mix

Table 4.17 **Key water- and energy-saving technologies of interest for the assessment of environmental and economic impacts associated to taps and showers**

Product	Sector
Tap with aerator and flow regulator only	Domestic
Tap with flow boosters	Domestic
Two-stage cartridge tap	Domestic
Push tap	Non-domestic
Sensor tap	Non-domestic
Shower system with thermostatic mixer	Domestic
Shower system with other water-saving device	Domestic

4.6 Conclusive recommendations for the products

A large number of taps and shower models are manufactured and sold on the market, offering the consumers the possibility to choose among products with different levels of performance in terms of water and energy savings. However, apart from reducing water consumption, other technical issues are also important, such as avoiding the risk of scalding, satisfying users´ performance expectations and designing and installing the product taking into account the specific conditions of use (e.g. the pressure of the water supply system).

In most cases, a reduction in water consumption can be achieved by installing flow regulators, which are largely applied by manufacturers in their product ranges. These are a cheap and flexible technology, easy to install and that offer possibilities of retrofitting. Considering also that their payback time is short, the regulation of the water flow seems to be technically feasible on a wide scale.

The number of water-saving technologies on the market is increasing. These are integrated, usually together with other features, in the product design with the aim of directly reducing water and/or energy consumption (e.g. through a flow regulator) or of promoting a change in the user's behaviour (e.g. through flow switch options). Some of these features are also available for retrofits (e.g. aerators).

The savings potential offered by water- and energy-using products strongly depends on the user practices. However, products implementing water- and energy-saving technologies in general appear technically effective, economically convenient considering the entire time of use and in some cases they offer greater flexibility to users.

5 ENVIRONMENTAL AND ECONOMIC ASSESSMENT OF BASE CASES

The aim of this section is to assess the environmental and economic impacts associated to different base cases. The assessment is based on the last updated version of the EcoReport Tool v3.06 2014, as provided with the MEErP[252], and published online in early 2014.

5.1 Identification of base cases

According to the MEErP 2011 methodology, base cases should reflect average EU products. Different products with similar functionalities, bills of materials (BoM), technologies and efficiency can be compiled into a single base case, thus it does not always represent a real product. For the identification of the base cases, two types of products (taps and shower systems) and two different applications (domestic and non-domestic) have been chosen.

The most appropriate base cases have been selected in accordance with the analysis presented in Sections 2, 3 and 4 and that concerned the analysis of market and environmental and technical elements associated to products used across the EU.

As introduced in Section 4, four base cases have been identified to assess the environmental and economic impacts over the life cycle:

- Base case 1: A typical tap made of brass (average weight) used in domestic applications.
- Base case 2: A typical tap made of brass (average weight) used in non-domestic applications.
- Base case 3: A typical shower system, including a shower valve with a shower outlet (average weight), used in domestic applications.
- Base case 4: A typical shower system, including a shower valve with a shower outlet (average weight), used in non-domestic applications.

Base cases are considered to be representative of the typical use of the average products installed in domestic and non-domestic applications. Some of these could include common water-saving devices such as aerators (see Section 4). The comparative assessment of improved design options is carried out in Section 6.

The average consumption of water and energy carriers per unit of product has been calculated based on the models described in Section 2 and Section 3. For all the base cases, the mix of energy carriers described in Section 3 (40% electricity, 40% natural gas, 20% oil) has been considered for the heating of water during the use phase.

5.2 Product-specific inputs for EcoReport tool

5.2.1 Manufacturing of the product: Bill of materials

The manufacturing phase includes the extraction and processing of the required materials and the following steps necessary to produce and assemble one product. The EcoReport tool v3.06 2014 contains a list of materials and processes for which materials and energy indicators are provided (see for instance the “Material Code in EcoReport tool” reported in Table 5.1).

The BoM of this preparatory study has been selected according to information included in Section 2 and Section 4. Firstly, a BoM of reference products has been selected based on input provided

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[252] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/ (accessed on 17/06/2014)

by stakeholders. Secondly, product weights have been modified slightly and normalised to the average weight calculated in Section 2: 1.8 kilograms for taps and 3.9 kilograms for shower systems.

The BoM of the four base cases are shown in Table 5.1 for taps and in Table 5.2 for shower systems.

Table 5.1: BoM considered for domestic and non-domestic taps

Component/Material		Weight (g)	Lifetime (years)		Material code in EcoReport tool
			Domestic	Non-domestic	
Tap	Body (brass)	1296.1	16	10	32 -CuZn38 cast
	Nickel chrome plating	2.2			41-Cu/Ni/Cr plating
	Plastic materials	79.4			12 -PA6
	Ceramic discs	22.7			Not available (inserted) - (Extra material, see Table A3.1 in Annex III)
	Handle (zinc)	233.3			33 -ZnAl4 cast
	Pressure hoses (plastic)	166.3			2 -HDPE
Packaging	Cardboard	607			57 -Cardboard

Table 5.2: BoM considered for domestic and non-domestic shower systems

Component/Material		Weight (g)	Lifetime (years)		Material code in EcoReport tool
			Domestic	Non-domestic	
Shower valve	Body (brass)	2118.1	16	10	32 -CuZn38 cast
	Nickel chrome plating	1.9			41-Cu/Ni/Cr plating
	Plastic materials	244.5			12 -PA6
	Ceramic discs	30			Not available (inserted) - (Extra material, see Table A3.1 in Annex III)
	Handle (zinc)	336.3			33 -ZnAl4 cast
Shower outlet	Plastic materials	264.5	10	7	11-ABS
	Brass	904.7			32 -CuZn38 cast
Packaging	Plastic (for the outlet)	352.9	10	7	3 -LLDPE
	Cardboard (for the valve)	540.4	16	10	57 -Cardboard

It can be observed that the BoM changes depending on the product (tap/shower system) but not on the application (domestic/non-domestic). However, it should be highlighted that different average lifetimes have been considered for domestic and non-domestic applications, as reported in Sections 2 and 4. In particular, in the case of shower systems, different lifetimes have been assigned to shower valves and shower outlets.

With respect to the materials used, environmental data for ceramics is not available in the EcoReport tool's list of materials (See Table 5.1 and 5.2). Ceramics has therefore been introduced as an extra material, based on the information reported in the background study for the development of EU Ecolabel and GPP criteria for toilets[253] (see Table A3.1 in Annex III). It should however be pointed out that the contribution of this material to the overall weight of the product and packaging is marginal (about 1% of the overall weight).

5.2.2 Distribution phase: volume of packaged product

This phase includes the distribution of the packaged product. According to Section 4.4.2 of Section 4, the average volume of the packaged product is 0.0103 m^3. The same value has been taken into account for both the tap and the shower system. Transport is modelled by default in the "Distribution" section of the EcoReport tool.

5.2.3 Use phase

Taps and showers are water- and energy-related products. The amount of water and energy resources demanded for the use phase during the lifetime should thus be considered. Consumption of hot water indeed requires energy for heating water. In addition, energy for water supply and for waste water treatment is also considered in this phase.

The average demand for resources per unit of tap and shower system has been calculated by dividing the consumption of water and energy from products (Section 3) by the stock of products installed (Sections 2). The results of this calculation have been shown in Section 4 and are also reported in Table 5.3.

Figures related to the consumption of energy carriers for water heating include energy conversion and transmission losses taking place in the water heating system, as specified in Section 3, while those related to water supply and waste water treatment are expressed in terms of electricity consumption. The energy input for the production and supply of energy has also been taken into account in the assessment with the Ecoreport tool. Water abstraction includes 24% losses, as reported in Section 3.

Input of materials in the maintenance is also considered by default in the use phase by the EcoReport tool as 1% of the total BoM.

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[253] http://susproc.jrc.ec.europa.eu/toilets/stakeholders.html

Table 5.3: Average demand for water and energy in the use phase of the base cases according to Sections 2 and 3

Parameter	Tap		Shower system	
	Domestic	Non-domestic	Domestic	Non-domestic
Lifetime (years)	16	10	16 for the valve 10 for the outlet	10 for the valve 7 for the outlet
Water abstraction (m^3/year per unit of product)	8.9	38.8	27.7	20.0
Electricity for water supply (MJ/yr per unit of product)	21.1	92.2	65.7	47.5
Electricity for waste water treatment (MJ/yr per unit of product)	47.8	209	149	107
Electricity consumption for hot water production (MJ/year per unit of product)	99.6	667.1	1230.5	889.2
Natural gas consumption for hot water production (MJ/year per unit of product)	99.6	667.1	1230.5	889.2
Oil consumption for hot water production (MJ/year per unit of product)	49.8	333.5	615.3	444.6

5.2.4 End-of-life (EoL)

The new version of the EcoReport tool v3.06 2014 contains some new features concerning material efficiency indicators, in particular the so-called recyclability benefit rates. Recycling of materials can avoid the extraction of raw materials and the production of virgin materials and this is modelled in the EcoReport tool as credits (avoided impacts), i.e. negative impacts.

The default values of the new EcoReport tool have been used for the recycling rates of the materials since no more specific figures were identified for the product group under study. For instance, default values for the recycling rate of metals and plastics are 94% and 29%, respectively. These recycling rates are considered comparable with the outcomes of the previous sections and thus suitable for the current environmental analysis.

Other new features of the EcoReport Tool v3.06 2014 concerning material efficiency, including recycled content, lifetime, and the critical raw material index, have not been judged relevant for the product group and are therefore not explored further in this report.

5.2.5 Life Cycle Cost inputs

Average market data and consumer expenditure data have been estimated in Section 2. These are summarised in Table 5.4 and form the data input for carrying out the economic assessment of the base cases. Data on water consumption and related energy consumption have been shown in Table 5.3 based on the results of Section 3.

Table 5.4: Selection of EU market and economic data for 2013

Input parameter	Taps		Shower systems	
	Domestic	**Non-domestic**	**Domestic**	**Non-domestic**
Annual sales (million units/year)	74.8	7.1	Shower valves: 24.9 Shower outlets: 39.9	Shower valves: 2.4 Shower outlets: 3.4
EU Stock (million units)	1197	70.8	399	23.9
Typical product price (EUR)	60	60	172	160
Indicative installation costs (EUR)	75	75	75	75
Indicative maintenance and repair costs (EUR)	31 (referred to 16 years)	19 (referred to 10 years)	77 (referred to 16 years)	48 (referred to 10 years)
Electricity rate (EUR/kWh)	0.198			
Fuel rate (Oil-Gas mix) (EUR/GJ LHV)	19.132			
Water rate (EUR/m^3)	3.887			

5.3 Environmental impact assessment of base cases

The environmental impacts of the base cases[254] are calculated using the EcoReport tool v3.06 2014 of the MEErP, according to the input data presented in the previous section.

5.3.1 Base case 1: Domestic tap

The environmental impacts related to the use of a domestic tap over its lifetime (16 years) are reported in Table 5.5.

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[254] The results of this environmental assessment are not necessarily in line with LCA ISO 14040/44 or the PEF (2013/179/EU) Commission recommendations (2013/179/EU).

Table 5.5: Life cycle environmental impacts related to the use of a domestic tap

ENVIRONMENTAL IMPACTS Domestic Tap per lifetime (16 years)										
LIFE CYCLE PHASES	**UNITS**	**MANUFACTURING OF THE TAP**			**PRODUCT DISTRIBUTION**	**USE PHASE***	**END-OF-LIFE OF THE TAP**			**TOTAL**
		Materials	**Manufacturing**	**Total**		**Total**	**Recycling**	**Disposal**	**Total**	
Resources & Waste										
Total Energy (GER)	MJ eq	102.25	13.40	**115.65**	**122.83**	**9671.59**	-31.23	1.45	**-29.78**	**9880.29**
of which, electricity (in primary MJ)	MJ eq	9.81	8.06	**17.87**	**0.03**	**6744.85**	-2.85	0	**-2.85**	**6759.90**
Water (process)	l	3.24	0.12	**3.36**	**0**	**142353.31**	-0.73	0	**-0.73**	**142355.94**
Water (cooling)	l	26.77	3.80	**30.57**	**0**	**300.07**	-4.90	0	**-4.90**	**325.74**
Waste, hazardous/ incinerated	g	159.74	41.97	**201.71**	**112.32**	**3475.79**	-52.59	4.82	**-47.78**	**3742.05**
Waste, non-haz./ landfill	g	3.47	0	**3.47**	**2.23**	**108.43**	-0.70	0	**-0.70**	**113.43**
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO_2 eq	4.35	0.74	**5.09**	**9.34**	**469.63**	-1.37	4.32E-03	**-1.37**	**482.69**
Acidification, emissions	g SO_2 eq	55.39	3.20	**58.59**	**27.31**	**1401.44**	-20.18	0.05	**-20.13**	**1467.21**
Volatile Organic Compounds (VOC)	mg	0.06	9.48E-04	**0.06**	**0.31**	**153.34**	-0.01	4.80E-06	**-0.01**	**153.70**
Persistent Organic Pollutants (POP)	ng TEQ	47.93	0	**47.93**	**0.63**	**16.22**	-18.38	0.02	**-18.36**	**46.42**
Heavy Metals	mg Ni eq	78.84	0	**78.84**	**5.72**	**68.98**	-30.23	0.08	**-30.15**	**123.40**
PAHs	mg Ni eq	4.89	4.10E-03	**4.90**	**3.17**	**15.89**	-1.83	0	**-1.83**	**22.12**
Particulate Matter (PM, dust)	g PM10 eq	2.99	0.49	**3.48**	**35.74**	**29.17**	-0.95	0.05	**-0.90**	**67.49**
Emissions (Water)										
Heavy Metals	mg Hg eq.	16.07	0	**16.07**	**0.18**	**29.19**	-5.29	0	**-5.29**	**40.14**
Eutrophication	mg PO_4 eq	0.43	0.01	**0.44**	**2.98E-03**	**1.28**	-0.13	0	**-0.13**	**1.60**
**Including electricity for water supply and waste water treatment*										

The results are also shown in Figure 5.1 in terms of the relative contributions (%) of each life cycle phase (i.e. manufacturing, distribution, use and end-of-life) to the overall results. In this figure, results are presented for each impact category as the sum of the contributions (%) of all the phases in absolute value (without the sign) summing up to 100%. Only the environmental impacts with a relative contribution higher than 5% of the total are discussed in the next paragraphs.

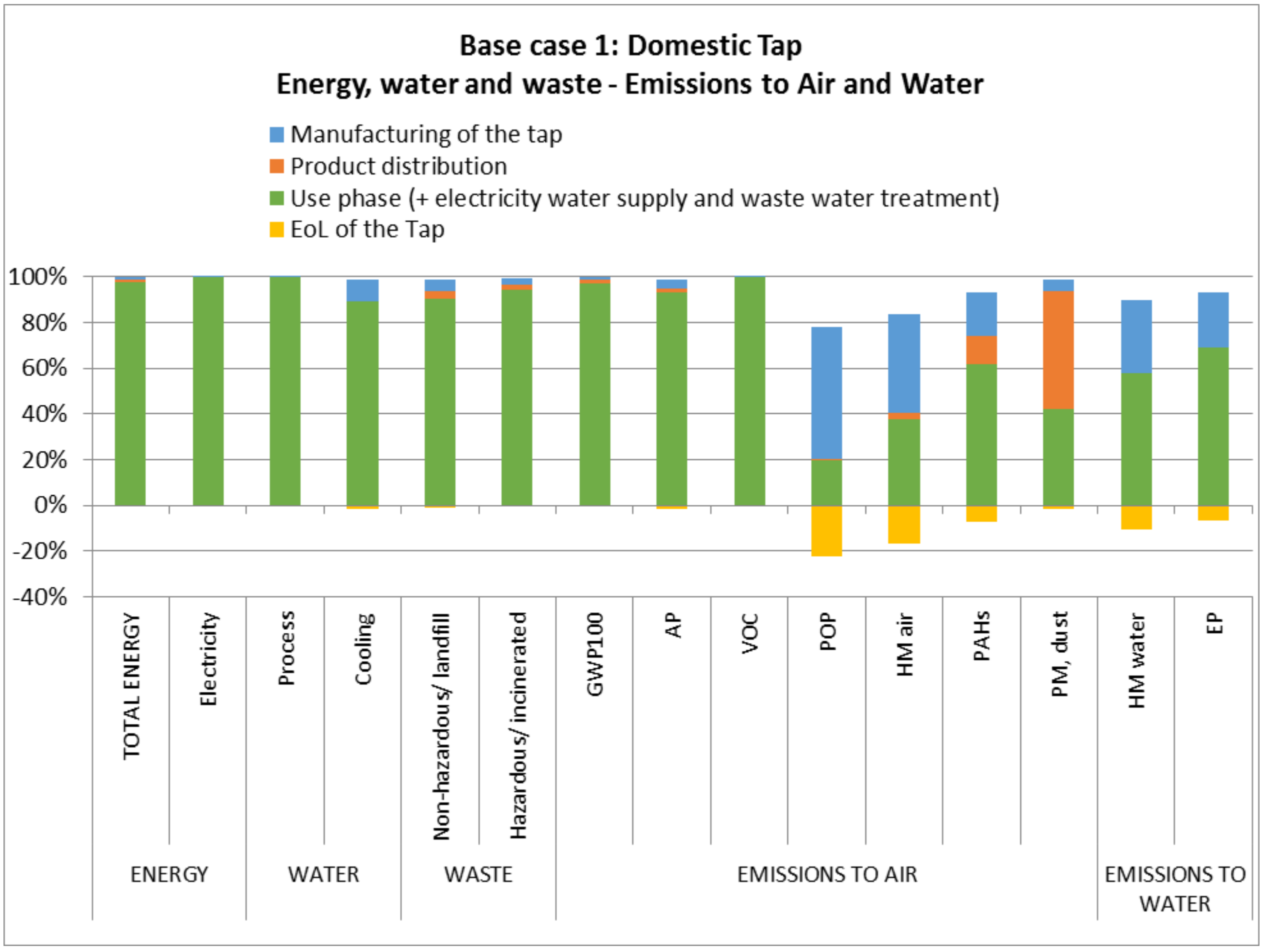

Figure 5.1 **Relative contribution of single life cycle phases to the environmental impact of the domestic tap**

Figure 5.1 shows that the use phase dominates (>89%) the consumption of ENERGY and WATER and the generation of WASTE during the life cycle of the base case. Besides Process Water, which is essentially related to the consumption of water, consumption of electricity is the main contributor to all the other indicators of these three macro categories (see also Table A3.2 in Annex III and Figure 5.2).

Regarding the EMISSIONS TO AIR AND WATER, the use phase also dominates (>93%) the impact categories of Global Warming Potential (GWP100), Acidification Potential (AP) and Volatile Organic Compounds (VOC). For Persistent Organic Pollutants (POP), Heavy Metals (HM air) to air, Polycyclic Aromatic Hydrocarbons (PAHs), Particulate Matter (PM, dust), Heavy Metals to water (HM water) and Eutrophication Potential (EP), the use phase has a contribution ranging from 20% to 69% of the total of each category. This is mainly caused by the consumption of electricity (see also Table 5.6 and Figure 5.2).

The contribution of the production phase is greater than or equal to 5% for Cooling Water (9%), POP (58%), HM air (43%), PAHs (19%), PM (5%), HM water (32%) and EP (24%). This is mainly due to the extraction of minerals and the further manufacturing of brass and nickel.

The distribution phase is relevant only for the generation of PAHs (12%) and PM (52%) due to the transport of the packaged products.

The EoL presents significant negative impacts in some categories. This is due to the credits (avoided impacts) that the EcoReport tool v3.06 2014 assigns to the recycling of materials. For instance, the contribution of the EoL for POP is -22%, for HM air it is -16%, for PAHs -7%, for HM water -10% and for EP -7%.

Figure 5.2 zooms in on the use phase to further analyse the processes which contribute most to the environmental impacts of this phase. Electricity for heating water is the process which contributes the most, ranging from 36% to 59% to every impact category except for the consumption of Process Water. Electricity for water supply and waste water treatment also contributes to all categories, from 19% to 31%. Natural gas and fuel oil for heating water contribute to the Total Energy consumption (11% fuel oil and 20% natural gas), GWP100 (16% fuel oil and 22% natural gas), AP (7% fuel oil and 2% natural gas) and PM (6% fuel and 2% natural gas).

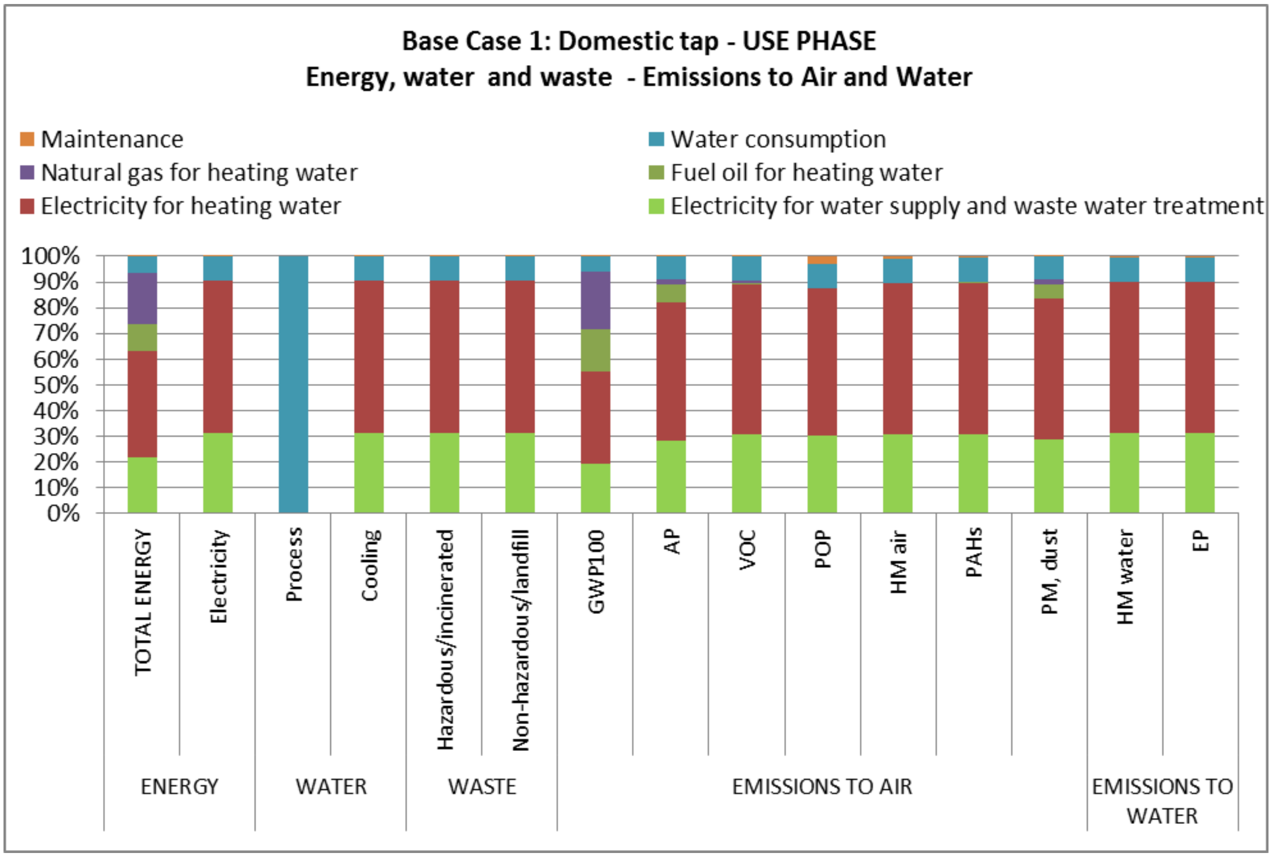

Figure 5.2. **Distribution of the environmental impacts of the use phases for the domestic tap**

5.3.2 Base case 2: Non-domestic tap

The environmental impacts related to the use of a non-domestic tap over its lifetime (10 years) are reported in Table 5.6.

Table 5.6: **Life cycle environmental impacts related to the use of a non-domestic tap**

ENVIRONMENTAL IMPACTS Non-domestic Tap per lifetime (10 years)										
LIFE CYCLE PHASES	**UNITS**	**MANUFACTURING OF THE TAP**			**PRODUCT DISTRIBUTION**	**USE PHASE***	**END-OF-LIFE OF THE TAP**			**TOTAL**
		Materials	**Manufacturing**	**Total**		**Total**	**Recycling**	**Disposal**	**Total**	
Resources & Waste										
Total Energy (GER)	MJ eq	102.25	13.40	**115.65**	**122.83**	**36463.81**	-31.23	1.45	**-29.78**	**36672.51**
of which, electricity (in primary MJ)	MJ eq	9.81	8.06	**17.87**	**0.03**	**24215.85**	-2.85	0	**-2.85**	**24230.90**
Water (process)	l	3.24	0.12	**3.36**	**0**	**387946.03**	-0.73	0	**-0.73**	**387948.66**
Water (cooling)	l	26.77	3.80	**30.57**	**0**	**1076.29**	-4.90	0.00	**-4.90**	**1101.96**
Waste, hazardous/ incinerated	g	159.74	41.97	**201.71**	**112.32**	**12479.45**	-52.59	4.82	**-47.78**	**12745.70**
Waste, non-haz./ landfill	g	3.47	0	**3.47**	**2.23**	**382.10**	-0.70	0	**-0.70**	**387.10**
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq	4.35	0.74	**5.09**	**9.34**	**1796.15**	-1.37	4.32E-03	**-1.37**	**1809.21**
Acidification, emissions	g SO2 eq	55.39	3.20	**58.59**	**27.31**	**5105.11**	-20.18	0.05	**-20.13**	**5170.88**
Volatile Organic Compounds (VOC)	mg	0.06	9.48E-04	**0.06**	**0.31**	**552.75**	-0.01	4.80E-06	**-0.01**	**553.11**
Persistent Organic Pollutants (POP)	ng TEQ	47.93	0	**47.93**	**0.63**	**56.50**	-18.38	0.02	**-18.36**	**86.71**
Heavy Metals	mg Ni eq	78.84	0	**78.84**	**5.72**	**245.33**	-30.23	0.08	**-30.15**	**299.74**
PAHs	mg Ni eq	4.89	4.10E-03	**4.90**	**3.17**	**57.74**	-1.83	0.00	**-1.83**	**63.97**
Particulate Matter (PM, dust)	g PM10 eq	2.99	0.49	**3.48**	**35.74**	**105.95**	-0.95	0.05	**-0.90**	**144.26**
Emissions (Water)										
Heavy Metals	mg Hg eq.	16.07	0	**16.07**	**0.18**	**104.27**	-5.29	0.02	**-5.28**	**115.24**
Eutrophication	mg PO4 eq	0.43	0.01	**0.44**	**2.98E-03**	**4.57**	-0.13	0.04	**-0.09**	**4.93**
**Including electricity for water supply and waste water treatment*										

Similarly to in the previous section, results are also shown in terms of the relative contribution (%) of each life cycle phase in Figure 5.3 for non-domestic taps. Only the environmental impacts with a relative contribution higher than 5% of the total are discussed in the next paragraphs.

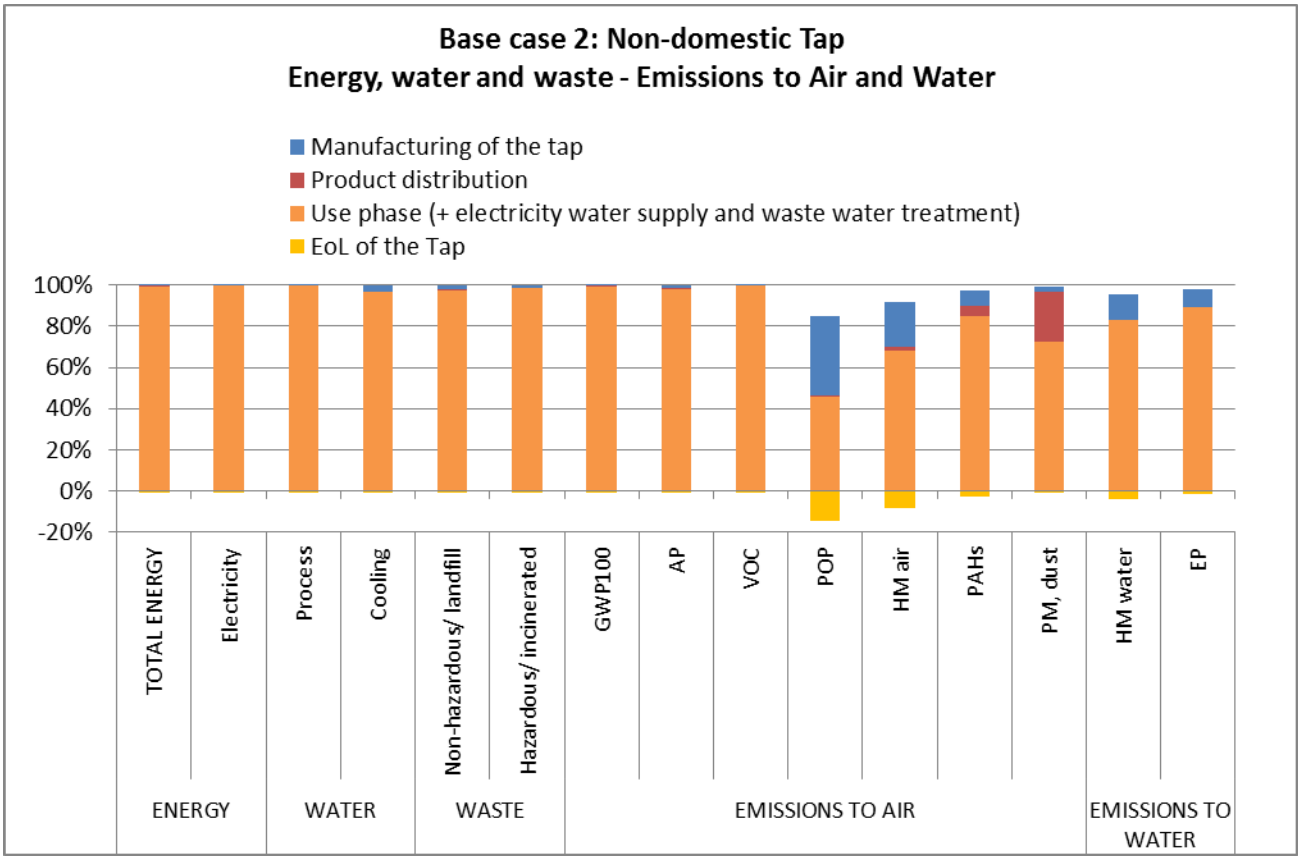

Figure 5.3. **Relative contribution of single life cycle phases to the environmental impacts of the non-domestic tap**

The use phase strongly dominates (>97%) the consumption of ENERGY and WATER and the generation of WASTE. Regarding the EMISSIONS TO AIR AND WATER, the use phase contributes the most (from 46% to 100%) to all the impact categories. The distribution of environmental impacts per process in the use phase is shown in Table A3.3 and Figure A3.1 in Annex III. This is qualitatively similar to that obtained for Base case 1 (domestic tap) and therefore it is not further discussed here.

The contribution of the manufacturing phase is greater than 5% in POP (39%), HM air (22%), HM water (13%) and EP (9%), while the distribution phase is relevant only for PM (24%) and PAHs (5%). The same materials identified in the analysis of Base case 1 (domestic tap) are found to have the most significant contributions to the impacts of the manufacturing phase.

The EoL phase shows significant negative values for POP (-15%) and HM air (-8%) due to the credits given by recycling of metals.

5.3.3 Base case 3: Domestic shower system

The environmental impacts related to the use of a domestic shower system over the lifetime of the shower valve (16 years) are reported in Table 5.7.

Table 5.7: Life cycle environmental impacts related to the use of a domestic shower system

ENVIRONMENTAL IMPACTS Domestic Shower System per lifetime of the shower valve (16 years)										
LIFE CYCLE PHASES	**UNITS**	**MANUFACTURING OF THE SHOWER SYSTEM**			**PRODUCT DISTRIBUTION**	**USE PHASE***	**END-OF-LIFE OF THE SHOWER SYSTEM**			**TOTAL**
		Materials	**Manufacturing**	**Total**		**Total**	**Recycling**	**Disposal**	**Total**	
Resources & Waste										
Total Energy (GER)	MJ eq	278.88	58.91	**337.79**	**122.83**	**93971.65**	-73.80	5.03	**-68.76**	**94363.51**
of which, electricity (in primary MJ)	MJ eq	18.47	35.46	**53.93**	**0.03**	**57821.58**	-3.50	0	**-3.50**	**57872.04**
Water (process)	l	10.94	0.53	**11.47**	**0**	**443271.79**	-1.65	0	**-1.65**	**443281.61**
Water (cooling)	l	192.69	16.73	**209.42**	**0**	**2571.92**	-21.04	0	**-21.04**	**2760.30**
Waste, hazardous/ incinerated	g	330.51	184.58	**515.09**	**112.32**	**29797.24**	-97.02	11.55	**-85.47**	**30339.18**
Waste, non-haz./ landfill	g	12.88	0	**12.88**	**2.23**	**917.44**	-2.05	0	**-2.05**	**930.50**
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO_2 eq	12.08	3.27	**15.34**	**9.34**	**4712.85**	-3.38	0.02	**-3.36**	**4734.17**
Acidification, emissions	g SO_2 eq	151.29	14.09	**165.39**	**27.31**	**12490.78**	-52.57	0.18	**-52.40**	**12631.08**
Volatile Organic Compounds (VOC)	mg	0.10	4.17E-03	**0.11**	**0.31**	**1324.83**	-0.02	7.25E-06	**-0.02**	**1325.22**
Persistent Organic Pollutants (POP)	ng TEQ	111.85	0	**111.85**	**0.63**	**136.03**	-42.90	0.05	**-42.85**	**205.68**
Heavy Metals	mg Ni eq	208.09	0	**208.09**	**5.72**	**586.72**	-79.79	0.21	**-79.58**	**720.94**
PAHs	mg Ni eq	13.65	0.02	**13.67**	**3.17**	**136.37**	-4.94	0	**-4.94**	**148.26**
Particulate Matter (PM, dust)	g PM10 eq	8.78	2.17	**10.95**	**35.74**	**258.06**	-2.39	0.20	**-2.19**	**302.56**
Emissions (Water)										
Heavy Metals	mg Hg eq.	45.23	0	**45.23**	**0.18**	**249.35**	-14.47	0.05	**-14.43**	**280.32**
Eutrophication	mg PO_4 eq	1.03	0.03	**1.06**	**2.98E-03**	**10.93**	-0.20	0.14	**-0.06**	**11.94**
**Including electricity for water supply and waste water treatment*										

As in the previous sections, the results are also shown in terms of the relative contribution (%) of each life cycle phase in Figure 5.4 for non-domestic taps. Only the environmental impacts with a relative contribution higher than 5% of the total are discussed in the next paragraphs.

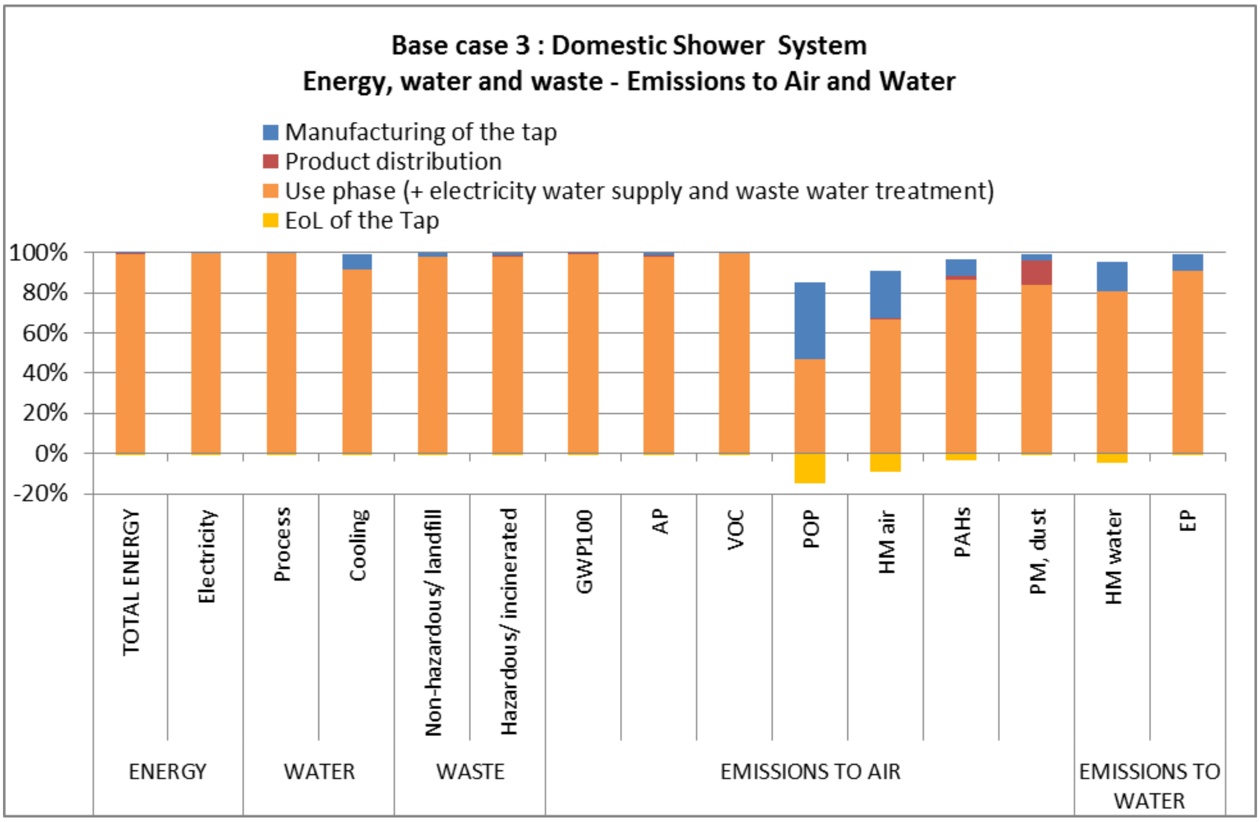

Figure 5.4 **Relative contribution of single life cycle phases to the environmental impacts of the domestic shower system**

The use phase is a major contributor (>92%) to the categories related to the consumption of ENERGY and WATER and the generation of WASTE. This phase is also dominant in the categories of EMISSIONS TO AIR and WATER, especially in GWP100, AP, VOC, PAHs, PM, HM water and EP, with a contribution between 81% and 100%. Regarding POP and HM air, the use phase also contributes significantly (47% and 67% respectively). The distribution of environmental impacts per process in the use phase is shown in Table A3.4 and Figure A3.2 in Annex III. This is qualitatively similar to that obtained for Base case 1 (domestic tap) and therefore it is not further discussed here.

The contribution of the manufacturing phase is greater than 5% in POP (38%), HM air (24%), PAHs (9%), HM water (15%) and EP (9%). The materials which mainly contribute to the impacts of this phase are brass and plastics (ABS and PA6), which are used in the valve and in the outlet of the shower system. The distribution phase is relevant only for PM (12%) due to the transport of the packaged product.

The EoL phase presents significant negative contributions (avoided impacts) for POP (-15%), HM air (-9%) and HM water (-5%).

5.3.4 Base case 4: Non-domestic shower system

The environmental impacts related to the use of a non-domestic shower system over the lifetime of the shower valve (10 years) are reported in Table 5.8.

Table 5.8: Life cycle environmental impacts related to the use of a non-domestic shower system

ENVIRONMENTAL IMPACTS Non-domestic Shower System per lifetime of the shower valve (10 years)										
LIFE CYCLE PHASES	**UNITS**	**MANUFACTURING OF THE SHOWER SYSTEM**			**PRODUCT DISTRIBUTION**	**USE PHASE***	**END-OF-LIFE OF THE SHOWER SYSTEM**			**TOTAL**
		Materials	**Manufacturing**	**Total**		**Total**	**Recycling**	**Disposal**	**Total**	
Resources & Waste										
Total Energy (GER)	MJ eq	264.14	54.24	318.38	122.83	42443.10	-70.82	4.69	-66.13	**42818.18**
of which, electricity (in primary MJ)	MJ eq	17.54	32.66	50.19	0.03	26115.17	-3.43	0	-3.43	**26161.97**
Water (process)	l	10.37	0.49	10.86	0	200010.91	-1.61	0	-1.61	**200020.16**
Water (cooling)	l	178.20	15.40	193.60	0	1160.76	-19.90	0	-19.90	**1334.46**
Waste, hazardous/ incinerated	g	317.80	169.97	487.77	112.32	13459.70	-93.98	11.03	-82.95	**13976.83**
Waste, non-haz./ landfill	g	12.15	0	12.15	2.23	412.15	-1.97	0	-1.97	**424.57**
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO_2 eq	11.53	3.01	14.54	9.34	2133.31	-3.25	0.01	-3.23	**2153.95**
Acidification, emissions	g SO_2 eq	144.70	12.98	157.67	27.31	5640.77	-50.40	0.17	-50.23	**5775.52**
Volatile Organic Compounds (VOC)	mg	0.10	3.84E-03	0.10	0.31	599.93	-0.02	6.70E-06	-0.02	**600.32**
Persistent Organic Pollutants (POP)	ng TEQ	107.90	0	107.90	0.63	60.94	-41.38	0.05	-41.33	**128.14**
Heavy Metals	mg Ni eq	199.23	0	199.23	5.72	265.13	-76.40	0.20	-76.20	**393.88**
PAHs	mg Ni eq	13.03	0.02	13.05	3.17	63.52	-4.73	0	-4.73	**75.01**
Particulate Matter (PM, dust)	g PM10 eq	8.37	2.00	10.37	35.74	116.63	-2.30	0.19	-2.11	**160.63**
Emissions (Water)										
Heavy Metals	mg Hg eq.	43.76	0	43.76	0.18	112.52	-13.94	0.05	-13.89	**142.56**
Eutrophication	mg PO_4 eq	0.99	0.03	1.03	0.00	4.93	-0.20	0.14	-0.06	**5.90**
**Including electricity for water supply and waste water treatment*										

Results are also shown in terms of the relative contribution (%) of each life cycle phase in Figure 5.5 for non-domestic taps. Only the environmental impacts with a relative contribution higher than 5% of the total are discussed in the next paragraphs.

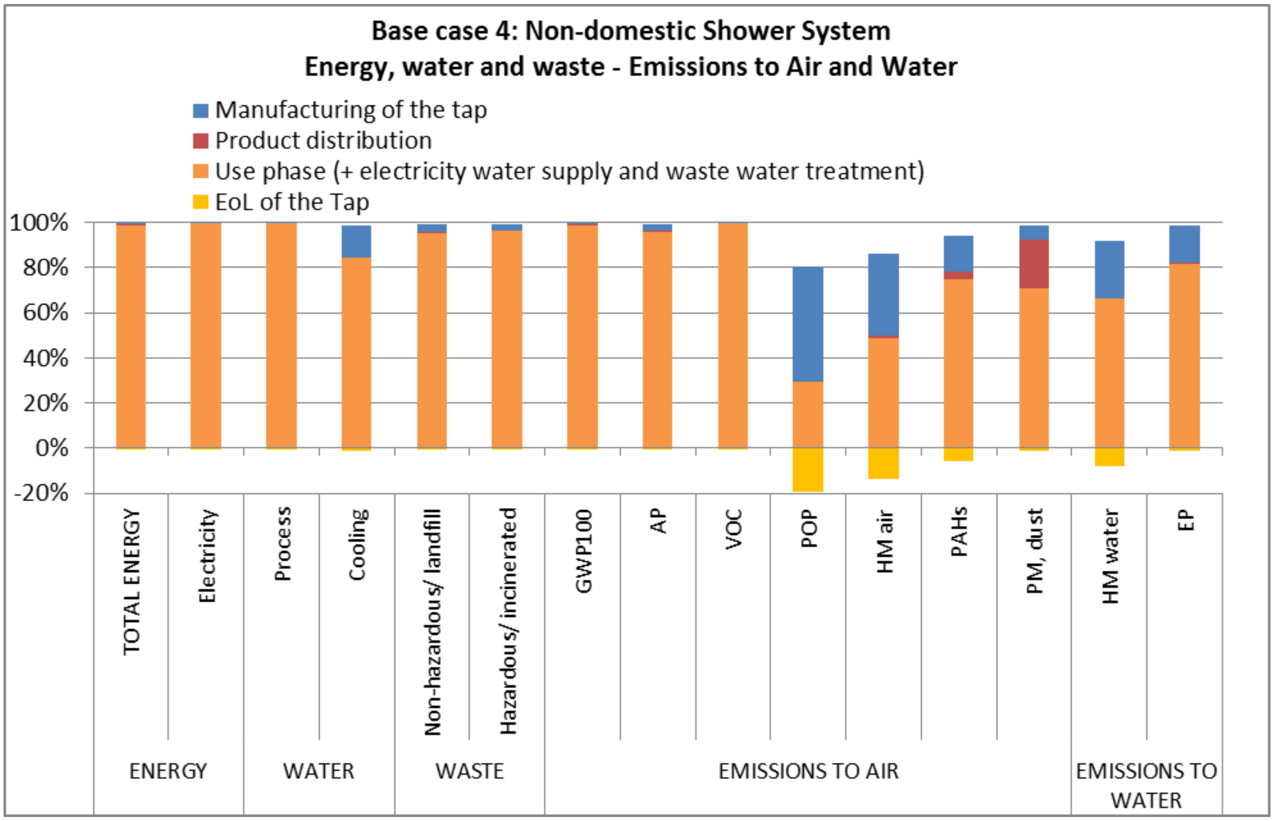

Figure 5.5 **Relative contribution of single life cycle phases to the environmental impacts of the non-domestic shower system**

Regarding the consumption of ENERGY and WATER and the generation of WASTE, the use phase is a predominant contributor (from 84% to 100%) in all categories. The manufacturing phase also makes a relevant contribution in Water (cooling) (14%).

For EMISSIONS TO AIR and WATER, the use phase dominates (96%-100%) the environmental impacts for GWP100, AP and VOC. The contribution is less but still very significant for the other indicators: POP (29%), HM air (49%), PAHs (75%), PM (71%), HM water (66%) and EP (82%). The distribution of environmental impacts per process in the use phase is shown in Table A3.5 and Figure A3.3 in Annex III. This is qualitatively similar to that obtained for Base case 1 (domestic tap) and therefore it is not further discussed here.

The contribution of the manufacturing phase is greater than or equal to 5% in POP (51%), HM air (36%), PAHs (16%), PM (6%), HM water (26%) and EP (17%). The same materials identified in the analysis of Base case 3 (domestic shower system) are found to have the most significant contributions to the impacts of the manufacturing phase. The distribution phase is relevant only for PM (22%) due to the transport of the packed shower system.

The EoL phase contributes as avoided impacts (negative values) to POP (-20%), HM air (-14%), PAHs (-6%), HM water (-6%) and EP (-8%).

5.4 Economic assessment: Life Cycle Costs of base cases

Life Cycle Costs (LCC) have been calculated using the EcoReport tool and the results are shown in Table 5.9, in reference to the lifetime considered for each of the base cases. Purchase price, installation costs, utilities bills and repair and maintenance costs for 2013 have been included in the assessment.

Table 5.9: Life Cycle Costs of the base cases referred to the lifetimes considered for each application (ref. 2013)

Cost/lifetime	**TAP**				**SHOWER SYSTEM**			
	Domestic		**Non-domestic**		**Domestic**		**Non-domestic**	
Product price	EUR 60	8%	EUR 60	3%	EUR 172	5%	EUR 160	10%
Installation costs	EUR 75	10%	EUR 75	4%	EUR 75	2%	EUR 75	5%
Fuels costs for water heating (natural gas + fuel oil)	EUR 49	7%	EUR 207	11%	EUR 610	18%	EUR 276	17%
Electricity costs for water heating (+ waste water treatment)	EUR 120	16%	EUR 455	24%	EUR 1,183	35%	EUR 535	32%
Water costs	EUR 399	54%	EUR 1,086	57%	EUR 1,241	37%	EUR 560	34%
Repair & maintenance	EUR 31	4%	EUR 19	1%	EUR 77	2%	EUR 48	3%
Total	**EUR 734**		**EUR 1,902**		**EUR 3,359**		**EUR 1,653**	
Lifetime	**16**		**10**		**16**		**10**	

The results of Table 5.10 show that water costs are the highest costs during the life cycle of all the base cases followed by the electricity costs for water heating and waste water treatment. Both costs together add up to 66-81% of the Life Cycle Costs. The higher relative contribution of fuel costs registered for shower systems is consistent with the energy model presented in Section 3 which pointed out the greater demand for hot water of this type of product.

5.5 EU totals

Following the MEErP 2011 Methodology, EU totals have been calculated using the EcoReport tool v3.06 2014, whose underlying data take 2011 as the reference year. Environmental impacts and LCC outcomes have been aggregated according to the stock and market data estimated in Section 2.

5.5.1 Environmental impact at EU level

The total annual impacts from the EU stock of products (domestic taps, non-domestic taps, domestic shower systems and non-domestic shower systems) are presented in Table 5.10. These are assumed to provide indications of the total impacts in the EU for 2011-2013. Due to the assumptions made for the estimation of the annual sales (Section 2), the figures reported in Table 5.11 for the stock of products are also representative of the total life cycle impact related to the new products produced in the same time interval.

Table 5.10: EU total annual environmental impacts form the installed stock of taps and showers (ref. 2011-2013)

BASE CASES	UNITS	TAPS		SHOWER SYSTEMS		TOTAL
		Domestic	Non-domestic	Domestic	Non-domestic	
Resources & Waste						
Total Energy (GER)	PJ eq	741.13	259.83	2356.78	102.62	**3460.37**
of which, electricity (in primary MJ)	PJ eq	505.95	171.58	1443.31	62.54	**2183.37**
Water (process)	mln. m^3	10650.15	2746.69	11054.38	478.05	**24929.28**
Water (cooling)	mln. m^3	25.12	7.88	68.35	3.15	**104.50**
Waste, non-haz./ landfill	Kt	284.00	90.63	760.68	33.73	**1169.03**
Waste, hazardous/ incinerated	Kt	8.38	2.75	23.18	1.02	**35.33**
Emissions (Air)						
Greenhouse Gases in GWP100	Mkg CO_2 eq	36.22	12.81	118.28	5.15	**172.46**
Acidification, emissions	kg SO_2 eq	111.38	36.77	316.72	13.95	**478.82**
Volatile Organic Compounds (VOC)	Kt	11.50	3.91	33.06	1.43	**49.90**
Persistent Organic Pollutants (POP)	g TEQ	4.85	0.75	6.21	0.41	**12.21**
Heavy Metals	ton Ni eq	11.49	2.34	20.05	1.13	**35.00**
PAHs	ton Ni eq	1.79	0.46	3.87	0.19	**4.52**
Particulate Matter (PM, dust)	Kt PM10 eq	4.95	1.03	8.13	0.42	**14.53**
Emissions (Water)						
Heavy Metals	ton Hg eq	3.43	0.86	7.35	0.37	**12.02**
Eutrophication	kt PO_4 eq	0.13	0.04	0.30	0.01	**0.48**

Aggregated impacts vary significantly depending on the product and the application considered. The ranking of products in decreasing order of aggregated impacts is:

1. Domestic shower systems
2. Domestic taps
3. Non-domestic taps

4. Non-domestic showers.

The same ranking at aggregated level resulted in Section 3 in terms of energy consumption. This underlines again the key contribution of energy in determining the environmental profile of these products. This is an interesting conclusion since, in terms of installed stock, the number of domestic taps is considerably higher than that of domestic showers, as calculated in Section 2.

5.5.2 Economic assessment at EU level

Table 5.11 shows the total annual expenditure in the EU associated to the use of the stock of products currently installed in the EU. Electricity costs for water supply have already been included in the water costs.

Table 5.11: EU total annual expenditure for taps and showers (ref. 2013) in millions of EUR

Cost (M EUR)	**TAP**		**SHOWER SYSTEM**		**TOTAL EU**	
	Domestic	**Non-domestic**	**Domestic**	**Non-domestic**		
Product price	4,488	426	4,283	384	**9,581**	*(6%)*
Installation costs	5,610	533	1,868	180	**8,190**	*(5%)*
Fuels costs for heating water (natural gas + gas oil)	3,695	1,464	15,217	659	**21,035**	*(13%)*
Electricity costs for water heating + electricity for waste water treatment	8,972	3,222	29,512	1,277	**42,983**	*(28%)*
Water costs	29,824	7,692	30,956	1,339	**69,811**	*(45%*
Repair & maintenance costs	2,319	135	1,920	115	**4,489**	*(3%)*
Total	**54,908** *(35%)*	**13,471** *(9%)*	**83,756** *(53%)*	**3,954** *(3%)*	**156,089**	

The results obtained previously are confirmed: domestic shower systems and domestic taps generate the higher expenditure per year. Among the elements considered in the assessment, water and electricity costs are the two predominant voices in terms of cost for the EU, in accordance with the results of the assessment for single units of product.

6 IMPROVEMENT POTENTIAL: ANALYSIS OF DESIGN OPTIONS

6.1 Overview of the design options

The improvement potential analysis has focused on seven design options identified in Section 4 for domestic taps (Base case 1), non-domestic taps (Base case 2) and domestic shower systems (Base case 3):

- Base case 1: domestic taps
  1. Taps with aerators and flow regulators only
  2. Tap with flow boosters
  3. Two-stage cartridge taps
- Base case 2: non-domestic taps
  4. Push taps
  5. Sensor taps
- Base case 3: domestic shower systems
  6. Shower systems with thermostatic mixers
  7. Other water-saving showers (including shower systems with aerators and flow regulators, automatic valves, flow boosters and mechanical brakes).

No design option has been considered for the non-domestic shower system (Base case 4) because of its lesser importance in terms of total environmental impacts and expenditure (see previous sections). Nevertheless, the outcomes for this base case can be extrapolated from the analysis of the other design options.

Design options have been defined in Section 4, where water- and various energy-saving technologies of relevance for taps and shower systems are presented and described. Selection of the technologies for building the design options has been based on:

- their representativeness of current stock and market of products within the respective sectors;
- their likelihood to cover an important market share in the future;
- their relevance in terms of technology and additional water- and energy-savings.

The pool of case studies analysed is considered to be broad and heterogeneous and also to provide useful indications for other combinations of products, technologies and sectors, as for instance could be the case when applying taps with aerators and flow regulators in public buildings.

All design options are considered to present new or optimised features which would allow saving of water and energy compared to the average products on the market. The theoretical water- and energy-saving potential associated to different options has been estimated in Sections 3 and 4. Average savings figures have been considered for the analysed design options, as indicated in Table 6.1 and referring to the respective base cases. For this reason, it could be that specific models of taps and shower systems differ from these average figures.

Although only explicit for the first design option (taps with aerators and flow regulators), these and other devices for controlling the flow rates can be integrated in all the options. In fact, these water/energy-saving technologies have already been commonly used in the last decade. Without integrating such devices in the product, the savings potential of these technologies could be lower, the savings potential being modelled as the result of: a) reduction of water flow (considered the same for all design options applying a technologically neutral approach); and b) improved action and control on temperature and water flow.

As already indicated in Sections 3 and 4, the analysis concentrated on the savings potentially achievable through a change of technology, since the main focus of this study is on product policy tools. However, it should be remarked again that user behaviour is a key element for determining the actual consumption of water and energy. This underlines the importance of the culture and education of users. With this in mind, it is possible that promoting the economic benefits associated to water- and energy-saving technologies may encourage users to consume water more responsibly.

Further technical information on products and water/energy-saving technologies are provided in the previous Sections. This section of the report focuses on the practical aspects needed for the modelling and assessment of the design options.

Table 6.1: Average savings potential considered for the design options

DESIGN OPTIONS			Savings potential (average)
TAPS	Domestic	Taps with aerators and flow regulators only	22.0%
		Taps with flow boosters	24.5%
		Two-stage cartridge taps	24.5%
	Non-domestic	Push taps	24.5%
		Sensor taps	25.5%
SHOWER SYSTEMS	Domestic	Showers with thermostatic valves	28.0%
		Other water-saving showers	27.0%

In contrast to the assessment of the base cases performed in Section 5, input to the EcoReport tool on consumption of water and energy carriers and costs for the purchase, repair and maintenance of products has been changed for each design option.

Input to the EcoReport Tool on lifetime, water and energy prices and market data has been instead kept unvaried for each type of product and application considered in the assessment of the design options.

With the exception of sensor taps, this is also the case for the bills of materials (BoM) considered for the different design options. BoMs are considered to change from product to product more because of fashion design features than for technical reasons. Although covering different material design options would be theoretically possible, this is not considered a priority within this study. The typical BoMs defined in Sections 4 and 5 in fact provide useful indications of the relative importance of materials within the environmental impact profile of taps and shower systems. Nevertheless, it was considered important to investigate further the impact of electronic components used in sensor taps.

To this aim, the BoM for sensor taps has been modified, compared to that of the base case, to include electronics, as shown in Table 6.2. The BoM for sensor taps has been estimated based on information received from stakeholders and on the analysis of information available in the literature[255].

Components including electronics have been considered to add 281 g to the typical weight considered for taps in the base cases (1.8kg), which results in a relative increase in the total product weight of 15.6%. Additional components present in sensor taps are mainly: a sensor, an

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[255] Hischier R., Classen M., Lehmann M. and Scharnhorst W. (2007) Life Cycle inventories of Electric and Electronic Equipment: Production, use and disposal. Ecoinvent report No. 18 Empa / Technology & Society Lab, Swiss Centre for Life Cycle Inventories, Dubendorf, 2007.

electric valve and an energy supplier, considered to be a mains adaptor for the modelling of this case study. The weight of single components and material compositions have been modelled based on information from stakeholders and the literature. Although included in the BoM, a specific and detailed analysis of the end-of-life of electronics was not conducted for this design option. This is because dimensions and mass of electronics are limited and because of the improbable possibility of setting up differentiated collection or treatment systems for this product group, and in particular for this design option. End-of-life of electronics is however considered in accordance with the Ecoreport tool by assigning credits for recycling of materials.

Table 6.2: Additional bill of material of the electronics of sensor taps

Component/Material		**Weight (g)**	**Material code in EcoReport tool**
Electric valve (12%)	Copper and brass	28.1	32 -CuZn38 cast
	PVC	2.8	8 -PVC
	ABS	2.8	11-ABS
Sensor (12%)	Electric components	16.9	50-PWB 1/2 lay 3.75kg/m^2
	PVC	8.4	8 -PVC
	ABS	8.4	11-ABS
Mains adaptors (76%)	Steel	106.9	26-Stainless 18/8 coil
	HIPS casing	53.4	7-HI-PS
	Copper wire	32.1	30-Cu wire
	PVC	21.4	8-PVC

The consumption of water and energy carriers for the design options analysed has been calculated based on to the average savings potential provided in Table 6.1 and reported in Table 6.3. The additional electricity consumption of sensor taps has been estimated as 2 Joules/L of water flow based on the information of Section 4.

Table 6.3: Use phase input for the different design options analysed

PARAMETER	TAPS					SHOWER SYSTEMS	
	Domestic			Non-domestic		Domestic	
	Taps with aerators and flow regulators only	Taps with flow booster	Two-stage cartridge taps	Push taps	Sensor taps	Showers with thermostatic valves	Other water-saving showers
Lifetime (years)	16			10		16 for the valve 10 for the outlet	
Water abstraction (m^3/year per unit of product)	5.0	4.8	4.8	21.1	20.8	14.4	14.6
Electricity for water supply (MJ/yr per unit of product)	12.6	12.2	12.2	53.4	52.7	36.3	36.8
Electricity for waste water treatment (MJ/yr per unit of product)	28.6	27.7	27.7	121.1	119.5	82.3	83.5
Electricity consumption for production of hot water (MJ/year per unit of product)	77.7	75.2	75.2	503.7	497.0	886.0	898.3
Natural gas consumption for production of hot water (MJ/year per unit of product)	77.7	75.2	75.2	503.7	497.0	886.0	898.3
Oil consumption for production of hot water (MJ/year per unit of product)	38.8	37.6	37.6	251.8	248.5	443.0	449.2
Electricity consumption for the use of sensor taps (MJ/year per unit of product)	-	-	-	-	41.7	-	-

Typical product purchase prices and indicative costs for repair and maintenance of the design options have been estimated in Sections 2 and 4, also based on inputs from stakeholders, and are reported in Table 6.4. Installation costs have been considered to be EUR 75 for all the options, as in previous sections.

Table 6.4: LCC inputs for the different design options analysed

COST	Taps					Shower systems	
	Domestic			Non-domestic		Domestic	
	Taps with aerators and flow regulators only	Taps with flow booster	Two-stages cartridge taps	Push taps	Sensor taps	Showers with thermostatic valves	Other water-saving showers
Typical product purchase price (EUR/unit)	70	80	75	80	210	242	192
Indicative repair & maintenance costs (EUR/unit)	31	107	107	143	143	153	153

Environmental impact assessments and LCC analysis have been carried out for each of the design options with the EcoReport tool v3.06 2014. The following sections present the results for the seven design options compared to their respective base cases.

It should be highlighted that results provide general indications of the performance of technologies, and it is possible that technical and economic differences exist among products using the same technology.

6.2 Environmental improvement of design options

Environmental impacts associated to the design options are presented in Table 6.5 with reference to a unit of product and the considered time of use. Relative variations of results from the respective base case (referred to as "% Var. BC" in Table 6.5) have also been calculated and shown in the table.

Table 6.5: Environmental impacts of design options referred to a unit of product over its lifetime and compared to base cases

INDICATOR		TAPS							SHOWER SYSTEMS		
		Domestic				Non-domestic			Domestic		
		Base case 1: Domestic tap	Taps with aerators and flow regulators only	Taps with flow booster	Two-stage cartridge taps	Base case 2: non-domestic taps	Push taps	Sensor taps	Base case 3: domestic shower systems	Water-saving shower	Thermostatic shower
Lifetime (years)		16				10			16		
Resources & Waste											
Total Energy (GER) (MJ eq)		9,880	7,753	7,511	7,511	36,672	27,739	28,443	94,363	68,991	68,051
	% Var. BC		-21.5%	-24.0%	-24.0%		-24.4%	-22.4%		-26.9%	-27.9%
of which, electricity (in primary MJ eq)		6,760	5,276	5,107	5,107	24,231	18,298	19,104	57,872	42,260	41,682
	% Var. BC		-21.9%	-24.4%	-24.4%		-24.5%	-21.2%		-27.0%	-28.0%
Water (process) (l)		142,356	111,065	107,512	107,512	387,949	292,940	289,076	443,282	323,536	319,117
	% Var. BC		-22.0%	-24.5%	-24.5%		-24.5%	-25.5%		-27.0%	-28.0%
Water (cooling) (l)		326	260	252	252	1,102	839	891	2,760	2,066	2,041
	% Var. BC		-20.2%	-22.5%	-22.5%		-23.9%	-19.2%		-25.1%	-26.1%
Waste, hazardous/ incinerated (g)		3,744	2,979	2,892	2,892	12,747	9,690	10,237	30,342	22,297	21,999
	% Var. BC		-20.4%	-22.7%	-22.7%		-24.0%	-19.7%		-26.5%	-27.5%
Waste, non-haz./ landfill (g)		111	88	85	85	387	293	330	925	679	670
	% Var. BC		-21.0%	-23.4%	-23.4%		-24.2%	-14.8%		-26.6%	-27.6%
Emissions (Air)											
Greenhouse Gases in GWP100 (kg CO_2 eq)		483	379	368	368	1,807	1,368	1,396	4,734	3,462	3,415
	% Var. BC		-21.4%	-23.8%	-23.8%		-24.3%	-22.8%		-26.9%	-27.9%
Acidification, emissions (g SO_2 eq)		1,467	1,159	1,124	1,124	5,171	3,921	4,083	12,631	9,259	9,134
	% Var. BC		-21.0%	-23.4%	-23.4%		-24.2%	-21.0%		-26.7%	
Volatile Organic		154	120	116	116	553	417	435	1,325	968	954

Compounds (VOC) (mg)	*% Var. BC*		-21.9%	-24.4%	-24.4%		-24.5%	-21.3%		-27.0%	-28.0%
Persistent Organic Pollutants (POP) (ng TEQ)		46	43	43	43	87	73	77	206	169	168
	% Var. BC		-7.5%	-8.3%	-8.3%		-15.9%	-12.2%		-17.7%	-18.4%
Heavy Metals (mg Ni eq)		123	108	107	107	300	240	261	721	563	557
	% Var. BC		-12.2%	-13.5%	-13.5%		-20.0%	-12.9%		-21.9%	-22.7%
PAHs (mg Ni eq)		22	19	18	18	63	49	54	148	111	110
	% Var. BC		-15.8%	-17.5%	-17.5%		-22.1%	-13.9%		-24.8%	-25.7%
Particulate Matter (PM, dust) (g PM10 eq)		67	61	60	60	144	118	123	303	233	230
	% Var. BC		-9.5%	-10.6%	-10.6%		-18.0%	-14.9%		-23.0%	-23.9%
Emissions (Water)											
Heavy Metals (mg Hg eq)		40	34	33	33	115	90	102	280	213	211
	% Var. BC		-15.9%	-17.7%	-17.7%		-22.1%	-11.3%		-24.0%	-24.9%
Eutrophication (mg PO_4 eq)		2	1	1	1	5	4	4	12	9	9
	% Var. BC		-17.2%	-19.1%	-19.1%		-22.7%	-14.4%		-24.7%	-25.6%
Note: "% Var. BC" indicates the relative variations of results from the respective base cases											

From the analysis of Table 6.5 the following can be observed:

- Depending on the indicator considered, it resulted that taps reducing water flow only through the use of aerators and flow regulators could on average allow a decrease of 7.5-21.9% in the environmental impacts generated by the use of the domestic tap assessed in the Base case 1. As described in Section 4 according to information gathered from stakeholders, aerators and flow regulators are technologies already available in many products. The decrease of the total impacts was instead assessed to be on average 8.3-24.5% for taps with flow boosters and two-stage cartridge taps. The savings potential due to the reduced water flow rate is considered to be achievable with all technologies. Additional savings of flow boosters and two-stage cartridge taps are due to the improved control of the water flow.
- Depending on the indicator considered, it resulted that push taps could on average allow a decrease of 15.9-24.5% in the environmental impacts generated by the use of the non-domestic tap assessed in the Base case 2. The decrease of the total impacts was instead assessed to be on average 11.3-22.4% for sensor taps. The water- and energy-saving potential was considered slightly greater for sensor taps due to the superior control of the flow rate, although for both the design options the actual water consumption depends on time settings and user behaviour. However, from an environmental point of view and depending on the specific material design of the products, it may be that this advantage of sensor taps is offset by the presence of additional materials in the form of electronics components.
- Depending on the indicator considered, it resulted that typical shower systems with thermostatic valves could on average allow a decrease of 18.4-28% in the environmental impacts generated by the use of the domestic shower system assessed in the Base case 3. According to the results of the assessment, a slightly lower decrease of impacts results on average for other water-saving showers (17.7-27%).

Based on the results, it seems that all the analysed design options have the potential to lead to important reductions in the environmental impacts associated to taps and showers. Environmental improvement has been considered to be a consequence of reduced water flows in the product and improved control over the flow rate and the temperature, in comparison with base cases. A technologically neutral approach was applied for the reduction of the water flow, while the improved control was considered dependent on the technology, as indicated in Sections 3 and 4. However, it should be noted that results for specific product designs could deviate from these general indications due to specific variations in technology and user behaviour.

6.3 Cost effects associated to design options

6.3.1 LCC of design options

The Life Cycle Costs (LCC) associated to the design options are presented in Table 6.6 with reference to a unit of product and the considered lifetime. Variations of results from the respective base cases have also been calculated and shown in the table. For the calculation, electricity costs for water supply have been considered to already be included in the water costs.

Table 6.6: LCC of design options referred to a unit of product over its lifetime and compared to base cases

INDICATOR	DOMESTIC TAPS				NON-DOMESTIC TAPS			DOMESTIC SHOWER SYSTEMS		
	Base case 1: domestic tap	**Taps with aerators and flow regulators only**	**Taps with flow booster**	**Two-stage cartridge taps**	**Base case 2: non-domestic tap**	**Push taps**	**Sensor taps**	**Base case 3: domestic shower systems**	**Water-saving showers**	**Thermostatic showers**
Lifetime (years)	16				10			16		
Product costs (EUR)	60	70	80	75	60	80	210	172	192	242
Installation costs (EUR)	75	75	75	75	75	75	75	75	75	75
Fuels costs for water heating (natural gas + fuel oil) (EUR)	49	39	37	37	207	156	154	610	445	439
Electricity costs (for water heating and waste water treatment) (EUR)	120	94	91	91	455	344	362	1,183	864	852
Water costs (EUR)	399	311	301	301	1,086	820	810	1,241	906	894
Repair & maintenance costs (EUR)	31	31	107	107	19	143	143	77	153	153
Total	**734**	**619**	**691**	**686**	**1,902**	**1,618**	**1,753**	**3,359**	**2,635**	**2,655**
Savings with respect to the Base case		*-16%*	*-6%*	*-7%*		*-15%*	*-8%*		*-22%*	*-21%*

From the analysis of Table 6.6 the following can be observed:

- The Life Cycle Costs of the analysed design options for taps in the domestic sector were found to be lower than those considered in Base case 1. The average decrease of LCCs has been estimated to be 16% for taps reducing the water flow only with aerators and flow regulators, 7% for two-stage cartridge taps and 6% for taps with flow boosters.
- The Life Cycle Costs of the analysed design options for taps in the non-domestic sector were found to be lower than those considered in Base case 2. The average decrease of LCCs has been estimated to be 15% for push taps and 8% for sensor taps.
- The Life Cycle Costs of the analysed design options for shower systems were found to be lower than those considered in Base case 3. The average decrease of LCCs has been estimated to be 21% for shower systems implementing thermostatic valves and 22% for other water-saving showers.

Based on the results, it appears that all the analysed design options, in addition to the improved environmental performance, could also generate economic savings over the lifetime of the products and thus potentially decrease the LCCs of taps and showers, depending on the conditions of use. However, it should be noted that results for specific product designs/markets could deviate from these general indications. Moreover, as already mentioned, it is possible that promoting the economic benefits associated to water- and energy-saving technologies may encourage users to consume water more responsibly.

6.3.2 Analysis of LLCC

Following the MEErP 2011 methodology and according to the outcomes from previous sections, the design options have been analysed to identify those with:

- the least life cycle environmental impacts in terms of consumption of energy (the "BAT", best available technology), and
- the Lowest Life Cycle Cost (LLCC).

Figures 6.1, 6.2 and 6.3 plot the performance of each design options in terms of consumption of primary energy and LCC and in comparison with the respective base cases.

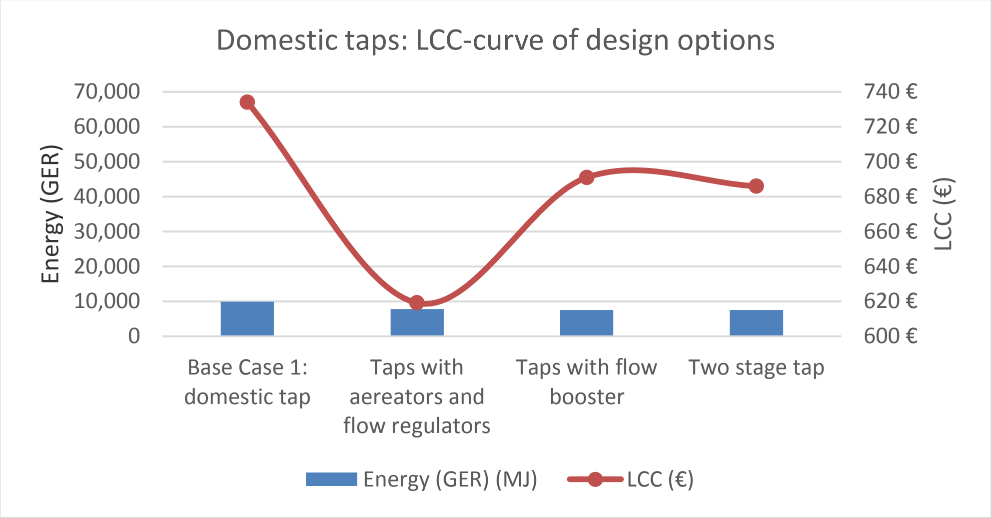

Figure 6.1: Design option with the LLCC for domestic taps

With respect to domestic taps, the three design options analysed are all considered to yield energy and cost savings. In particular, the same energy saving was estimated for both taps with flow boosters and for two-stage cartridge taps, which may thus be considered the BAT. However, taps with aerators and flow regulators, because of the lower costs of the technology, may be considered as the Lowest Life Cycle Cost option.

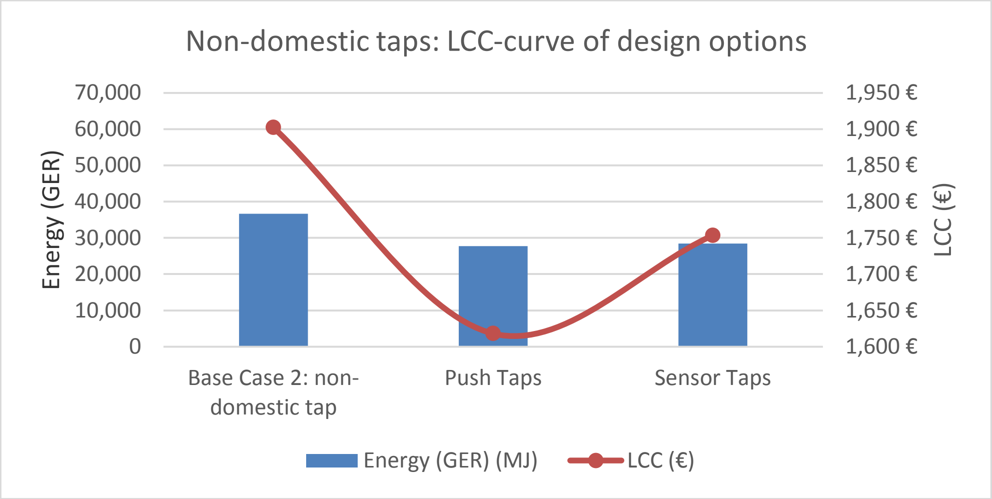

Figure 6.2: Design option with the LLCC for non-domestic taps

With respect to non-domestic taps, the two design options analysed are both considered to yield energy and cost savings. Push taps resulted to be the BAT. However, the energy performance of the two options seems quite similar and dependent on the conditions of use and setting of the products. In terms of costs, push taps are significantly cheaper and are thus the Lowest Life Cycle Cost option.

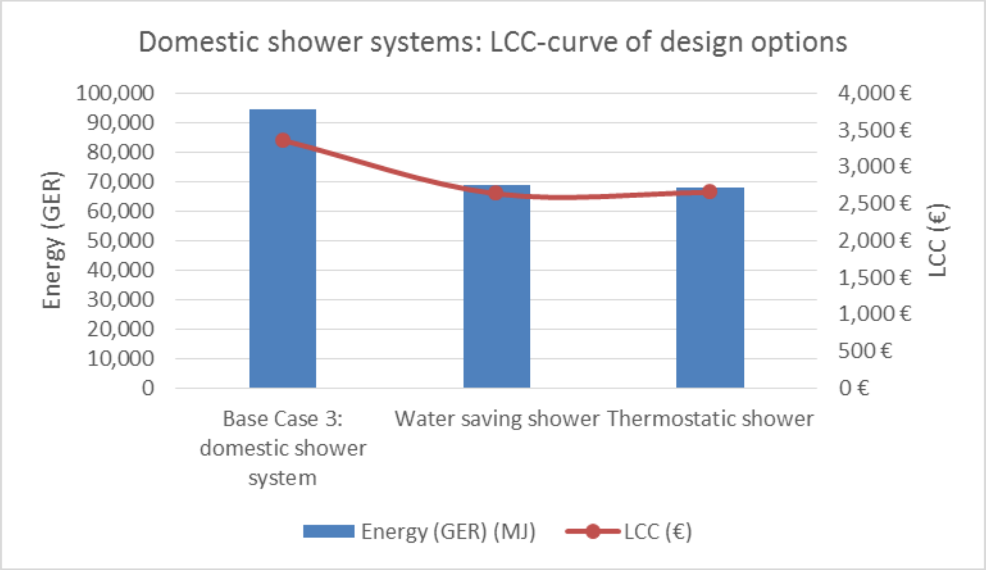

Figure 6.3: Design option with the LLCC for domestic shower systems

With respect to domestic shower systems, the two design options analysed are both considered to yield energy and cost savings. The energy and economic performance of the two options seems quite similar. However, shower systems with thermostatic valves may be considered to be the BAT although other water-saving showers may be less expensive and represent the Lowest Life Cycle Cost option.

However, it should be noted that results for specific product designs and markets could deviate from these general indications as technical and economic differences exist among products installing the same technology.

7 ANALYSIS OF POLICY SCENARIOS

7.1 Introduction

Building on the information gathered and produced in the previous sections, this section aims to wrap up the study by describing potential policy measures which could be proposed for this product group and assessing their potential impacts against a Business-as-Usual scenario. The benefits which these measures could bring, the possible presence of negative impacts and their feasibility are analysed and described, also based on intensive consultation with stakeholders. A shortlist of selected policy measures is recommended at the end.

7.2 Analysis of stakeholders' views on policy options and technical measures of potential relevance

The background information gathered so far in the study highlighted that:

- water consumption and scarcity is and will be a problem in many areas of the European Union;
- the water- and energy-saving potential of taps and showers at European level is significant;
- a large number of taps and shower models are on the market which offer consumers the possibility of choosing between different levels of water and energy consumption;
- water-saving technologies represent technically effective, economically affordable and flexible product options.

A consultation with stakeholders was held in the first quarter of 2014 to receive preliminary views on the potential development and implementation of policy instruments and associated technical measures for taps and showers, such as:

- energy and resource label[256];
- ecodesign requirements[257];
- harmonisation and development of technical standards and testing, measurement and calculation methods;
- information and education of sellers, installers and users.

Analysis of the feedback received from stakeholders is presented in the next sections. The consultation saw the active participation of representatives of European manufacturers of taps and showers and the related industry associations (indicatively contributing to 75% of the input). Governmental and non-governmental organisations, including some representatives from universities, also took part in this consultation by providing comments.

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[256] as set out by Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0001:0012:en:PDF

[257] as set out by Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:EN:PDF

7.2.1 Energy and resource label[258] – Analysis of stakeholders' views

7.2.1.1 Preliminary indications for shaping approach, scope and timing

The importance of informing consumers about environmental burdens associated to the use of taps and showers seems to be an element of convergence and general agreement among stakeholders. According to them, this could be done for instance through a resource efficiency label focusing on water and/or energy consumption, potentially including energy and water efficiency indicators to stimulate the development of products that provide the required function with less energy and water use. A label could be implemented relatively easily. Split views are however expressed on which information should be transmitted to consumers and how.

Most of the industry stakeholders, although not unanimously, would encourage resorting to existing voluntary labelling approaches (e.g. ANQIP label[259], European Water Label[260], Swedish Energy Efficiency Labelling[261], Swiss Energy Label for Sanitary Fittings[262], Water Efficiency Label[263]) and possibly finding a harmonisation among them. Industry remarked that it is engaged in developing and putting on the market appliances which save water and at the same time deliver a satisfactory performance.

On the other hand, NGOs and other stakeholders, including a share of industry, would be in favour of relying on a unique, recognisable scheme and seeing a mandatory label designed similar to or based on the well-established EU Energy and Resource Label. Classification requirements should be more stringent for high flow rates and should support the promotion of lower flow rate products.

An option proposed by stakeholders is to indicate the maximum water usage from a specific type of product under normal conditions of use. This would be the only information which can be adequately measured with standardised methods and provided consistently to consumers. The label should provide comparable information for similar types of products with differing designs and it should be backed up with an appropriate audit scheme. Additional environmental/life cycle information may be added but water consumption should be the key parameter to be indicated.

In case of inclusion of energy aspects, the theoretical energy demand at the point of use may be calculated directly using a defined equation relating to the water usage. Energy savings are indeed achievable also through water saving only. The annual theoretical energy demand at the point of use could be calculated based on the flow rate and by setting a default temperature difference between the inlet and outlet and usage time (see Section 3). It is considered that this approach would allow the decoupling of the label from the systems for the production and supply of energy across Europe and it would be consistent with the EU energy labels for other product groups where the final demand for energy at the end of use is shown.

Meanwhile, it was also reported that a label based exclusively on water flows would not take into due account the function expected by the user. An alternative approach could be based on using an energy and water efficiency indicator to stimulate the development of products that provide the required function with less energy and water use. This would require standardised procedures for measuring and calculating the water and/or energy efficiency of

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[258] as set out by Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0001:0012:en:PDF

[259] http://www.anqip.pt/

[260] http://www.europeanwaterlabel.eu/

[261] http://services.1kiwa.com/sweden/product-certification/energy-efficiency-labelling

[262] http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=en&name=en_163840118.pdf&endung=Energy%20Label%20Regulation%20for%20Sanitary%20Fittings

[263] http://www.well-online.eu/

taps and showers. Examples of such standards are the Swedish Standards 820000 (mechanical basin and sink mixing valves) and 820001 (thermostatic mixing valves with shower), which define standard cycles of functions and activities to test. However, no harmonised standards exist at EU level. In this sense, it was thus indicated that the Swedish standards may constitute the basis for developing a harmonised European standard.

The scope of the label should be based on an agreed classification of products. Some existing voluntary labels described in Section 1 could serve as a starting point, for example:

- the ANQIP label[264],
- the Swedish Energy Efficiency Labelling[265],
- the Swiss Energy Label for Sanitary Fittings[266],
- the Water Efficiency Label[267],
- the Water Label[268].

The label could potentially apply to almost all products, with the exception of specific products whose main function is to fill volumes. This is for instance the case of bathtub taps and of big 3/4" taps used in professional kitchens for filling pots or kettles, where the implementation of water-saving measures would simply require a longer time to draw the same volume of water.

Normal 1/2" commercial catering taps instead have the same design and serve the same purpose as domestic taps since they are used to fill buckets for cleaning or hand washing. An energy and resource label could also be applied to pre-rinse spray units used in commercial catering. However, for these units it is essential to ensure the functionality and cleaning performance of the product. For this reason, standard test methods would be needed in order to calculate the water and energy consumption related to a predefined rinse performance (i.e. removing food leftovers from a standard plate). In this sense, test standards on the water and energy consumption of pre-rinse sprays have been defined by EFCEM, The European Federation of Catering Equipment Manufacturers[269], and a database on energy consumption of commercial kitchen appliances developed by HKI Cert[270]. Gaining experience from testing and analysis of results is considered an important prerequisite for the potential implementation of regulations.

The label, which should work also for retrofitting technologies and systems to be added to existing installations, could be introduced relatively soon, because a legal reference (Directive 2010/30/EU) already exists and because parameters can be measured and/or calculated.

According to some stakeholders (mainly from non-profit organisations), labelling requirements could potentially be coupled with Ecodesign requirements for phasing out the worst-performing products from the market. However, according to other stakeholders, consumers should be able to choose products in which high amounts of water and energy are consumed, similarly to with cars.

7.2.1.2 Expected benefits

The implementation of a mandatory label on energy and resources is considered:

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[264] http://www.anqip.pt/

[265] http://services.1kiwa.com/sweden/product-certification/energy-efficiency-labelling

[266] http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=en&name=en_163840118.pdf&endung=Energy%20Label%20Regulation%20for%20Sanitary%20Fittings

[267] http://www.well-online.eu/

[268] http://www.europeanwaterlabel.eu/

[269] http://www.efcem.eu/

[270] http://grosskuechen.cert.hki-online.de/

1. to create a level playing field for companies placing water- and energy-saving products on the European market;
2. to stimulate innovation and competitiveness and to promote a market shift towards water- and energy-saving technology options;
3. to provide comprehensive and understandable information to consumers, who can compare the performance of any relevant water-using products, and to protect against unsubstantiated environmental claims;
4. to avoid confusion for consumers by harmonisation of labels;
5. to improve consumer awareness and to have a positive influence on user behaviour;
6. to penetrate more effectively and quickly than a voluntary label;
7. to be the easiest and most cost-effective solution to save resources given the fact that market conditions, demographics and cultures vary across the EU-28.

Consequently, a mandatory label would allow the saving of resources by playing an active role on both a technology level and a behaviour level. Nevertheless, it was reported by some stakeholders that benefits attributed to the implementation of a mandatory label on energy and resources could also be achieved through the harmonisation of voluntary labelling schemes across Europe and the possible diffusion of the European Water Label.

7.2.1.3 Potential challenges and drawbacks

Economic drawbacks associated to the implementation of a mandatory label on energy and resources do not seem significant, although it depends on the management of the program. The label should be cost-effective and simple because too many or different rules would otherwise complicate compliance and confuse consumers. The cost of labelling should be proportionate to the product cost.

On the other hand, some challenges and risks have been highlighted:

1. The potential confusion of some consumers, if the mandatory label does not focus on energy only, since water efficiency labels already exist in European countries.
2. The potential impact on the existing labelling schemes which could risk undermining the investments and the work done in the same area by others across Europe. The European Water Label, for instance, covers different product categories and it has grown in recent years in terms of registered products, and a possible expansion to additional types of water-using products is now being considered.
3. Assessment and verification of the energy consumption could be difficult because the actual energy saving, which is mainly associated to a saving of hot water, is highly dependent on a number of factors such as type of heating system (fuel and appliance) and climatic conditions.
4. Actual water and energy savings depend on the public understanding of the scheme and on consumer behaviour in terms of both product purchase and use.
5. Ensuring through market surveillance that the label is adopted consistently in all MS and for all relevant products which enter the EU market.

7.2.2 Ecodesign requirements[271] – Analysis of stakeholders' views

7.2.2.1 Preliminary indications for shaping approach, scope and timing

No mandatory ecodesign requirements are currently in place for taps and showers in the EU. However, there are some examples of national voluntary regulations (e.g. France and Denmark) which require compliance with lowest maximum flow rates.

According to Directive 2009/125/EC, ecodesign requirements can be generic or specific. Generic ecodesign requirements are technical prescriptions which do not set thresholds for particular environmental aspects (e.g. energy consumption during use), while specific ecodesign requirements do.

Whilst manufacturers do not support the implementation of ecodesign requirements, according to some stakeholders (mainly from non-profit organisations), generic ecodesign requirements could potentially accompany a mandatory label and pave the way towards specific requirements as a first regulatory step. However, it is generally agreed that these should have a clear and defined scope and this seems very challenging for this product group.

Some stakeholders have indicated that generic requirements for potential consideration in the study could for instance include:

1. implementation of flow and temperature barriers;
2. automatic shut-off of the function after some time;
3. implementation of water meters in products;
4. extension of the time of use of the product;
5. ease of maintenance and cleaning, retrofitting, and dismantling.

A technology-neutral approach should be applied. However, too detailed requirements could hamper innovation while too vague requirements could leave broad margins of interpretation. Manufacturers should be left to design energy- and water-efficient features for taps and showers without necessarily using flow restrictors which could lead to poor user comfort. Moreover, it was also reported that activities on hygiene, water flow, temperature, and time control have been already promoted by the sanitary taps and fittings industry.

Specific ecodesign requirements would be expressed in terms of measurable performance/characteristics. A small number of stakeholders support the application of this type of requirement based on the fact that it is theoretically possible to produce products which save water and energy without compromising fitness for use and without increasing the life cycle costs for consumers. It was also reported that a Eurobarometer poll published in March 2014 revealed overwhelming citizens' support to energy efficiency policies and orientation to the purchase of more efficient products. However, according to most stakeholders, great care should be given to the scope and it should be borne in mind that consumer limitation and dissatisfaction would be very likely, for example in the case of restrictions for products destined for private use and for wellness applications. In general, imposing maximum flow rates might be possible for specific uses of some categories of products, for instance in the non-domestic sector, although more detailed indications for the definition of such products and uses have not been provided.

Ecodesign requirements should also be supported by standards and consumer information, and the timing required could lead to their implementation in 2016-2018 considering that some products may need to be significantly redesigned. A specific competent body should also control the performance of products.

Ecodesign requirements could generate burdens for producers and consumers without completely ensuring the achievement of an actual market transformation and the intended

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[271] as set out by Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:EN:PDF

aim. For instance, it has been reported by stakeholders that, although mandatory requirements on flow rate have been in place in the USA for 20 years, the average water consumption per person per year is significantly higher in the USA compared to the EU. It has been indicated that measures would be effective if the consumers have a personal interest in saving water and that, in this sense, the cost of drinking water may be a key element.

Due to the large variation in water availability among European regions, it was also indicated by some stakeholders that ecodesign does not seem to be flexible and adaptable enough to different hydrological circumstances. Water saving in water-rich regions could indeed create new problems, like rising groundwater levels or underutilisation of infrastructure. Other instruments of the Water Framework Directive could thus be more appropriate to deal with regional water-saving needs.

The Ecodesign Directive (2009/125/EC) foresees the possibility to resort to voluntary agreements and self-regulation by industry. However, due to the complexity of the taps and showers industry, stakeholders pointed out that voluntary agreements may be less effective and consistent and that they would require more time than implementing Ecodesign requirements at EU level.

However, although several voluntary labels have been developed by the industry or at national level, these are not examples of self-regulation and/or voluntary agreements in the context of the Ecodesign Directive. This is because the recognition of voluntary agreements, which are a possible alternative to Ecodesign measures (as set out in Article 17 of the Ecodesign Directive), is specifically excluded by the Energy Labelling Directive (2010/30/EC) given that a "completely voluntary scheme would lead to only some products being labelled, or supplied with standard product information, with the risk that this might result in confusion or even misinformation for some end-users."

7.2.2.2 Expected benefits

The implementation of generic ecodesign requirements is considered:

1. to contribute to water and energy saving and to improve the efficiency of buildings, which would be perceived positively by consumers;
2. to be easy to achieve from a technological point of view, without excessively limiting the consumer choice;
3. to provide uniformity and clarity throughout Europe.

The implementation of specific ecodesign requirements is considered:

1. to have the potential to achieve water and energy saving more effectively than a label;
2. to be easy to be understood;
3. to be technically feasible because technologies are already available;
4. to be technologically neutral and to incentivise product innovation without creating excessive burdens;
5. to provide uniformity and clarity throughout Europe.

The implementation of self-regulation/voluntary agreements is considered:

1. to contribute to water and energy saving, leaving more flexibility to industry;
2. to reduce economic burdens for industry, to create competitiveness and to be easier to implement;

3. to potentially build on existing schemes backed by the industry and to be more easy to update than an EU legal instrument.

7.2.2.3 Potential challenges and drawbacks

Challenges and drawbacks associated to the implementation of generic and/or specific ecodesign requirements could be as follows:

1. In the case of specific ecodesign requirements, the definition of the scope is the greatest challenge since many products can be used differently (kitchen or basin for example) or installed in different contexts (private/public for example). Standards should reflect and be representative of the actual usage patterns and of the overall hot water delivery system.
2. Finding an agreement could be a challenging and lengthy process (for instance, criteria for materials in contact with drinking water have been examined for 15 years without reaching an agreement at EU level).
3. Water pressure varies between regions and buildings (new/refurbished). Different water pressures require different solutions.
4. The demand for technical expertise and the economic burdens may be significant for SMEs, many of which could risk closure. There could also be an issue of commercial sensitivity for companies which would be forced to show the design options they have been working on. The economic drawbacks could be even more significant in the case of specific ecodesign requirements. These could be very expensive to implement for manufacturers, with little chance to increase prices.
5. The potential limitation for end-user choices may not be accepted by all consumers in Europe, where demographic and cultural differences are significant. There is also a potential safety issue related to the risk that some consumers may tamper with products on their own. In particular, in the case of specific ecodesign requirements, there could be a risk of excessively limiting comfort, especially in the bathroom, which is more and more becoming a personal wellness zone rather than a simple plumbing unit.
6. Mandatory measures are often perceived negatively by consumers and they may thus prefer products purchased online or from outside the EU territory. These products may not provide adequate information or confidence regarding the compliance of the product with the EU requirements.
7. Potential misinterpretation of the CE marking may lead consumers to consider that aspects related to safety of materials in contact with drinking water, on which there is still ongoing discussion, have been regulated.
8. Public information campaigns are needed to improve consumer awareness and make the measures effective in practice.
9. Burdens related to enforceability and monitoring at European level could be significant.
10. Not enough flexibility and capability to adapt to the different hydrological circumstances of Europe.

Challenges and drawbacks associated to the implementation of self-regulation/voluntary agreements could be as follows:

1. more time could be needed for full implementation than in the case of Ecodesign requirements;
2. less effectiveness than in the case of implementation of mandatory EU-wide instruments;

3. complete adoption by all companies would be difficult to ensure;
4. there is a need for independent third party supervision but quantification of the benefits and monitoring would be difficult;
5. the cost reduction is uncertain and economic drawbacks could be significant for producers.

7.2.3 Harmonisation and development of technical standards and testing, measurement and calculation methods – Analysis of stakeholders' views

7.2.3.1 Preliminary indications for shaping approach, scope and timing

Harmonised standards are important elements for the assessment and verification of ecodesign/labelling requirements and the consequent consistency and comparability of information on product options. In particular, standard methods should cover:

1. measurement and calculation of water and energy consumption;
2. measurement and calculation of the water/energy efficiency of product functions.

An extensive analysis of standards has been presented in Section 1 based on an intensive consultation with stakeholders of the study. To date, water flow of products is the only aspect which can be measured with international standardised methods. Reference EN standards for this product group could include:

- EN 200, Sanitary tapware - Single taps and combination taps for water supply systems of type 1 and type 2 - General technical specification;
- EN 246, Sanitary tapware - General specifications for flow rate regulators;
- EN 816, Sanitary tapware - Automatic shut-off valves PN 10;
- EN 817, Sanitary tapware - Mechanical mixing valves (PN 10) - General technical specifications;
- EN 1111, Sanitary tapware - Thermostatic mixing valves (PN 10) - General technical specification;
- EN 1112, Sanitary tapware - Shower outlets for sanitary tapware for water supply systems type 1 and type 2 - General technical specification;
- EN 1286, Sanitary tapware - Low pressure mechanical mixing valves - General technical specification;
- EN 1287, Sanitary tapware - Low pressure thermostatic mixing valves - General technical specifications;
- EN 15091, Sanitary tapware - Electronic opening and closing sanitary tapware.

The average energy content associated to such flows of water could also be estimated through considerations related to physics and average conditions of use of the product (see Section 3), such as:

- frequency and length of use per year;
- percentage demand of hot water;
- inlet and outlet temperatures;
- percentage wastage of water.

However, no standard formula is available for this calculation.

The Swedish Standards 820000 (mechanical basin and sink mixing valves) and 820001 (thermostatic mixing valves with shower) have been developed recently for measuring and calculating the energy efficiency of valves and showers based on considerations related to their rinsing function. This appears to be so far the only example of a test method already available in this area.

According to persons involved in the development of the Swedish standards, the measurement of water flows only, with/without calculation of the related energy demand, would not take into consideration the function of the product, which may increase the time of use and which may result in lower savings than those expected. Water and/or energy efficiency indicators would be useful to promote the use of products which consume less water and energy for providing certain functions.

Although the appropriateness of the focus on rinsing performance and hot water may be debatable for some applications (e.g. brushing teeth with cold water in southern regions of Europe), it was remarked that the greatest benefit of the standards is to provide a framework with which to quantify the energy consumption of products taking into account parameters related to their function(s). The standards are used in a voluntary scheme for the labelling of energy-efficient sanitary products in Sweden, where they appear to have wide support and to have contributed to the diffusion of energy-efficient taps that do not limit the function of the product and the comfort of users. The experience of the Swedish standards is also considered to be functional to the potential development of harmonised European standards.

However, finding a standard definition of "product function" would be difficult due to differences among product uses and users. This is also the view of the European Association for the Taps and Valves Industry (CEIR)[272] and of other individual stakeholders from industry consulted during the development of this study. The Swedish Standards 820000 and 820001 are generally considered not suitable by European manufacturers outside Sweden because:

- they are not considered to be applicable to all categories of products;
- the representativeness, repeatability and reproducibility of the approach may be debatable;
- they are considered to be excessively complicated also considering that the main factor influencing the efficiency of products is the water flow (which can be measured based on widely accepted methods).

CEIR informed that they are conducting a pre-normative activity for defining methods for measuring the rinsing efficiency of showers. However, no indication on timing or technical details is available at the moment. It was reported that further work is necessary in order to ensure the representativeness and accuracy of tests.

Based on the elements gathered during the course of the study, although some initiatives in this area have been started, it seems that there is a lack of widely accepted and robust methods for assessing the performance of taps and showers in terms of the water/energy used to provide a certain function.

According to some stakeholders (mainly from Sweden and from non-profit organisations), requests should be issued to the European standardisation organisations in order to define standard methods for measuring and calculating the water/energy efficiency of product functions to use to support the implementation of policy measures for this product group.

Existing standards could be used, updated or modified. However, harmonisation of standards would be challenging and could require even more than five years. The possible date for the development of final versions of new standards could thus be 2016-2020 (or even later). Key organisations involved in standardisation should also be involved (e.g. AENOR, AFNOR, KIWA).

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[272] http://www.ceir.eu/

It was also reported by stakeholders from industry that a similar request has already been discussed within the CEN/TC 164 in the past. However, no standardisation work has followed, apparently because at that time the existing European standards were considered to provide a reliable and recognised set of calculation methods.

Additional information on the state of the art on standards for assessing the efficiency of products can be found in Section 1.4.5.

7.2.3.2 Expected benefits

Standards are in general considered:

1. to achieve the unification of test methods and thus to set a level playing field for all manufacturers;
2. to provide better clarity since the presence of different methods may cause confusion, misunderstandings and misinterpretation;
3. to provide cross-EU border benefits for producers and retailers;
4. to ease market surveillance.

Additionally, depending on the view of individual stakeholders, harmonisation and development of new standards for measuring the water/energy efficiency of taps and showers based on considerations related to their function(s) are generally perceived either:

1. to provide a common understanding on how to measure the performance of products allowing all interested parts to participate in the development of widely accepted solutions; or
2. to be unnecessary since existing European standards provide a reliable and recognised set of calculation methods for potential use in water- and energy-saving initiatives.

7.2.3.3 Potential challenges and drawbacks

Challenges and drawbacks associated to harmonisation and development of new standards for measuring the water/energy efficiency of taps and showers based on considerations related to their function(s) could be:

1. To find a widely accepted definition of the product function(s) and of the related activities to test such function(s). This is a subjective topic because of the differences existing between users and possible uses of products. Such technical definitions should be found for all categories of products and technologies of interest in order to ensure a coherent and comprehensive approach is implemented.

In addition, as a general rule for all standards:

1. because of the differences among EU MS, the harmonisation of standards could take a long time and it could still be difficult, as in the case of the requirements on materials in contact with drinking water;
2. harmonisation of standards does not ensure the harmonisation of legal requirements across the EU;
3. economic burdens may be significant for producers and users are generally not aware of the advantages related to certifications.

7.2.4 Information and education of sellers, installers and users – Analysis of stakeholders' views

7.2.4.1 Preliminary indications for shaping approach, scope and timing

Informing and educating the different actors involved in the product's value chain (sellers, installers, users) is considered fundamental both at industry level (e.g. manufacturers, trade) and at the level of public organisations (e.g. EU, MS). People should be instructed on:

1. how to install and use, maintain and dispose of products correctly;
2. how to save water and energy;
3. the benefits associated to water and energy saving.

This aspect is considered to be crucial for achieving an actual market transformation and behaviour change. Information for distributors, plumbers and end-users should thus necessarily accompany mandatory labels and ecodesign requirements, although alone it would probably be not effective. Education campaigns could start as soon as 2014-2015 and transmit simple information based on Life Cycle Thinking. It is considered important that information on the correct use of products are made available: at the points of sale, on the packaging of products and as operative manuals, on websites. This should also be coupled with improved communication between manufacturers, distributors, plumbers and end-users. It was reported that a mandatory regulation could be beneficial in this sense.

7.2.4.2 Expected benefits

Information and education along the product's value chain are considered:

1. to be essential elements for informed purchase and use of products;
2. to increase public awareness and to allow the effective achievement of water and energy savings;
3. to produce some positive effects on user behaviour independently of the implementation of product policy actions.

7.2.4.3 Potential challenges and drawbacks

Challenges and drawbacks associated to information and education along the product's value chain could be as follows:

1. Changing end-user behaviour takes a long time and needs a consistent marketing campaign. Some markets will be more responsive/less to the message depending on the country’s current water need.
2. Very difficult to reach all the population, alone it may be not effective.
3. The direct link with water and energy bills, which are different across the EU. If water is too cheap or being paid at flat rates, there would be no acceptance or recognition of water-saving measures. Once it affects the consumers, the demand to save would increase promptly.

7.2.5 Other options

Other options presented by stakeholders are discussed in Table 7.1.

Table 7.1 Other policy options presented by stakeholders

Option	Expected benefits	Potential challenges and drawbacks
Progressive increase of the water price	• Water and energy saving would be encouraged	• Higher water and energy bills for consumers with consequent complaints
Harmonised directive about the acceptance of materials	• To reduce the energy used to make the product (production of more materials means more energy is needed for their manufacture and more logistical pressure)	• This does not appear a major issue for this product group
Addressing the hot water delivery system (not only taps and showers) through building codes and retrofit requirements	• Complementing products with a systems approach for increased water and energy savings	• Dependent on national standards • Hard to asses, implement and monitor at EU level
No action other than EU Ecolabel and GPP	• If additional regulations are not implemented there should be no risk of undermining the existing labelling instruments and changing the state of play of manufacturers, which could ultimately bring some confusion to consumers	• Market transformation may not be accelerated as desired. The market will continue to change to water-saving products as an ongoing trend but not quickly enough. Uptake would possibly remain limited.

7.3 Policy scenarios analysis

7.3.1 Modelling of Business-as-Usual (BAU) scenarios

Business-as-Usual (BAU) scenarios have been built at EU level for the period 1990-2030 for the following parameters:

- stock of taps and showers installed in the EU;
- annual sales of products;
- annual water abstraction associated to the use of taps and showers;
- annual demand for primary energy associated to the use of water in taps and showers;
- emissions of greenhouse gases (GHG) related to the annual demand for primary energy in taps and showers;
- total annual expenditure for consumers.

Water abstraction, primary energy demand and GHG emissions are considered as key performance indicators for this policy discussion.

Modelling of scenarios has been based on the information contained in the previous Sections and on further assumptions outlined below and necessary for taking into consideration the main elements related to socio-demographic developments, existing market trends, labelling schemes and EU policy tools and targets.

7.3.1.1 Stock of products

The overall stock of products installed in the EU has been modelled in Section 2 for:

- domestic taps;
- domestic shower systems;
- non-domestic taps;
- non-domestic shower systems.

The results for the period 1990-2030 are presented in Figure 7.2 and reported at five-year intervals. The reference year of the model has been set to 2010 in accordance with the stock model presented in Section 2. This also allows the timeframe of the analysis to be split symmetrically into 8 intervals of five years. Due to the nature of the products, variations between consequent years are limited. Extrapolations to future and previous years have been done based on statistics and forecasts for the population of the EU, as described in Section 2.

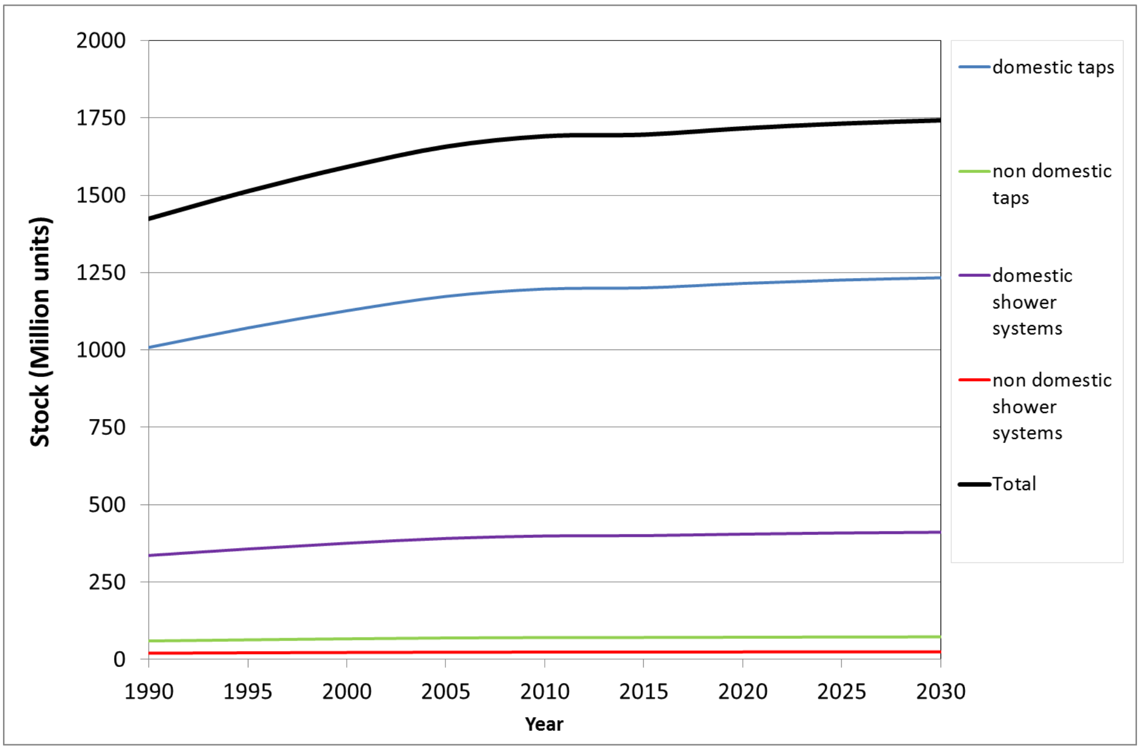

Figure 7.2 **Stock of taps and shower systems installed in the EU estimated for the period 1990-2030**

7.3.1.2 Annual sales of products

The overall annual sales of products in the EU have been modelled in Section 2 for:

- domestic taps;
- domestic shower valves;
- domestic shower outlets;
- non-domestic taps;
- non-domestic shower valves;
- non-domestic shower outlets.

The results for the period 1990-2030 are presented in Figure 7.3 and reported at five-year intervals. The reference year of the model is 2010, extrapolations to future and previous years have been done based on statistics and forecasts for the population of the EU, as described in Section 2.

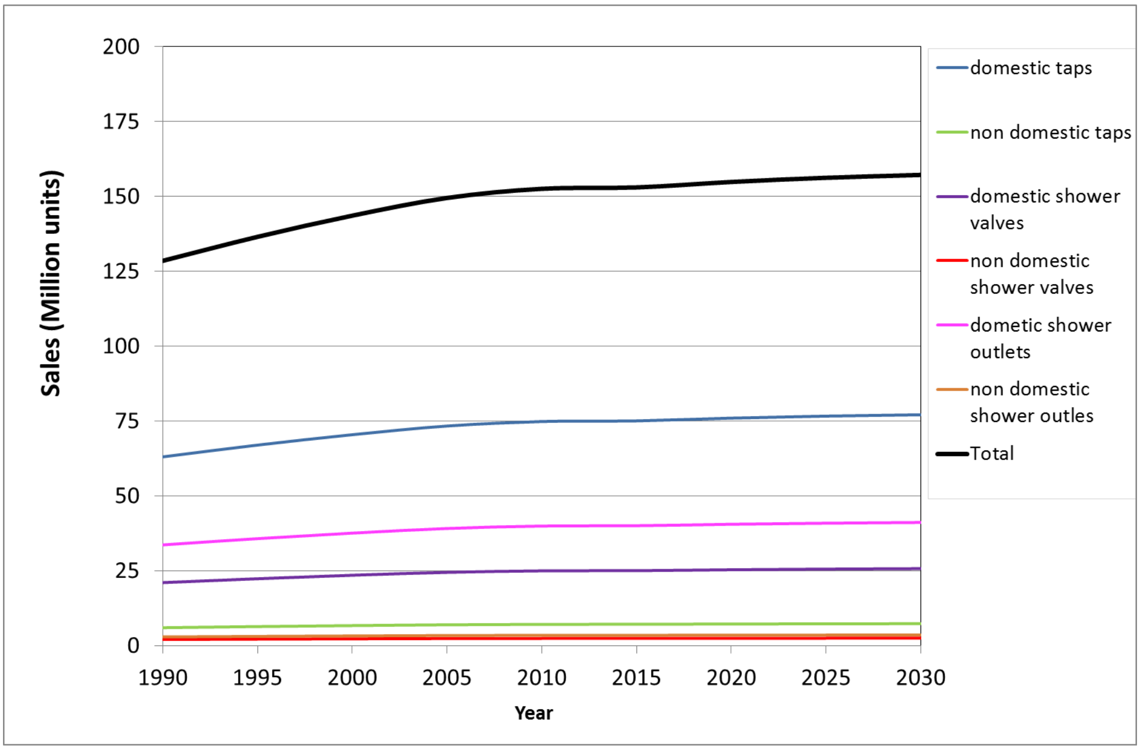

Figure 7.3 **EU annual sales of taps, shower valves and shower outlets estimated for the period 1990-2030**

7.3.1.3 Annual water abstraction

The annual amount of water abstracted in the EU for use in taps and showers has been modelled in Section 3 for:

- domestic taps;
- domestic shower systems;
- non-domestic taps;
- non-domestic shower systems.

The results of the model presented in Section 3 have been applied to 2010. Extrapolations to future and previous years have been done applying a 0.1% annual variation rate, taking into account that urban use of water in Europe can be expected to rise by 3% from 2000 to 2030 because of demographic and economic trends[273].

As pointed out by stakeholders involved in the project, market trends indicate a current shift towards water-saving products, which may be accelerated through the implementation of a mandatory energy and resource label or even through the existing voluntary labelling schemes. Based on information gathered from stakeholders in Section 3, it has been assumed that:

- the average maximum flow rates of taps and showers sold until 2015 is 8 L/minute for taps and 11.3 L/minute for shower systems;
- from 2015, the average maximum flow rates of a share of sold products will decrease to 5.3 L/minute for taps and 8 L/minute for showers.

For this specific product group, different voluntary labelling programmes are already in place across the EU, as presented in the report (see for instance Section 1, Section 7.2 and Section

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[273] http://www.eea.europa.eu/publications/state_of_environment_report_2005_1/SOER2005_Part_A.pdf/view

7.3). For the BAU scenario it has been considered that existing labelling schemes and industry initiatives can have a positive influence in terms of water flow reduction on:

- 40% of sales in 2015;
- 60% of sales in 2020;
- 80% of sales in 2025.

Figures are based on the analysis of data shared by industry in April-July 2014. It has been considered that the minimum level of penetration of the main voluntary initiatives for this product group could represent about 40% of the market. Predictions for the future are characterised by higher uncertainty. It has been considered that the effectiveness could increase up to 60% in 2020 and 80% in 2025. This may be optimistic from the perspective of voluntary labelling but credible for this product group, considering the significant diffusion in the EU of voluntary labelling programmes. It should be observed that in general this may not be the case for other products for which the presence of voluntary labels may not be significant.

The assumptions made allow the estimation of the maximum and theoretical water-saving potential achievable without the implementation of any other policy tool. Additional savings could be achieved through a mandatory label and/or ecodesign requirements, which represent recognised and trusted policy instruments able to cover the entire market. It is apparent that additional savings would be greater considering the more limited effectiveness of existing labelling schemes and industry initiatives.

In addition to the consideration of the influence of labelling schemes and industry activities and in line with Section 3:

- an 85% savings reduction factor has been applied to take incomplete opening of products and any inefficiencies of use of products into account;
- the savings potential has been considered to be actually achievable for 35% of taps (estimated as a share of water use in bathroom taps and in hand dish washing over the total use of water in taps) and 100% of shower systems.

Table 7.2 reports the corrected water-saving potential of the total stock of taps and shower systems estimated for the BAU scenario as a consequence of the market change. Results for the period 1990-2030 are presented in Figure 7.4.

Table 7.2 Total corrected water-saving potential considered for the BAU scenario

Product	Until 2015	2020	2025	2030
Taps, domestic	0%	1%	3%	6%
Taps, non-domestic	0%	2%	5%	9%
Shower systems, domestic	0%	5%	12%	22%
Showers, non-domestic	0%	7%	18%	25%

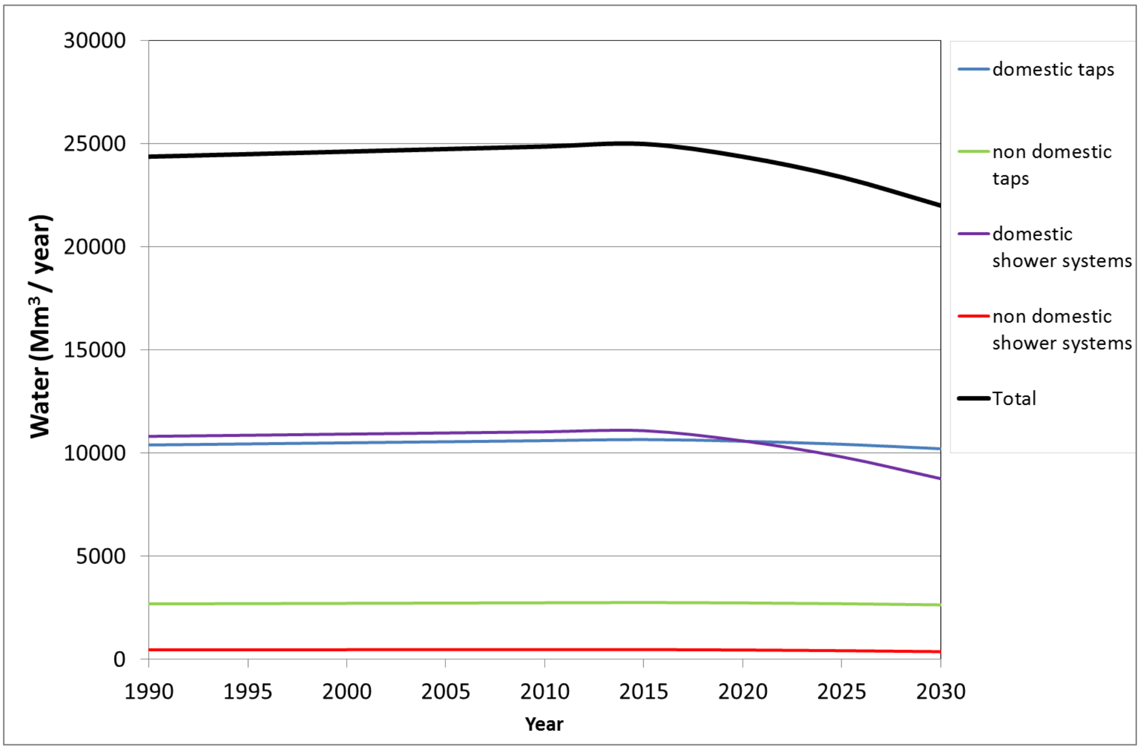

Figure 7.4 **EU annual abstraction of water for use in taps and shower systems estimated for the period 1990-2030**

7.3.1.4 Annual demand for primary energy

The annual demand for primary energy associated to the use of water in taps and showers in the EU has been modelled in Section 3 for:

- domestic taps;
- domestic shower systems;
- non-domestic taps;
- non-domestic shower systems.

The results of the model presented in Section 3 have been applied to 2010. In line with the BAU scenario for water:

- extrapolations to future and previous years have been done applying the same 0.1% annual variation rate;
- the water-saving potential considered for the influence of market trends has been applied after 2015 and also for the energy saving.

Moreover, in order to take into account the increased efficiency of production and supply of energy due to the coexistence of other policy instruments on water-heating systems, it has been roughly estimated that the primary energy demand would decrease by 10% in 2020, by 20% in 2025 and by 30% in 2030[274]. The results for the period 1990-2030 are presented in Figure 7.5 and reported at five-year intervals. The overall effects appear magnified because of the additional consideration of the potential influence of already existing initiatives for this product group (see Section 7.3.1.3). All in all, the assumptions made in the modelling are not considered to underestimate the savings figures for the BAU scenario. On the contrary, the savings estimation could have been rather accentuated. This would represent a conservative basis of comparison for the assessment of other policy scenarios.

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[274] http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2013/swd_2013_0295_en.pdf

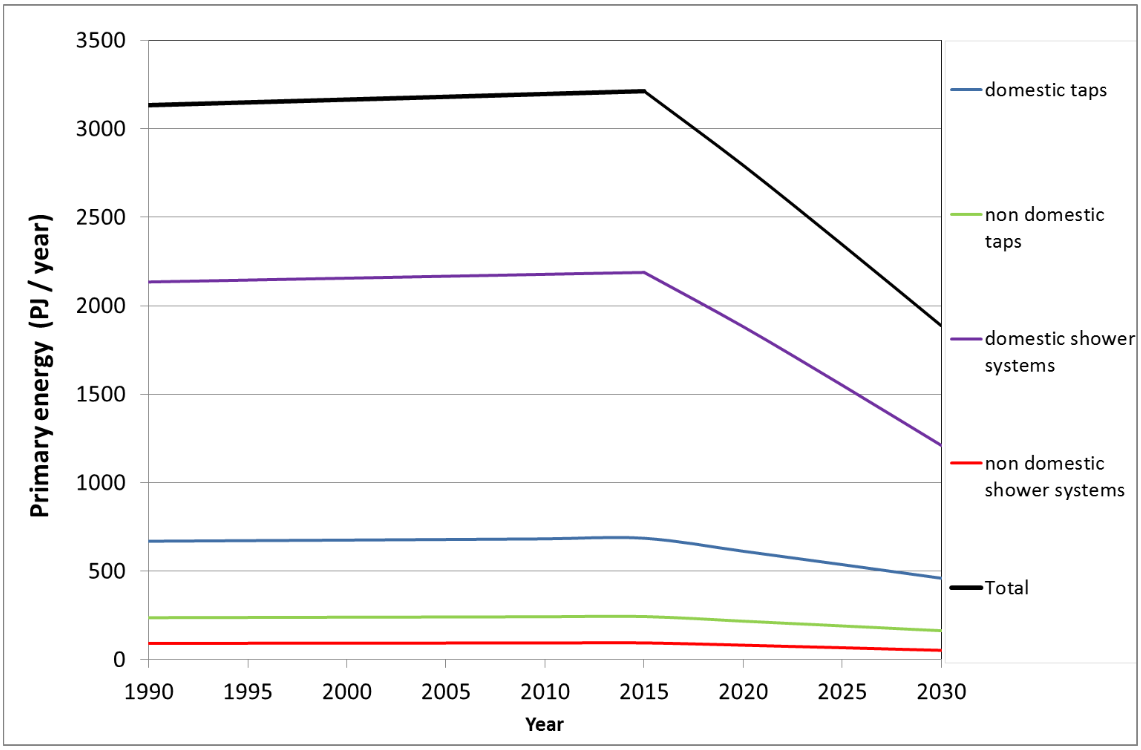

Figure 7.5 **EU annual demand of primary energy associated to the use of taps and shower systems estimated for the period 1990-2030**

7.3.1.5 Annual emissions of GHGs

The annual emissions of GHGs related to the use of water in taps and showers in the EU have been modelled based on the BAU scenario built for the demand for primary energy.

An average emission factor of 52.2 grams of CO_2 eq per kJ of primary energy has been considered to convert energy input into greenhouse gases output. This emission factor has been estimated based on data from the Ecoreport tool and on the energy input of electricity, natural gas and fuel oil modelled in Section 3.

In order to simplify the estimation, the emission factor has been referred to primary energy and considered to be constant over time. The results for the period 1990-2030 are presented in Figure 7.6 and reported at five-year intervals for the following products:

- domestic taps;
- domestic shower systems;
- non-domestic taps;
- non-domestic shower systems.

The total emissions of GHGs related to the EU annual demand for primary energy in taps and shower systems has been estimated to be about 160 million tonnes in 2010.

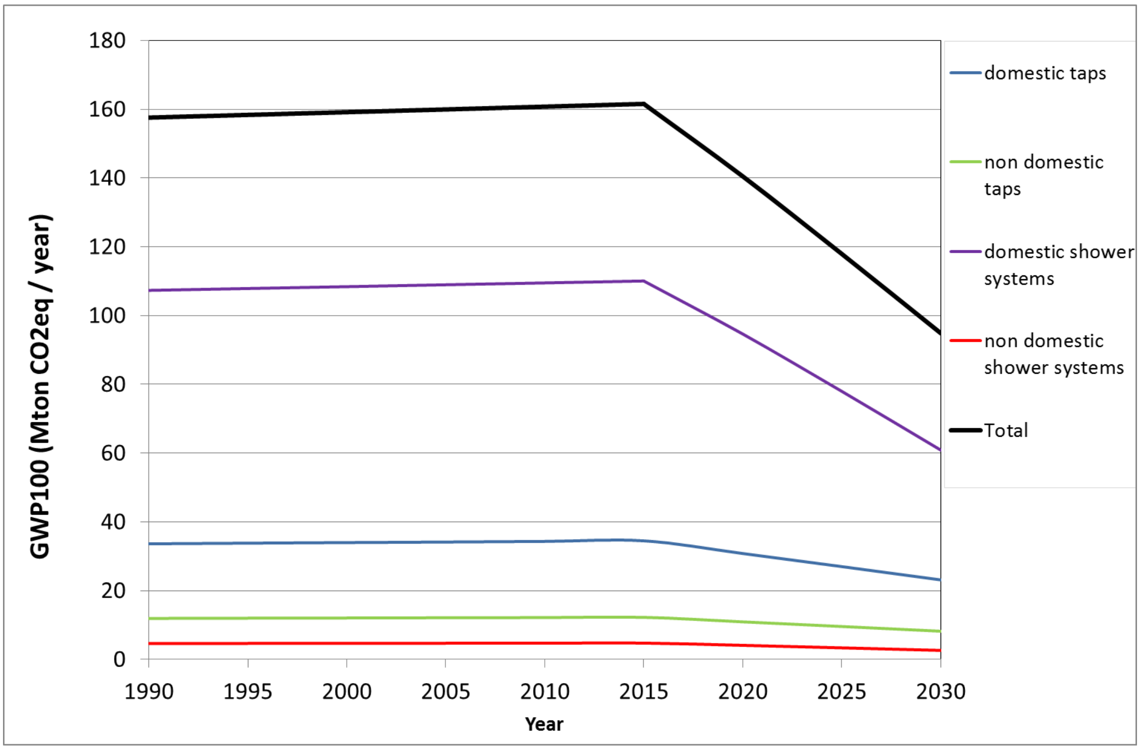

Figure 7.6 **Emissions of GHGs related to the EU annual demand for primary energy in taps and shower systems estimated for the period 1990-2030**

7.3.1.6 Total annual expenditure for consumers

The total EU annual expenditure for consumers associated to the use of taps and showers over their lifetime has been modelled as described below.

Example products have been selected in accordance with Sections 4, 5 and 6 and costs over their lifetime have been calculated based on:

- information on lifetime and cost of technologies from Section 2;
- information on water and energy consumption at the point of use from Section 3;
- water and energy costs from Section 2.

Table 7.3 summarises the average costs of purchase, installation, repair and maintenance considered for model products over the lifetime. The average consumption of water and energy carriers at the point of use is instead reported in Table 7.4 together with the water and energy prices for consumers considered in the model for the BAU scenario.

The following assumptions have been considered in order to calculate the life cycle costs of an average unit of the product stock:

- The share of installed products with water/energy-saving features is 40% until 2015 and it increases in the following years because of the penetration of new water/energy-saving products (53% in 2020, 64% in 2025, 96% in 2030 for domestic taps and shower systems; 60% in 2020, 91% in 2025, 100% in 2030 for non-domestic taps and shower systems).
- The average product costs of water/energy-saving taps in the domestic sector are given by the combination of the costs of taps with improved aerators/flow regulators (allocation basis: 85% until 2015, 75% in 2020, 65% in 2025, 60% in 2030), taps with flow boosters (allocation basis: 5% until 2015, 10% in 2020, 15% in 2025, 20% in 2030), and two-stage cartridge taps (allocation basis: 10% until 2015, 15% in 2020, 20% in 2025, 20% in 2030).

- The average product costs of water/energy-saving taps in the non-domestic sector are given by the average of the costs of push taps and sensor taps.
- The average total costs of water/energy-saving shower systems in the domestic sector are given by the average of the costs of shower systems with thermostatic mixers and of other water-saving shower systems.
- The water and energy savings estimated for the total stock of products have been applied after 2015.

Table 7.3 Key assumptions on lifetime and costs of products

Product	Application of reference	Lifetime (years)	Average cost of a unit of product over the lifetime (EUR)[a]
Tap, conventional	Domestic	16	166
Tap, with improved aerator/flow regulator	Domestic	16	176
Tap with flow booster	Domestic	16	262
Two-stage cartridge tap	Domestic	16	257
Tap, conventional	Non-domestic	10	154
Push tap	Non-domestic	10	298
Sensor tap	Non-domestic	10	428
Shower system, conventional	Domestic	16	324
Shower system with thermostatic mixer	Domestic	16	470
Other water-saving shower system	Domestic	16	420
Shower system, conventional	Non-domestic	10	283
Shower system, water-saving, water/energy-saving	Non-domestic	10	427

a) Product costs = costs of purchase, installation, repair and maintenance of the product over its lifetime.

Table 7.4 Key assumptions related to water and energy use and related costs

Product	Water consumption (m^3/yr per unit of product)	Electricity consumption (MJ/yr per unit of product)	Fuel consumption (MJ/yr per unit of product)
Domestic taps	6.8	99.6	149.4
Non-domestic taps	29.5	667.1	1000.6
Domestic shower systems	21.1	1230.5	1845.8
Non-domestic shower systems	15.2	889.2	1333.8

Notes:

1) Water and energy price:

- water price (EUR/m^3): 3.89
- electricity price (EUR/kWh): 0.2
- fuel price (EUR/GJ): 19.1

The costs related to a unit of average product of the stock have been normalised to one year of use by dividing the total life cycle costs by the respective lifetime, as shown in Table 7.5. This provides an indication of the total annual expenditure associated to the use of average products of the stock over their time of use.

Table 7.5 Total annual costs for a unit of average product of the stock

Product	Until 2015	2020	2025	2030
Tap, domestic	EUR 45.6	EUR 45.6	EUR 45.6	EUR 45.6
Tap, non-domestic	EUR 194.3	194.9 EUR	EUR 196.0	EUR 191.5
Shower system, domestic	EUR 208.2	203.4 EUR	EUR 196.2	EUR 186.7
Shower system, non-domestic	EUR 167.6	163.8 EUR	EUR 158.1	EUR 146.6

In order to streamline the estimation of costs over the horizon 1990-2030, costs have been kept constant over time. This is a simplification of the reality but the operation would in any case be characterised by a significant level of uncertainty. In addition, with regards to the potential update of future expenditures and the potential consideration of inflation rates, it can be said that these are two counteracting factors, which would balance each other's effects. The total annual costs for a unit of average product of the stock have then been multiplied by the number of products installed over the years, calculated with the stock model (Section 2).

The results for the period 1990-2030 are presented in Figure 7.7 and reported at five-year intervals for the following products:

- domestic taps;
- domestic shower systems;
- non-domestic taps;
- non-domestic shower systems.

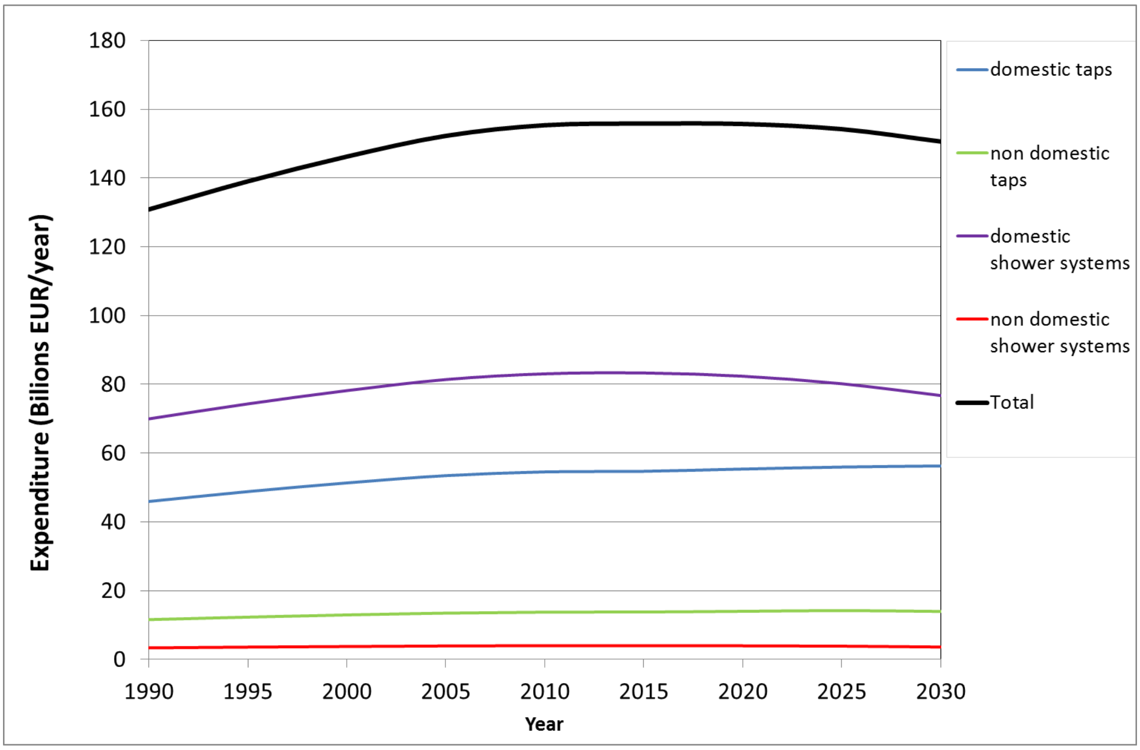

Figure 7.7 EU annual consumer expenditure associated to the use of taps and shower systems over their lifetime and estimated for the period 1990-2030

7.3.2 Preliminary definition and screening of policy scenarios

Based on the information gathered in Section 7.3.1, a series of potential policy options and technical measures have been preliminarily identified for analysis of their relevance and feasibility and, if appropriate, for a quantitative assessment of their impacts at EU benchmarking level against the BAU scenario:

1. mandatory water and energy label;
2. mandatory restrictions on water flow rates for some products (specific ecodesign requirement);
3. mandatory implementation of technical devices to control and/or limit the consumption of water and/or energy (generic ecodesign requirement);
4. implementation of water meters in products (generic ecodesign requirement);
5. inclusion of elements related to durability, ease of maintenance and cleaning, retrofitting and dismantling in the design of products.

As indicated in Section 7.2.4, informing and educating sellers, installers and users is perceived as an essential element for promoting and assisting the effective achievement of water and energy savings for this product group, independently of mandatory measures or voluntary initiatives.

Some elements which contribute to the definition of the above-mentioned measures have been reported below. A streamlined impact assessment of selected options is presented in Section 7.3.3. Also, the technical elements and the pros and cons described in Section 7.3.1 are to be taken into account while proposing and evaluating the possibility of starting any process potentially leading to the implementation of a policy measure.

7.3.2.1 Mandatory water and energy label

Based on the analysis of voluntary labels focusing on aspects related to water and/or energy saving and on the consultation held with stakeholders, a mandatory label on water and energy is preliminarily considered to be the most practical and potentially interesting option.

Such a label would be implemented under the EU energy and resource labelling legislative framework[275] and could benefit from the experience of existing schemes.

There are at the moment some examples which a mandatory label could build on, such as:

- the ANQIP label[276];
- the Swedish Energy Efficiency Labelling[277];
- the Swiss Energy Label for Sanitary Fittings[278];
- the Water Efficiency Label[279];
- the Water Label scheme[280].

The scope of the label should be based on agreed classifications and it should possibly harmonise those used in the existing schemes.

The label could potentially apply to almost all products used in domestic and non-domestic applications, with the exception of specific products whose main function is to fill volumes. For these products the implementation of water-saving measures would simply result in it taking longer time to draw the same volume of water. This, for instance, is the case for:

- bathtub taps ,
- big 3/4" taps used in professional kitchens for filling pots or kettles.

It must also be noted that electric showers are included in Regulation No 814/2013[281] and in Regulation No 812/2013[282] establishing ecodesign requirements and energy labelling requirements for water heaters and hot water storage tanks.

Based on the observation of existing labelling schemes, preliminary indications which may serve as a basis for discussion for shaping the scope of a potential mandatory label have been provided in Table 7.6. Product categories which may be considered include:

1. showers, shower valves and shower systems with water/energy-saving devices;
2. showers, shower valves and shower systems without water/energy-saving devices;
3. washbasin taps with water/energy-saving devices;
4. washbasin taps without water/energy-saving devices;
5. kitchen taps with water/energy-saving devices;
6. kitchen taps without water/energy-saving devices;
7. flow regulators for showers;
8. flow regulators for taps;
9. self-closing taps.

However, it should be noted that these elements serve only for illustrative purposes since further discussion would be needed in the event of considering the implementation of this option. In particular, a mandatory label should not classify products based only on water flow

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[275] as set out by Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0001:0012:en:PDF

[276] http://www.anqip.pt/

[277] http://services.1kiwa.com/sweden/product-certification/energy-efficiency-labelling

[278] http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=en&name=en_163840118.pdf&endung=Energy%20Label%20Regulation%20for%20Sanitary%20Fittings

[279] http://www.well-online.eu/

[280] http://www.europeanwaterlabel.eu/;Update at 13 September 2013

[281] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0814&from=EN

[282] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0812&from=EN

rates but it should also incorporate, as much as possible, elements related to the function of the products, comfort, health and system performance.

Table 7.6 Basic and illustrative example of indications to consider for shaping the scope of a potential mandatory label on resources (further discussion necessary)

Product category	**Class (based on max. water flow in L/min)**							**Reference**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	
Showers, shower valves and shower systems, without water/energy-saving devices	< 5	<7.2	7.2-9	9-15	15-30	>30	-	Adapted from ANQIP
	<6	6-8	8-10	10-13	>13	-	-	Adapted from EWL
	4-6	6-9	9-12	12-15	>15	-	-	Adapted from Swiss label
	4.5-8 (high pressure); 3-8 (low pressure)	-	-	-	-	-	-	Adapted from EU Ecolabel
	4.5-6 (high pressure); 3-6 (low pressure)	6-8	8-10	10-12	12-15	15-30	>30	Example for illustrative purposes only
Washbasin taps, without water/energy-saving devices	<2	2-4	4-6	6-8	>8	-	-	Adapted from ANQIP
	<6	6-8	8-10	10-13	>13	-	-	Adapted from EWL
	4-6	6-8	8-10	10-12	>12	-	-	Adapted from Swiss label
	2-6	-	-	-	-	-	-	Adapted from EU Ecolabel
	2-4	4-6	6-8	8-10	10-12	12-15	>15	Example for illustrative purposes only
Kitchen taps, without water/energy-saving devices	<4	4-6	6-8	8-10	>10	-	-	Adapted from ANQIP
	<6	6-8	8-10	10-13	>13	-	-	Adapted from EWL
	4-9	9-12	12-15	15-18	>18	-	-	Adapted from Swiss label
	2-6	-	-	-	-	-	-	Adapted from EU Ecolabel
	2-4	4-6	6-8	8-10	10-12	12-15	>15	Example for illustrative purposes only
Preliminary indication of other elements to potentially be taken into account in further discussion: - Same requirements for flow regulators depending on the application. - In presence of aerators the thresholds can be X% higher. - In presence of devices for the control/limitation/management of water flow rates and/or temperatures the thresholds can be X% higher. - Consideration of default shut-off time for automatic taps (sensor and push taps, taps versus shower systems) - In case of multiple outlets / water flow modes, information for each possible mode should be provided on the label. - Additional information (e.g. warning messages about the possibility of increasing the risk of scalding or prolonged use with lower flow rates, recommendations for use of aerators, ensuring compatibility with drainage system conditions).								

Different possible approaches have been identified for the implementation of the mandatory label on resources. The mandatory label should focus on the resource efficiency of products and consider elements related to their function(s), such as for instance the rinsing function provided by showers and taps. The label should stimulate the development of products that provide the required function(s) with less energy and water use.

An Energy Efficiency Indicator (EEI) could for instance be based on the following equation:

$EEI = E_P / E_B$ (%)

where:

- E_P is the energy consumption in a cycle of tests involving the use of the product
- E_B is the energy consumption in a cycle of tests involving the use of a benchmark product.

This would require the presence of standardised procedures for measuring and calculating the water and/or energy efficiency of taps and showers. Examples of initiatives in this area are the Swedish Standards 820000 (mechanical basin and sink mixing valves) and 820001 (thermostatic mixing valves with shower) and the pre-normative activities of industry for defining methods for measuring the rinsing efficiency of showers. However, a general agreement at EU level on efficiency could also require a significant time period considering that a harmonised definition of "product function" and test methods is challenging due to the need to eliminate subjective interpretations and due to differences among product uses and users.

Requests should thus be issued to the European standardisation organisations in order to develop standard methods for measuring and calculating the water/energy efficiency of products, to be used for labelling.

In the meanwhile, until harmonised standards become available, a series of measures may be taken into consideration to overcome the current lack of widely accepted and robust methods for assessing the performance of taps and showers in terms of the water/energy used to provide a certain function.

From a technological point of view, the efficiency of products could be considered a function of water flow rate, temperature and design characteristics, with water flow rate being the main factor of influence. One way to implement a mandatory resource efficiency label would be thus to refer to the water flow rates of products under nominal conditions of use, as typically done in some of the existing voluntary labels. To date, this is the only information which can be measured adequately through standardised methods.

Water flow rates could be related mathematically, through physics considerations, to the theoretical energy which would be needed to heat up that amount of water under conditions of absence of heat loss and other system aspects. The annual theoretical demand for energy at the point of use could for instance be calculated based on flow rate and by setting default average usage times and temperature differences between the inlet and the outlet.

This would decouple the label from the systems for the production and supply of energy across Europe. The inclusion of other system aspects in the label is considered difficult considering the variability of scenarios from a geographical, technical and cultural point of view.

Based on average data gathered in Section 3, the following assumptions could be considered for the calculation of the theoretical annual demand for energy from an average user of a product with a certain maximum water flow rate:

- 90% of the water used for showering is hot and flows at a temperature of 38°C;
- 40% of the water from taps is hot and flows at a temperature of 35°C;
- the average temperature of inlet water across Europe is 15°C;

- showers are used on average once per day, 365 days per year, for 7 minutes, with a wastage of 10% of water;
- washbasin taps are used on average 5 times per day, 365 days per year, for 1 minute, with a wastage of 10% of water;
- kitchen taps are used on average 5 times per day, 365 days per year, for 1 minute, with a wastage of 10% of water.

Bonus saving factors could also be assigned to some technologies which would allow improved management of water flow rate and temperature, in line with the information presented in Section 3. In the event that products allow multiple water flow rates/modes, indications may be provided for all the positions.

An Energy Efficiency Indicator could then be calculated by comparing the annual consumption of products against benchmark products.

This approach would have the benefit of being simple, ready-to-use, understandable and effective to drive the market towards products that consume less water and, indirectly, to decrease the consumption of energy associated to the use of taps and showers. However, an important drawback of the approach is that the exclusive measurement of water flows, with/without calculation of the related energy demand, would not take into full consideration the product function(s), which may increase the time of use and result in lower savings than those expected.

Transitional assessment and verification procedures for testing predefined functions and activities may thus build on relevant Swedish standards and/or other test methods developed by industry (although the existing limits of such initiatives have been presented in Sections 1.4.5 and 7.2.3). The virtual availability of data on test results could also allow the definition of empirical formulas for correlating water flow rate with energy consumption/efficiency.

In any case, it is considered that a mandate should be issued to European standardisation organisations to develop water and energy efficiency standards for taps and showers.

Measures may also be applied to overcome potential consumer dissatisfaction. Lowest maximum flow rates could for instance be set to ensure minimal performance requirements are fulfilled, as done for instance in the EU Ecolabel (2 L/minute for taps, 4.5 L/minute for showerheads and showers, 3 L/minute for electric showers and low-pressure showers) or in the Swiss Energy Label.

In terms of information carried by the label, the following elements could for example be shown:

- energy and/or water efficiency indicators;
- average energy and water consumption per year;
- nominal flow rate(s);
- additional elements related to the function(s) of the products, comfort, health and system performance.

7.3.2.2 Mandatory restrictions on water flow rates for some products (specific ecodesign requirement)

The analysis of the market distribution of products in terms of water flow rate and expected trends (see Table 7.7) and of the products registered in existing labelling schemes (see Table 7.8), which were presented in Sections 3 and 4 based on input from stakeholders, has pointed out that the portfolio of products on the market is quite broad in terms of water flow rate.

Table 7.7 **Estimated average maximum water flow rate of taps and showers at EU-28 level based on information from stakeholders**

	2013[a]	Short term[a]	Medium-long term[a]	Baseline[b] (L/min)	Theoretical limit[b] (L/min)
	Average (L/min)	Average (L/min)	Average (L/min)		
Taps[c]	8.0	6.0	5.3	7	5
Shower systems[d]	11.3	9.7	8.0	10	6

(a) Maximal flow rates.
(b) Real flow.
(c) Washbasin taps considered as reference product for taps.
(d) 6 L/min may be needed to ensure operation, 8 L/min may be the technical limit to avoid the risk of scalding.

Table 7.8 **Number of taps and showers registered under the European Water Label scheme**

Flow rate (L/min)	Basin taps		Shower controls		Shower handsets		Kitchen taps	
	Number	%	Number	%	Number	%	Number	%
< 6	572	32.6	25	2.5	50	10.9	20	7.9
6-8	309	17.6	216	21,4	42	9.2	6	2.4
8-10	630	35.9	161	15.9	119	26.0	84	33.3
10-13	9	0.5	84	8.3	163	35.6	11	4.4
>13 *	234	13.4	524	51.9	84	18.3	131	52.0
total	1754	100	1010	100	458	100	252	100
*** Flow rate (L/min)**	**Basin taps**		**Shower controls**		**Shower handsets**		**Kitchen taps**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
13-20	36	15.4	312	59.5	17	20.2	16	12.2
20-30	88	37.6	139	26.6	56	66.7	12	9.2
30-40	48	20.5	21	4.0	6	7.1	42	32.1
>40 (a)	62	26.5	52	9.9	5	6.0	61	46.5
Sub-total	234	100	524	100	84	100	131	100

Notes:
(a) Ffigures updated in June 2014
(b) For basin taps - Low-pressure product tested at 3 bar and does not reflect how the product will be installed and used.

Based on these figures, it could be considered theoretically possible to exclude some categories of products on the market which consume an excessive amount of water. This could be a specific ecodesign requirement which could potentially stand alone or flank a mandatory label.

However, the practical possibilities of implementing this option could be limited by the difficulties associated to the identification and the technical definition of specific categories of products and related thresholds, which could be open to interpretation and bypass rules.

Essential elements for the implementation of this policy option would be:

- the support and consultation of industry, to identify and to define where restrictions could be effectively implemented without negatively affecting the fitness for use of the products and the possibility of comfort for the user;

- the potential consideration of water and energy efficiency indicators, dependent on the development of harmonised standards in line with what has been presented for the mandatory label option.

However, it should be pointed out that there could be some difficulties associated with the definition of market segments for which to limit the water flow rates. For instance, the key point for shower systems would be to find a definition for luxury/wellness products, for which this type of requirements should not apply. This task is apparently difficult at the moment and, even if it were possible to define flow rate thresholds for some products it could still be possible to bypass the rule set. Some stakeholders consider that luxury products should not be exempted by ecodesign requirements because many of these products already integrate water-saving devices because the luxury aspect is not linked only to the water flow as such but to the number of water outlets. However, difficulties still remain in defining what a luxury/wellness product is and what its flow rate should be. A similar issue would also apply for taps, where kitchen and bathroom taps are technically the same products with the exception of the style of the design. Ecodesign measures may indeed produce undesired effects rather than benefits where filling of volumes is required. Other stakeholders consider specific requirements a possible option for the non-domestic sector but, as indicated for kitchen and bathroom taps, no technical and objective parameter has been identified which would allow for differentiation between products intended for one market or another.

7.3.2.3 Mandatory implementation of technical devices to control and/or limit the consumption of water and/or energy (generic ecodesign requirement)

The mandatory implementation of water/energy-saving technologies in relevant categories of products is another generic ecodesign requirement which could potentially stand alone or flank a label. Prescription should be kept generic and could require, for instance, the presence of one or more devices or technical solutions which can allow for:

- limiting the flow (e.g. water brakes, automatic shut-off), and/or
- managing the temperature and/or the use of hot water (e.g. hot water brakes, cold water supply in middle position, thermostatic mixing valves).

The possibility of retrofitting should also be taken into account as well as ensuring that the users can effectively control flow and temperature without limitation in the ease of use and/or the comfort. Proper guidance and education of consumers may also be needed in support of this measure.

Consultation with industry would be essential to agree on the classification and list of technologies. This should be as exhaustive as possible but should also maintain flexibility for allowing the inclusion of new technologies and to avoid creating any barriers to product innovation. It has been pointed out that the risk of limiting technical innovation with this requirement may be high and that it may be preferable to rely on functional criteria.

7.3.2.4 Implementation of water meters in products (generic ecodesign requirement)

Measurement and billing of hot water consumption at apartment level is required by the Energy Efficiency Directive. The potential implementation of water meters in products is a requirement that was preliminarily proposed for discussion with stakeholders. This is a technology that does not act on the performance of the product itself but that would have an effect on user behaviour. Coupled with proper guidance and education of consumers, water meters could contribute to water (and related energy) savings without imposing any constraints on the use of products. However, several drawbacks have been identified after consultation with industry, indicating that this is not a relevant and feasible option, at least at this stage:

1. Water meters only indicate how much water is consumed and do not necessarily result in water/energy savings, one of the reasons being that not all end-users may be able to interpret the data provided (no indications on whether water is wasted can be reported). They may only have an influence for shower systems but the key parameters will still be user behaviour (also in relation to the need for comfort) and water bill pressures (which also affect the willingness to save water).
2. The introduction of water meters in products would affect the product design which would increase the cost of products (for instance, it may at least double the price of a conventional single-lever mixer) and which may not be accepted by consumers.
3. Water meters have a much lower lifetime than the product itself with a consequent increase in maintenance costs and the amount of waste to dispose of.
4. The current market penetration of this technology can be considered marginal, if not negligible.

7.3.2.5 Inclusion of elements related to durability, ease of maintenance and cleaning, retrofitting and dismantling in the design of products

Generic ecodesign requirements could also require the inclusion of aspects related to durability, ease of installation, maintenance and cleaning, the possibility of retrofitting and dismantling in the conception and manufacture of products. This is a measure which would not contribute directly to the saving of water but which could have some benefits in terms of end-of-life and energy and material resource savings.

Increased dismantlability of products could be of some relevance for products containing electronic components. However, the prioritisation and the significance of measures in this area could be questionable considering the already high recycling/recovery rate for materials used in taps and shower systems (Sections 4, 5 and 6) and the less significant contribution of materials, maintenance and end-of-life to the key impacts associated to these products such as water abstraction, primary energy and emissions of GHGs (see Sections 5 and 6).

Apart from this, other elements could negatively affect the appeal of this option, in comparison with the previous ones:

- such ecodesign requirements would need to be relatively generic, with the risk of having no tangible effect in practice;
- a more significant effort on the education of installers and consumers would be needed in order to ensure the achievement of any environmental benefits.

7.3.2.6 Selection of options for further assessment of impacts

From a preliminary analysis of the described policy options, a mandatory water and energy label appears to be an interesting measure to take into consideration. Other options seem to be less relevant for this product group and/or to present technical limitations which could hinder their proposal and the further development and implementation of related policy measures.

Nevertheless, the assessment of the following policy scenarios has been considered relevant in order to understand the possible magnitude of impact at EU level of a mandatory label:

A. Business-as-Usual (BAU) scenario, also taking into account mandatory and voluntary instruments which already exist;
B. mandatory water and energy resource label;

C. mandatory restrictions on water flow rates for some products (specific ecodesign requirement);
D. mandatory implementation of technical devices to control and/or limit the consumption of water and/or energy (generic ecodesign requirement).

In addition, since the co-implementation of options would theoretically be possible, the following combinations of policy options are also discussed:

- B + C
- B + D
- C + D
- B + C + D.

7.3.3 Streamlined impact assessment of policy scenarios

The potential impact at EU level has been assessed for all the policy measures presented above. The assessment has been based on a set of necessary assumptions which are described below and the results of this streamlined impact assessment have been benchmarked against the modelled BAU scenarios.

7.3.3.1 Policy scenarios modelling

The two key elements for the assessment of the impacts due to the implementation of policy measures have been the analysis and estimation of:

1. the savings potential possibly achievable with the analysed measure over the years;
2. the associated variation of costs.

It should be highlighted that potential benefits due to the implementation of a policy tool only become tangible after a certain time delay.

The common assumption for all the policy scenarios is that stock and annual sales of products are not affected by the implementation of policy measures.

7.3.3.2 Mandatory water and energy resource label

The modelling of the scenario considering the implementation of a mandatory water and energy resource label is based on the assumptions presented for the BAU scenarios.

The only modification applied, in comparison with the models built for the BAU scenario, is that a mandatory label would influence more effectively and rapidly the transition of the market toward products which consume less water and energy. In practical terms, this has been translated in the model by considering that a mandatory label would have positive effects in terms of water flow reduction on:

- 100% of sales in 2015;
- 100% of sales in 2020;
- 100% of sales in 2025.

As a result of the modelling, the total water/energy savings potential and total annual costs for a unit of average product of the stock change are as reported in Table 7.9 and in Table 7.10.

Table 7.9 Total corrected water- and energy-saving potential for the scenario considering the implementation of a mandatory water and energy resource label

Product	Until 2015	2020	2025	2030
Tap, domestic	0%	3%	6%	9%
Tap, non-domestic	0%	5%	10%	10%
Shower system, domestic	0%	12%	25%	25%
Shower system, non-domestic	0%	18%	25%	25%

Table 7.10 Total annual costs for a unit of average product of the stock for the scenario considering the implementation of a mandatory water and energy resource label

Product	Until 2015	2020	2025	2030
Tap, domestic	EUR 45.6	EUR 45.3	EUR 45.9	EUR 44.5
Tap, non-domestic	EUR 194.3	EUR 196.0	EUR 189.8	EUR 189.7
Shower system, domestic	EUR 208.2	EUR 196.2	EUR 184.3	EUR 170.1
Shower system, non-domestic	EUR 167.6	EUR 158.2	EUR 143.3	EUR 143.1

7.3.3.3 Mandatory restrictions on water flow rates for some products (specific ecodesign requirement)

As outlined in Section 7.3.3.2, the definition of specific ecodesign requirements with which to reduce the flow rates of specific types of taps and showers is considered to be difficult, both in terms of shaping the scope of the requirement and meeting the expectations of consumers. Nevertheless, a rough assessment of the theoretical savings potential associated to this option has been carried out as described below.

On the basis of the information reported in Table 7.8, on the detailed distribution of products by water flow rate as indicated by the European Water Label, it has been hypothetically assumed that:

- the water flow rate could be decreased from 32.1 L/minute to 16.5 L/minute for 11% of taps (49% of reduction);
- the water flow rate could be decreased from 9 L/minute to 7 L/minute for 36% of taps (22% of reduction);
- the water flow rate could be decreased from 27 L/minute to 16.5 L/minute for 15% of shower systems (39% of reduction);
- the water flow rate could be decreased from 11.5 L/minute to 10 L/minute for 36% of shower systems (13% of reduction).

This has been translated into a theoretical maximum water-saving potential of 36% for 48% of taps and of 26% for 50% of shower systems.

As in the model for the BAU scenario:

- an 85% savings reduction factor has been applied to take incomplete opening of products and any inefficiencies of use of products into account.

- the savings potential has been considered to be actually achievable for 35% of taps (estimated as a share of water use in bathroom taps and in hand dish washing over the total use of water in taps) and 100% of shower systems.
- the same assumptions used for the calculation of primary energy demand, emissions of GHGs and total annual costs have been applied.

Saving is considered achievable, gradually and up to the physical limits indicated before, through the introduction of new products on the market from 2015.

As a result of the modelling, the total water/energy-saving potential and total annual costs for a unit of average product of the stock change as reported in Table 7.11 and in Table 7.12. It is worth observing that the potential savings for some products are lower than those estimated for the BAU scenarios in 2025 and 2030 (see yellow boxes). The lower savings have to be interpreted as the measure having positive effects in the short term until it stops being effective and becomes "absorbed" in the BAU scenario. This is consistent with the fact that the market dynamics could be sufficient in the long term to reduce the consumption of water (and energy) from these types of product. The model has thus been corrected by applying for such products the figures calculated for the BAU scenarios for 2025 and 2030.

Table 7.11 Total corrected water- and energy-saving potential for the scenario considering the implementation of specific ecodesign requirements on water flow reduction (in yellow the figures which are lower than those for the BAU scenario)

Product	Until 2015	2020	2025	2030
Tap, domestic	0%	3%	5%	5%
Tap, non-domestic	0%	5%	5%	5%
Shower system, domestic	0%	11%	11%	11%
Shower system, non-domestic	0%	11%	11%	11%

Table 7.12 Total annual costs for a unit of average product of the stock for the scenario considering the implementation of specific ecodesign requirements on water flow reduction

Product	Until 2015	2020	2025	2030
Tap, domestic	EUR 45.6	EUR 45.2	EUR 45.7	EUR 45.9
Tap, non-domestic	EUR 194.3	EUR 195.8	EUR 198.1	EUR 198.1
Shower system, domestic	EUR 208.2	EUR 197.9	EUR 192.5	EUR 192.5
Shower system, non-domestic	EUR 167.6	EUR 160.1	EUR 161.7	EUR 161.7

7.3.3.4 Mandatory implementation of technical devices to control and/or limit the consumption of water and/or energy (generic ecodesign requirement)

In line with Section 3 it has been considered that the bonus in terms of water and energy savings due to improved limitation/control of flow/temperature through the application of water/energy-saving devices alone is 5% for both taps and showers. The figure does not take into account the reduction of water flow, which is of more relevance for other measures analysed and must be considered as an additional saving achievable through improved control of water flow rates and/or temperature. For this reason, a savings reduction factor expressing the potential longer use of products is not needed for this policy scenario.

As in the model of the BAU scenario:

- the share of installed products with water/energy-saving features is 40% until 2015 and it increases in the following years because of the penetration of new water/energy-saving products sold on the market;
- the savings potential has been considered to be actually achievable for 35% of taps (estimated as a share of water use in bathroom taps and in hand dish washing over the total use of water in taps) and 100% of shower systems;
- other assumptions used for the calculation of primary energy demand, emissions of GHGs and total annual costs have been kept unchanged.

Additional saving is considered achievable, gradually and up to the physical limits indicated before, through the introduction of new products on the market from 2015. The savings estimated for the BAU scenarios have also been considered for the calculation of the total annual costs in order to estimate the economic interference due to this option.

As a result of the modelling, the total water/energy-saving potential and total annual costs for a unit of average product of the stock change as reported in Table 7.13 and in Table 7.14. In particular it is worth observing that the potential savings are lower than those of the previous options. This is because these must be seen as "additional" savings according to the modelling performed. For shower systems in the non-domestic sector, based on the characteristics of the model built, it results that conditions of technology saturation can be achieved in a short time so that the maximum savings potential is exploitable from 2020.

Table 7.13 **Total corrected water- and energy-saving potential for the scenario considering the implementation of generic ecodesign requirements for flow/temperature limitations and control**

Product	Until 2015	2020	2025	2030
Tap, domestic	0%	0%	1%	1%
Tap, non-domestic	0%	1%	1%	1%
Shower system, domestic	0%	2%	3%	3%
Shower system, non-domestic	0%	3%	3%	3%

Table 7.14 **Total annual costs for a unit of average product of the stock for the scenario considering the implementation of generic ecodesign requirements for flow/temperature limitations and control**

Product	Until 2015	2020	2025	2030
Tap, domestic	EUR 45.6	EUR 45.8	EUR 46.1	EUR 45.5
Tap, non-domestic	EUR 194.3	EUR 199.9	EUR 196.8	EUR 190.0
Shower system, domestic	EUR 208.2	EUR 201.6	EUR 192.9	EUR 181.6
Shower system, non-domestic	EUR 167.6	EUR 165.3	EUR 156.3	EUR 143.2

7.3.3.5 Combinations of the above options

Combinations of the above measures may produce aggregated effects on the BAU scenarios. During the modelling of each policy scenario, the intention has been to analyse each measure as independently as possible in order to avoid double counting external elements associated to the simultaneous implementation of policy instruments.

BAU and mandatory label scenarios form the substrata on which to consider the potential implementation of additional ecodesign requirements. As simplifying assumptions for streamlining the assessment of the combinations of policy options, and also supported by the nature of the modelling, it can be considered that:

- the effects due to specific and generic ecodesign requirements are decoupled from each other;
- the effects due to generic ecodesign requirements are considered to add up linearly to the BAU or mandatory label scenarios;
- the effects due to specific ecodesign requirements are to be evaluated critically and in comparison with the BAU or mandatory label scenarios.

These effects are qualitatively discussed in the next section.

7.3.3.6 Comparison of BAU vs. Policy Scenarios

The impact at EU level of the policy scenarios analysed is presented in Figures 7.8 (water abstraction), 7.9 (primary energy demand), 7.10 (emissions of GHGs), 7.11 (annual total consumer expenditure) benchmarking against the BAU scenario. The quantified results for 2015, 2020, 2025 and 2030 have been reported in Tables 7.15 and 7.16, together with indications of the possible cumulative effects of individual policy options in the 2015-2030 time interval. The summed effects associated to combined options are also described qualitatively below.

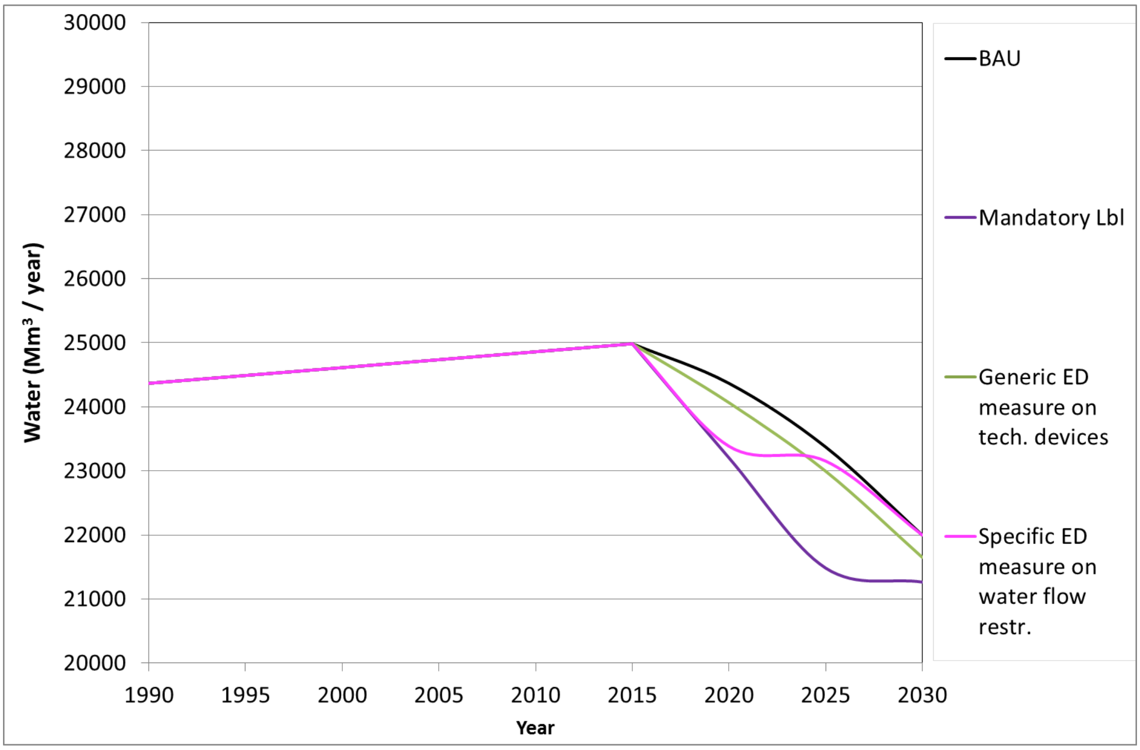

Figure 7.8 EU annual abstraction of water for use in taps and shower systems estimated for the period 1990-2030, comparison of total values between BAU and other policy scenarios

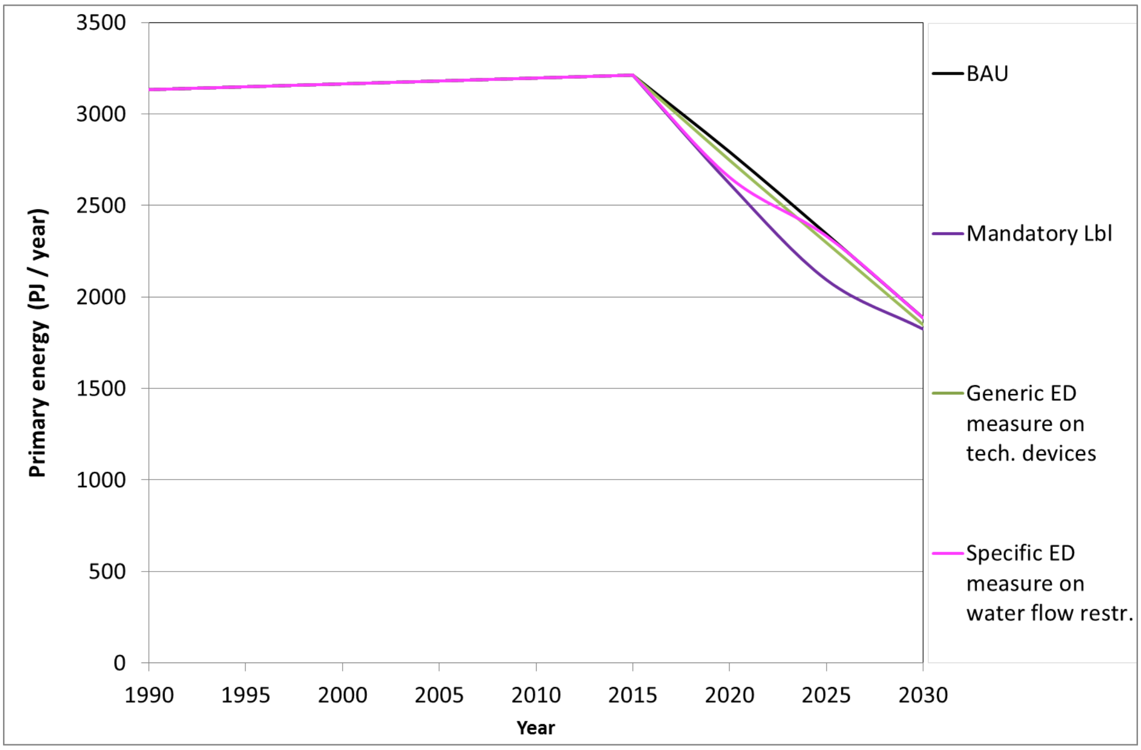

Figure 7.9 EU annual demand for primary energy associated to the use of taps and shower systems estimated for the period 1990-2030, comparison of total values between BAU and other policy scenarios

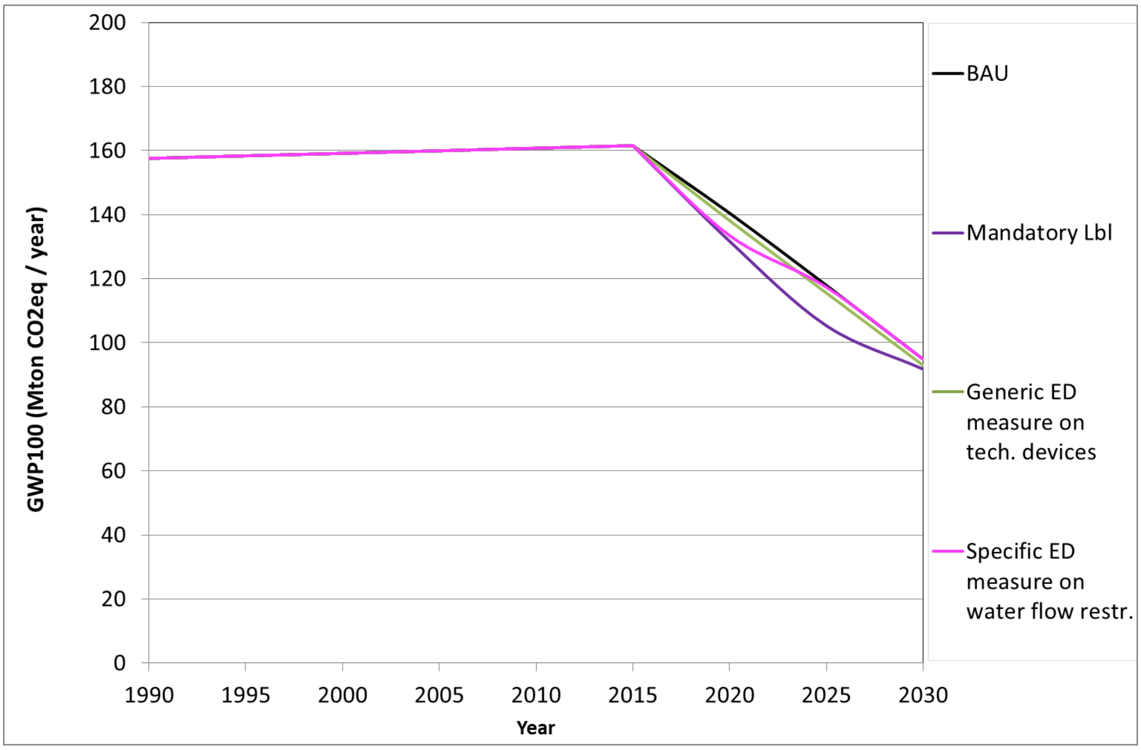

Figure 7.10 Emissions of GHGs related to the EU annual demand for primary energy for taps and shower systems estimated for the period 1990-2030, comparison of total values between BAU and other policy scenarios

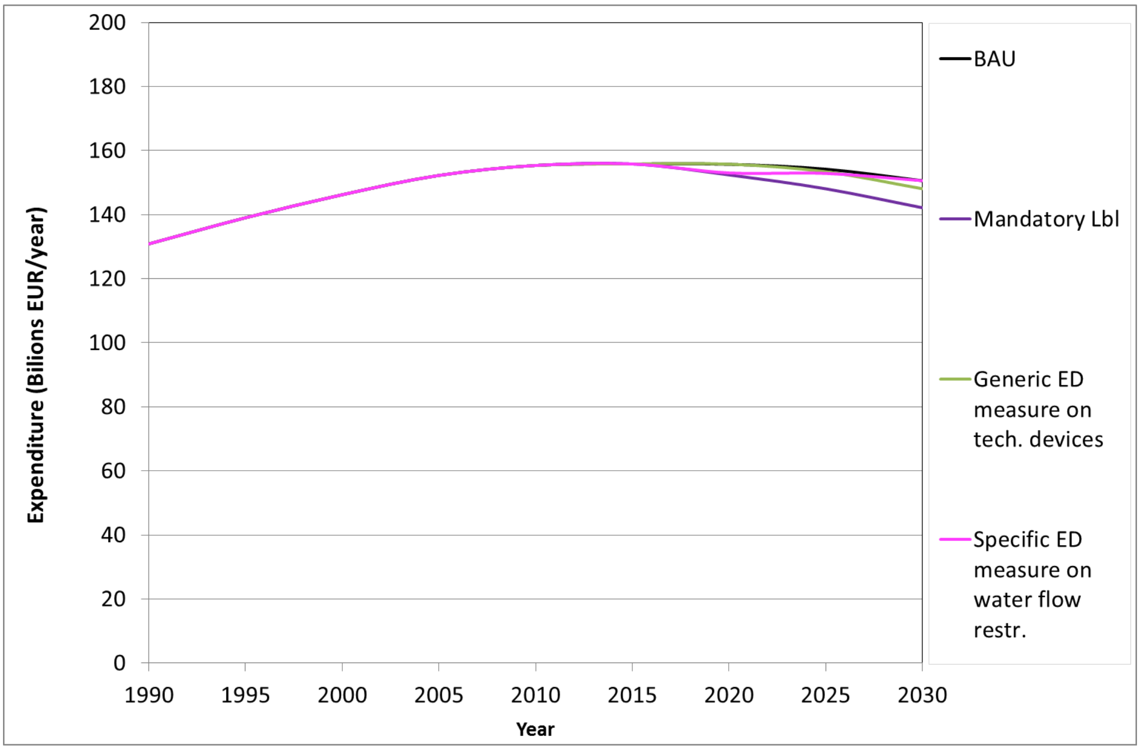

Figure 7.11 EU annual consumer expenditure associated to the use of taps and shower systems over their lifetime and estimated for the period 1990-2030, comparison of total values between BAU and other policy scenarios

Table 7.15 Comparison at EU level of results obtained for BAU and other policy scenarios: Water Abstraction and Primary Energy Demand

POLICY SCENARIO	WATER ABSTRACTION (Gm^3/year)					PRIMARY ENERGY DEMAND (PJ/year)				
	2015	2020	2025	2030	Cum.	2015	2020	2025	2030	Cum.
BAU										
- absolute result	25.0	24.4	23.4	22.0	356.2	3212	2793	2345	1886	38437
(% var. 2015-2030)				(-12%)					(-41%)	
Mandatory Lbl										
- absolute result	25.0	23.2	21.5	21.3	339.1	3212	2619	2094	1825	36159
(% var. 2015-2030)				(-15%)					(-43%)	
- difference from BAU	0.0	-1.2	-1.9	-0.7	-17.1	0	-174	-251	-61	-2278
(% var)					(-5%)					(-6%)
Specific ED measure on water flow restr.										
- absolute result (% var. 2015-2030)	25.0	23.4	23.2	22.0	350.1	3212	2654	2334	1886	37865
(% var. 2015-2030)				(-12%)					(-41%)	
- difference from BAU	0.0	-1.0	-0.2	0.0	-6.0	0	-139	-11	0	-752
(% var)					(-2%)					(-2%)
Generic ED measure on tech. devices										
- absolute result (% var. 2015-2030)	25.0	24.1	23.0	21.6	351.9	3212	2747	2297	1848	37875
(% var. 2015-2030)				(-13%)					(-42%)	
- difference from BAU	0.0	-0.3	-0.4	-0.3	-4.3	0	-46	-48	-38	-562
(% var)					(-1%)					(-1%)

Table 7.16 Comparison at EU level of results obtained for BAU and other policy scenarios: Emissions of GHGs and Total Consumer Expenditure

POLICY SCENARIO	Emissions of GHGs (Mt CO_2 eq/year according to GWP100)					TOTAL CONSUMER EXPENDITURE (Billion EUR/yr)				
	2015	**2020**	**2025**	**2030**	**Cum.**	**2015**	**2020**	**2025**	**2030**	**Cum.**
BAU										
- absolute result	161.6	140.5	117.9	94.9	1933	156	156	154	151	2316
(% var. 2015-2030)				(-41%)					(-3%)	
Mandatory Lbl										
- absolute result	161.6	131.7	105.3	91.8	1818	156	152	148	142	2248
(% var. 2015-2030)				(-43%)					(-9%)	
- difference from BAU	0	-8.8	-12.6	-3.1	-114	0	-3	-6	-8	-68
(% var)					(-6%)					(-3%)
Specific ED measure on water flow restr.										
- absolute result (% var. 2015-2030)	161.6	133.5	117.4	94.5	1895	156	153	154	151	2303
(% var. 2015-2030)				(-41%)					(-3%)	
- difference from BAU	0	-7.0	-0.6	0	-38	0	-3	0	0	-12
(% var)					(-2%)					(-1%)
Generic ED measure on tech. devices										
- absolute result (% var. 2015-2030)	161.6	138.2	115.5	93.0	1905	156	156	153	148	2305
(% var. 2015-2030)				(-42%)					(-5%)	
- difference from BAU	0	-2.3	-2.4	-1.9	-28	0	0	-1	-3	-11
(% var)					(-1%)					(0%)

Based on the assumptions made, it can be observed that each of the policy scenarios assessed in the study has the potential to result in environmental benefits, at least for the indicators considered in the impact assessment (water abstraction, demand for primary energy and emissions of GHGs).

With reference to the EU total values for 2015, the impacts assessed in the BAU scenarios for 2030 decrease by 12% for water abstraction and by 41% for demand for primary energy and emissions of GHGs.

The environmental benefits estimated in 2030 for the BAU scenario are a consequence of market trends and existing industry initiatives and policy tools, including voluntary labels. Because of this market transformation, the additional benefits achievable with mandatory policy options in 2030 could be limited, as is the case of the mandatory water and energy label and the generic ecodesign requirements on technologies, or could even disappear, as is the case of mandatory restrictions on water flow rates.

The main potential advantage of mandatory policy options would be to accelerate the market transition towards water/energy-saving products. This can be observed by comparing the potentially achievable environmental benefits under different scenarios in 2020 and 2025. In other words, the cumulative saving of water and energy achievable between 2015 and 2030 becomes a crucial parameter in the determination of the policy option ranking.

Mandatory water and energy resource label

According to the model, from an environmental point of view the most interesting option seems to be the implementation of a mandatory water and energy label. Compared to the BAU scenarios, this option has been assessed to lead to:

- the annual saving of 1200 million m^3 of abstracted water and 174 PJ of primary energy and to avoid the emission of 8.8 million tonnes of CO_2 eq per year in 2020;
- the annual saving of 1900 million m^3 of abstracted water and 251 PJ of primary energy and to avoid the emission of 12.6 million tonnes of CO_2 eq per year in 2025;
- the annual saving of 700 million m^3 of abstracted water and 61 PJ of primary energy and to avoid the emission of 3.1 million tonnes of CO_2 eq per year in 2030;
- the cumulative saving of 17100 million m^3 of abstracted water (5% of the cumulative value for the BAU scenario) and 2278 PJ of primary energy (6% of the cumulative value for the BAU scenario) and to avoid the emission of 114 million tonnes of CO_2 eq (6% of the cumulative value for the BAU scenario) in the period 2015-2030.

This option may also be beneficial in terms of the life cycle costs allocated to consumers. It has been roughly estimated that between 2015 and 2030 these could decrease by 3% in the BAU scenario and by 9% in the case of implementation of a mandatory label.

Although relative figures may initially appear marginal, absolute values for energy can be considered significant if compared with:

- the energy saving of ecodesign requirements already implemented for other product groups[283] (see Table 7.17), or
- the primary energy consumption of European countries[284] (see Table 7.18).

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[283] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/files/brochure_ecodesign_en.pdf

[284] http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=44&pid=44&aid=2&cid=r3,&syid=2012&eyid=2012&unit=QBTU

Mandatory implementation of technical devices to control and/or limit the consumption of water and/or energy (generic ecodesign requirement)

Additional environmental benefits may be achieved with the introduction of requirements for the mandatory implementation of devices for the management of water flow rates and temperature. However, in this case the magnitude of the benefits is more limited since most of the market is inherently made up of or shifting towards products that already implement such devices. Compared to the BAU scenarios, possible benefits have been quantified to be:

- the annual saving of 300 million m^3 of abstracted water and 46 PJ of primary energy and the avoidance of 2.3 million tonnes of CO_2 eq per year in 2020;
- the annual saving of 400 million m^3 of abstracted water and 48 PJ of primary energy and the avoidance of 2.4 million tonnes of CO_2 eq per year in 2025;
- the saving of 300 million m^3 of abstracted water and 38 PJ of primary energy and the avoidance of 1.9 million tonnes of CO_2 eq per year in 2030;
- the cumulative saving of 4300 million m^3 of abstracted water (1% of the cumulative value for the BAU scenario) and 562 PJ of primary energy (1% of the cumulative value for the BAU scenario) and the avoidance of 28.3 million tonnes of CO_2 eq (1% of the cumulative value for the BAU scenario) in the period 2015-2030.

According to model, the implementation of this option would not produce any economic burdens for consumers from a life cycle perspective, also because devices for the management of water flow rates and temperature are commonly implemented in products.

Mandatory restrictions on water flow rates for some products (specific ecodesign requirement)

The implementation of mandatory requirements on water flow reductions is an option which may lead to some environmental benefits, if any, only in the short term, as the market is evolving towards water- and energy-saving products which would at some point nullify any potential advantages for this option. Compared to the BAU scenarios, possible additional benefits have been quantified to be:

- the annual saving of 1000 million m^3 of abstracted water and 139 PJ of primary energy and the avoidance of 7 million tonnes of CO_2 eq per year in 2020;
- the annual saving of 200 million m^3 of abstracted water and 11 PJ of primary energy and the avoidance of 0.6 million tonnes of CO_2 eq per year in 2025;
- zero in 2030;
- the cumulative saving of 6000 million m^3 of abstracted water (1% of the cumulative value for the BAU scenario) and 752 PJ of primary energy (1% of the cumulative value for the BAU scenario) and the avoidance on of 37.8 million tonnes of CO_2 eq (1% of the cumulative value for the BAU scenario) in the period 2015-2030.

The effect described through comparison with the BAU scenarios may be significantly anticipated in the case of implementation of a mandatory water and energy label (see Figures 7.8, 7.9, 7.10, 7.11) because of the acceleration in the market transformation potentially pushed by this option. In other terms, a label may be sufficient to achieve satisfactory environmental benefits without limiting the consumer choice.

The mandatory restrictions of water flows for some products may be viable from an economic point of view. However, the impact assessment presented for this option should be considered a rough estimation of the possible maximum theoretical savings potential achievable in case of implementation of this option. It has previously been described how the definition of target products and the calibration of thresholds for this option are difficult and delicate tasks. It may be that the risks associated with the implementation of this option are greater than the benefits which would be yielded. This option indeed may limit consumer choice, which could be perceived negatively without being balanced by significant benefits.

Remarks on user behaviour

Although not explicitly addressed in the impact assessment, it is important to underline the significant influence of user behaviour in determining environmental impacts and ensuring the effective achievement of any potential benefit. In this sense, informing and educating retailers, installers and consumers should be considered a priority for this product group no matter which policy scenario is followed.

Table 7.17 Ranking of potential energy savings for different product groups

Product group	**Estimated savings in terms of primary energy (PJ/yr)**
Space heaters [a, c]	1900
Electric motors [b, d]	1215
Water heaters [a, c]	450
Domestic lighting [b, d]	351
Street & office lighting [b, d]	342
Standby [b, d]	315
Fans [b, d]	306
Televisions [b, d]	252
Mandatory water and energy label for taps and showers [e]	**251**
Circulators [b, d]	207
Air conditioners and comfort fans [b, d]	99
External power supplies [b, d]	81
Simple set top boxes [b, d]	54
Mandatory implementation of technical devices for water flow and/or temperature management	**48**
Domestic refrigerators [b, d]	36
Domestic dishwashers [b, d]	18
Domestic washing machines [b, d]	14
Mandatory restriction of water flows for some products	**11**
Total without considering taps and showers [b, d]	3294
(a) In-house data (e.g. from http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2013/swd_2013_0295_en.pdf). (b) In-house calculation based on the values reported in http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/files/brochure_ecodesign_en.pdf (1 PJ of power considered equivalent to	

2.5 PJ of primary energy).

(c) Estimated at 2020 and considered to refer to 2025 (+10 years from entry into force of regulations).

(d) Estimated at 2020.

(e) Estimated as additional saving in 2025 (+10 years) in comparison with BAU scenarios.

Table 7.18 Available information on primary energy consumption for European countries in 2012[285]

Country	**Primary energy consumption in 2012 (PJ)**
Germany	12491
France	10019
United Kingdom	8014
Italy	6750
Spain	5581
Netherlands	3803
Poland	3739
Belgium	2616
Sweden	2101
Norway	1893
Czech Republic	1454
Austria	1419
Greece	1179
Finland	1153
Portugal	937
Denmark	721
Slovakia	712
Ireland	541
Slovenia	282
Luxembourg	180

7.3.3.7 Analysis of the savings achievable from a mandatory label in case of lower effectiveness of voluntary initiatives

As explained in Section 7.3.1.3, existing labelling schemes and industry initiatives have been taken into account in the definition of the BAU scenario by considering that these could have a positive influence in terms of water flow reduction on:

- 40% of sales in 2015;

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[285] http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=44&pid=44&aid=2&cid=r3,&syid=2012&eyid=2012&unit=QBTU

- 60% of sales in 2020;
- 80% of sales in 2025.

The assumptions made are considered to be optimistic from the perspective of voluntary labelling and to allow the estimation of the maximum and theoretical water-saving potential achievable without the implementation of any other policy tool. Nevertheless, figures for the future are characterised by a certain level of uncertainty.

It is apparent that the additional savings achievable through a mandatory label and/or ecodesign requirements would be greater considering the more limited effectiveness of existing labelling schemes and industry initiatives. Two alternative BAU scenarios have been analysed where the effectiveness of voluntary labels is more limited.

In the first alternative BAU scenario ("BAU reduced"), the effectiveness of voluntary initiatives has been reduced considering that these would have a positive influence on:

- 40% of sales in 2015;
- 50% of sales in 2020;
- 60% of sales in 2025.

In the second alternative BAU scenario ("BAU minimum"), the effectiveness of voluntary initiatives for 2015 has been maintained constant over time (40%).

The effects of such variations on the estimated savings potential have been evaluated for the mandatory label, which has resulted the most appealing option in terms of magnitude of energy savings and technical feasibility.

The results of the comparison between the three BAU scenarios and the scenario considering the presence of a mandatory label are presented in Tables 7.19 and 7.20 and in Figures 7.11 and 7.12. If the influence of voluntary initiatives in the BAU scenario were less significant, the positive effects of a mandatory label would be magnified:

- in 2025, 2000-2300 million m^3 of abstracted water (+5% and +21% compared to the 1900 million m^3 calculated in the more conservative estimation) and 276-301 PJ of primary energy per year (+10% and +20% compared to the 251 PJ calculated in the more conservative estimation) would be saved per year and 13.9-15.1 million tonnes of CO_2 eq (+10% and +20% compared to the 12.6 million tonnes of CO_2 eq calculated in the more conservative estimation) would be avoided per year;
- in 2030, 1300-1900 million m^3 of abstracted water (+86% and +171% compared to the 700 million m^3 calculated in the more conservative estimation) and 128-194 PJ of primary energy (+110% and +218% compared to the 61 PJ calculated in the more conservative estimation) would be saved per year and 6.4-9.8 million tonnes of CO_2 eq (+106% and +216% compared to the 3.1 million tonnes of CO_2 eq calculated in the more conservative estimation) would be avoided per year;
- in the period 2015-2030, 19400-21800 million m^3 of abstracted water (+13% and +25 compared to the 17100 million m^3 calculated in the more conservative estimation) and 2569-2861 PJ of primary energy (+13% and +26% compared to the 2277 PJ calculated in the more conservative estimation) would be saved in total and 129.2-143.9 million tonnes of CO_2 eq (+13% and +26% compared to the 114.5 milloin tonnes of CO_2 eq calculated in the more conservative estimation) would be avoided in total;
- the decrease in life cycle costs associated to consumers would be still more evident because of the greater differential penetration of water- and energy-saving technologies.

Table 7.19 Comparison at EU level of results obtained for mandatory label and alternative BAU scenarios: Water Abstraction and Primary Energy Demand

POLICY SCENARIO	**WATER ABSTRACTION (Gm^3/year)**					**PRIMARY ENERGY DEMAND (PJ/year)**				
	2015	**2020**	**2025**	**2030**	**Cum.**	**2015**	**2020**	**2025**	**2030**	**Cum.**
Mandatory label										
- absolute result	25.0	23.2	21.5	21.3	339.1	3212	2619	2094	1825	36159
(% var. 2015-2030)				(-15%)					(-43%)	
BAU										
- absolute result	25.0	24.4	23.4	22.0	356.2	3212	2793	2345	1886	38437
(% var. 2015-2030)				(-12%)					(-41%)	
- difference between Mandatory label and BAU	0.0	-1.2	-1.9	-0.7	-17.1	0.0	-174	-251	-61	-2277
(% var. Mandatory label vs. BAU)					(-5%)					(-6%)
"BAU reduced"										
- absolute result	25.0	24.4	23.6	22.6	358	3212	2793	2370	1953	38729
(% var. 2015-2030)				(-9%)					(-39%)	
- difference between Mandatory label and "BAU reduced"	0.0	-1.2	-2.0	-1.3	-19.4	0.0	-174	-276	-128	-2569.4
(% var. Mandatory label vs. "BAU reduced")					(-5%)					(-7%)
"BAU minimum"										
- absolute result	25.0	24.4	23.7	231	360.8	3212	2793	2395	2018	39020
(% var. 2015-2030)				(-7%)					(-37%)	
- difference between Mandatory label and "BAU minimum"	0.0	-1.2	-2.3	-1.9	-21.8	0.0	-174	-301	-194	-2861
(% var. Mandatory label vs. "BAU minimum")					(-6%)					(-7%)

Note: Effectiveness of voluntary initiatives:

- BAU: 40% in 2020, 60% in 2025, 80% in 2030.
- "BAU reduced": 40% in 2020, 50% in 2025, 60% in 2030.
- "BAU minimum": 40% in 2020, 2025, 2030.

Table 7.20 **Comparison at EU level of results obtained for mandatory label and alternative BAU scenarios: Emissions of GHGs and Total Consumer Expenditure**

POLICY SCENARIO	Emissions of GHGs (Mt CO_2 eq / year according to GWP100)					TOTAL CONSUMER EXPENDITURE (Billion EUR/yr)				
	2015	2020	2025	2030	Cum.	2015	2020	2025	2030	Cum.
Mandatory label										
- absolute result	161.6	131.7	105.3	91.8	1818.5	156	152	148	142	2248
(% var. 2015-2030)				(-43%)					(-9%)	
BAU										
- absolute result	161.6	140.5	117.9	94.9	1933.1	156	156	154	151	2316
(% var. 2015-2030)				(-41%)					(-3%)	
- difference between Mandatory label and. BAU	0.0	-8.8	-12.6	-3.1	-114.5	0	-3	-6	-8	-68
(% var. Mandatory label vs. BAU)					(-6%)					(-3%)
"BAU reduced"										
- absolute result	161.6	140.5	119.2	98.2	1948	156	156	155	152	2323
(% var. 2015-2030)				(-39%)					(-2%)	
- difference between Mandatory label and "BAU reduced"	0.0	-8.8	-13.9	-6.4	-129.2	0	-3	-7	-10	-76
(% var. Mandatory label vs. "BAU reduced")					(-7%)					(-3%)
"BAU minimum"										
- absolute result	161.6	140.5	120.5	101.5	1962.4	156	156	155	154	2330
(% var. 2015-2030)				(-37%)					(-1%)	
- difference between Mandatory label and "BAU minimum"	0.0	-8.8	-15.1	-9.8	-143.9	0	-3	-7	-12	-83
(% var. Mandatory label vs. "BAU minimum")					(-7%)					(-4%)

Note: Effectiveness of voluntary initiatives:

- BAU: 40% in 2020, 60% in 2025, 80% in 2030.
- "BAU reduced": 40% in 2020, 50% in 2025, 60% in 2030.
- "BAU minimum": 40% in 2020, 2025, 2030.

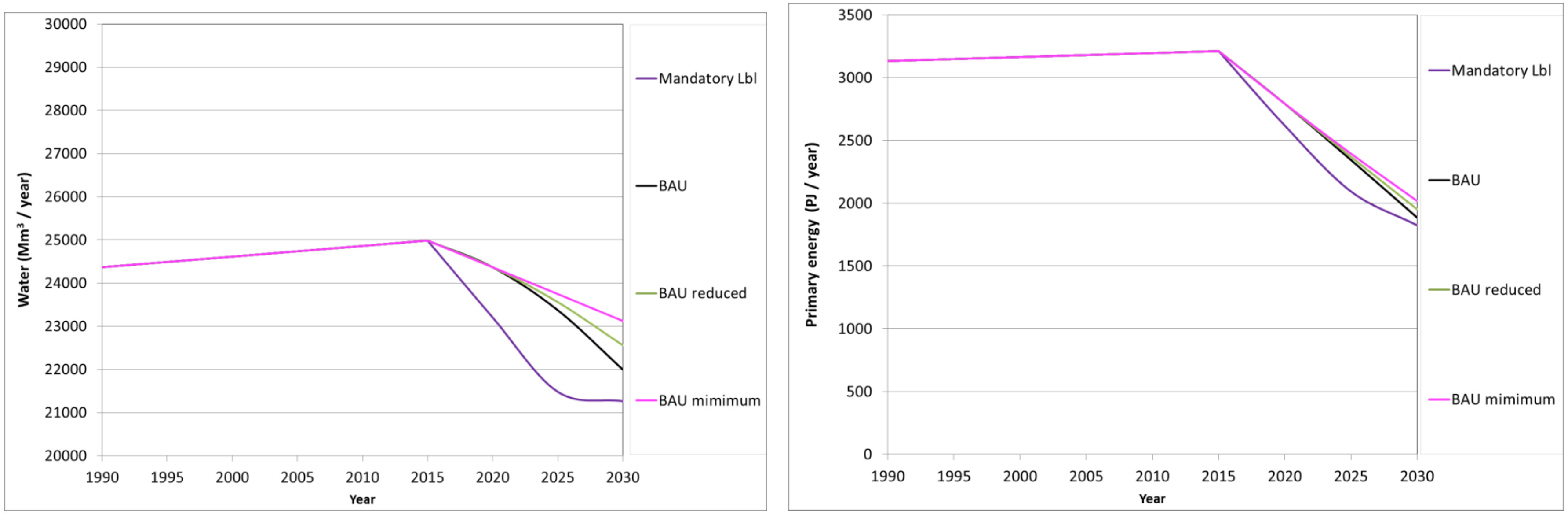

Figure 7.11 Estimation of EU annual abstraction of water for use in taps and shower systems and associated demand for primary energy for the period 1990-2030, comparison of total values between mandatory label and different BAU scenarios based on different assumptions about the effectiveness of voluntary initiatives for this product group

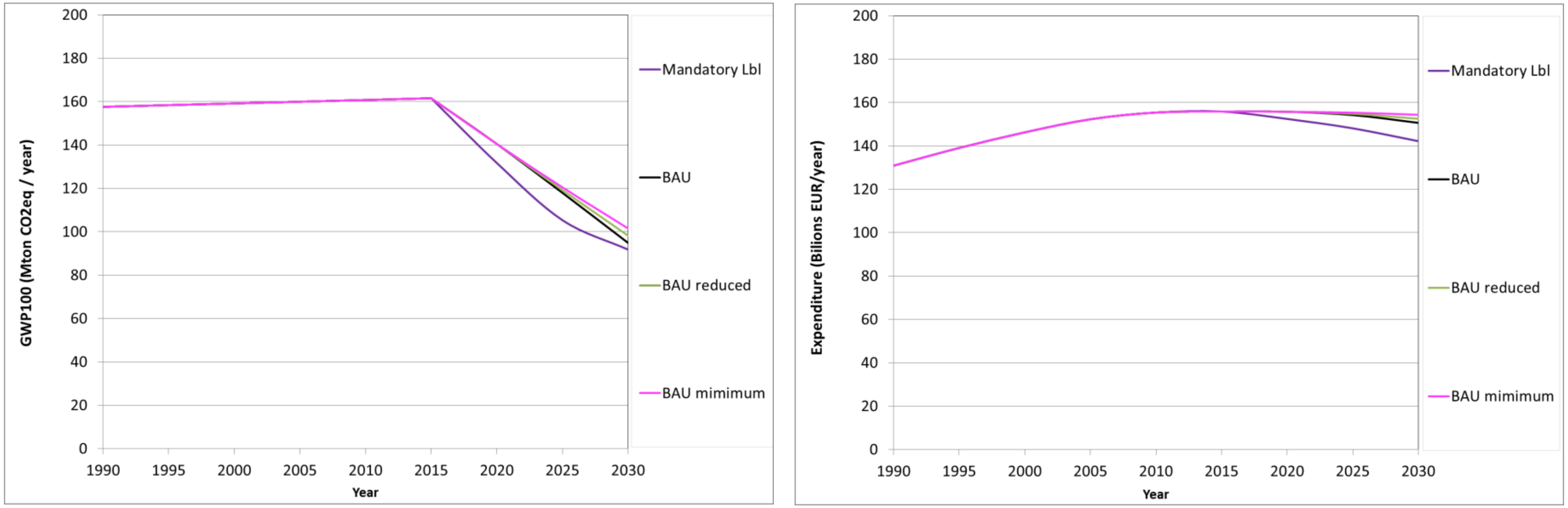

Figure 7.12 Estimation of EU annual emissions of GHGs and of EU annual consumer expenditure associated to the use of taps and shower systems for the period 1990-2030, comparison of total values between mandatory label and different BAU scenarios based on different assumptions about the effectiveness of voluntary initiatives for this product group

7.4 Conclusions

A series of potential policy options have been identified as promising and for which it is worth assessing the impacts at EU level.

The results of the streamlined impact assessment carried out in this Section show that market transformation, current policy instruments and industry initiatives are already generating some environmental benefits for this product group. Nevertheless, it seems that there is still an important margin for environmental improvement through the implementation of additional policy tools.

Among the options assessed, a mandatory water and energy label seems to be an interesting tool for accelerating further the market transformation towards water- and energy-saving products and achieving significant benefits at EU level in terms of water, energy and cost savings and reduction of GHG emissions. However, it is recognised that clear technical guidelines on how to set up such a scheme should be defined taking into account experience from the existing voluntary schemes and coupled with a strategic communication policy at European level. In this sense, user behaviour is indeed a key issue for ensuring the effective achievement of any potential benefit with this and, more generally, any initiative.

The potential for adding significant environmental benefits to the existing market and policy framework through the aid of ecodesign requirements instead appear limited. These options also appear less attractive considering:

- the associated technical drawbacks and difficulties, like the definition of market segments for limiting water flow rates or for proposing the mandatory presence of water/energy-saving devices, and
- the risk of not meeting the expectations of consumers.

Last but not least, another important aspect emerged is the current lack of harmonised standards for measuring and calculating the water/energy efficiency of taps and shower systems taking into account the function of the product. This could be an important element to integrate into the proposal of any mandatory policy option, although this may require a considerable amount of time.

However, this would not necessarily imply the necessity to delay/avoid the potential implementation of new policy options. A mandate to the European Standardisation Organisation may therefore be appropriate to develop standards for measuring the efficiency of product functions and to provide tools with which to revise policy options in a second stage. In the meanwhile, until such standards become available, a series of transitory measures could be considered for assessing the efficiency of products and taking their functionality into account.

ANNEX I: SUPPORTING INFORMATION FOR SCOPE

Table A1.1 NACE[286], PRODCOM[287] and Combined Nomenclature[288] classifications of potential relevance for taps and shower systems

Code	Description
NACE 22.23	Manufacture of builders' ware of plastic (Manufacture of builders' plastics ware; plastic doors, windows, frames, shutters, blinds, skirting boards; tanks, reservoirs; plastic floor, wall or ceiling coverings in rolls or in the form of tiles etc.; plastic sanitary ware like plastic baths, shower baths, washbasins, lavatory pans, flushing cisterns etc.; Manufacture of resilient floor coverings, such as vinyl, linoleum etc.; Manufacture of artificial stone (e.g. cultured marble))
Prodcom 22.23.12.90 CN 3922 90 00	Plastic bidets, lavatory pans, flushing cisterns and similar sanitary ware (excluding baths, showers-baths, sinks and wash-basins, lavatory seats and covers) Bidets, lavatory pans, flushing cisterns and similar sanitary ware of plastics (excl. baths, shower-baths, sinks, washbasins, lavatory seats and covers)
NACE 25.99	Manufacture of other fabricated metal products n.e.c (Manufacture of metal household articles (e.g. plates, pots, kettles, pans); Manufacture of building components of zinc: gutters, roof capping, baths, sinks, washbasins and similar articles; Manufacture of metal goods for office use, except furniture; Manufacture of safes, strongboxes, armoured doors etc.; Manufacture of various metal articles (e.g. ship propellers and anchors); Manufacture of foil bags; Manufacture of permanent metallic magnets; Manufacture of metal vacuum jugs and bottles; Manufacture of metal badges and metal military insignia; Manufacture of metal hair curlers, metal umbrella handles and frames, combs)
Prodcom 25.99.11.31 CN 7324 90 00	Sanitary ware and parts of sanitary ware of iron or steel Sanitary ware, and parts thereof, of iron or steel (excl. cans, boxes and similar containers of heading 7310, small wall cabinets for medical supplies or toiletries and other furniture of chapter 94, and fittings, complete sinks and washbasins, of stainless steel, complete baths and fittings)
Prodcom 25.99.11.35 CN 7418 20 00	Sanitary ware and parts thereof of copper Sanitary ware and parts thereof, of copper (excl. cooking and heating appliances of heading 7417, and fittings)
Prodcom 25.99.11.37	Sanitary ware and parts thereof of aluminium
CN 7615 20 00	Sanitary ware and parts thereof, of aluminium (excl. cans, boxes and similar containers of heading 7612, and fittings)
NACE 28.14	Manufacture of other taps and valves (Manufacture of industrial taps and valves, including regulating valves and intake taps; Manufacture of sanitary taps and valves; Manufacture of heating taps and valves)
Prodcom 28.14.12.33 CN 8481 80 11	Mixing valves for sinks, wash basins, bidets, water cisterns etc. excluding valves for pressure-reducing or oleohydraulic/pneumatic power transmissions, check valves, safety/relief valves Mixing valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures
Prodcom 28.14.12.35 CN 8481 80 19	Taps, cocks and valves for sinks, wash basins, bidets, water cisterns etc. excluding valves for pressure-reducing/oleohydraulic transmissions, check, safety, relief and mixing valves Taps, cocks and valves for sinks, washbasins, bidets, water cisterns, baths and similar fixtures (excl. Mixing valves)

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[286] http://epp.eurostat.ec.europa.eu/portal/page/portal/nace_rev2/introduction

[287] http://epp.eurostat.ec.europa.eu/portal/page/portal/prodcom/introduction

[288] http://ec.europa.eu/taxation_customs/customs/customs_duties/tariff_aspects/combined_nomenclature/

Table A1.2 Classification and definitions applied to taps and showers according to international standards and stakeholders

Product	Nomenclature	Definition	Standard
Taps and faucets	Tap	Small diameter manually operated valve from which water is drawn	BS 6100-7[289]
	Faucet	Lavatory faucet, kitchen faucet, metering faucet, or replacement aerator for a lavatory or kitchen faucet	Energy Policy Act 1992[290]
	Spray tap	A tap supplied with water at a predetermined temperature which it delivers, at a restricted rate of flow, in the form of a spray	BS 5388:1976[291]
	Flow rate regulator	A device which is fitted on the nozzle outlet of a tap to enable its jet to be regulated. Flow regulators are also fitted alternatively to inlets of taps or valves or within showerheads	EN 246:2003[292]
	Flow-restrictor	That component of a spray tap, not being the spray outlet, which governs or restricts the rate of discharge	BS 5388:1976291
	Spray outlet	A fitting that is attached to the outlet of a tap and causes water passing through it to break up into a spray	BS 5388:1976291
	Dead-leg	A length of hot water pipe leading to a draw-off point and not forming part of a circuit	BS 5388:1976291
	Thermostatic mixing valve	Valve, with one or more outlets, which mixes hot and cold water and automatically controls the mixed water to a selected temperature. The flow rate between no flow and maximum flow conditions can be effected either by the same control device or a separate flow control device, where fitted.	EN 1111:1998[293]
Showers and showerheads	Shower	A showerhead through which water is intended to pass to form a spray for bathing purposes, which may include a fixed or pivot arm, a flexible hose (with or without a flow controller), tap top assemblies, or other components	AS/NZS 3662:2005[294]
	Shower outlet	Device for ablutionary purposes which allows water to be emitted in the form of jets or water droplets	EN 1112:2008[295] and EN 13904:2003[296]
	Showerhead	Fixed overhead shower outlets which direct water onto the user from above	EN 1112:2008[19] and EN 13904:2003[20]
		Any showerhead (including a handheld showerhead), except a safety shower showerhead	US Energy Policy Act 1992[297]
	Fixed showerhead	A fixed height outlet fitting through which water passes and is emitted as either a number of separate	BS 6340-4:1984[298]

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[289] BS 6100-7:2008. Building and civil engineering. Vocabulary. Services. British Standards Institution, London 2008

[290] https://www1.eere.energy.gov/femp/regulations/epact1992.html

[291] BS 5388:1976. Specification for spray taps. British Standards Institution, London 1976

[292] EN 246:2003. Sanitary tapware – General specifications for flow rate regulators. European Committee for Standardization, Brussels 2003

[293] EN 1111:1998. Sanitary tapware – Thermostatic mixing valves (PN 10) – General technical specification. European Committee for Standardization, Brussels 1998

[294] AS/NZS 3662:2005. Performance of showers for bathing. Standards Australia & Standards. New Zealand, Sydney/Wellington, 2005

[295] EN 1112:2008. Sanitary tapware – Shower outlets for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

[296] EN 13904:2003. Low resistance shower outlets for sanitary tapware. European Committee for Standardization, Brussels 2003

[297] https://www1.eere.energy.gov/femp/regulations/epact1992.html

Product	Nomenclature	Definition	Standard
		jets or as water droplets	
	Swivel showerhead	A fixed height outlet fitting through which water is emitted as either a number of separate jets or as water droplets. This showerhead incorporates a universal joint enabling it to be swivelled through a limited angular arc, thereby permitting the water spray trajectory to be adjusted	BS 6340-4:1984[298]
	Shower arm	Component which supports a showerhead and connects it to the water supply	EN 1112:2008[19] and EN 13904:2003[20]
		A pipe or casting which connects the concealed and/or exposed rigid riser to the showerhead	BS 6340-4:1984[298]
	Shower handset	Moveable hand held shower outlets which are connected to the sanitary tapware via a shower hose, complying with EN 1113[299]. They can be hung directly on the tapware or on the wall with the aid of an appropriate support	EN 1112:2008[19] and EN 13904:2003[20]
		A mobile showerhead with an integral handle which, when used in conjunction with a flexible hose, permits the user to direct the water trajectory as required	BS 6340-4:1984[298]
	Handset holder	A device for holding a shower handset in a fixed height position such that the hands of the user are free and that the water spray emitted can be used for ablutionary purposes. Some handset holders incorporate a degree of angular movement which enables the water spray trajectory to be adjusted	BS 6340-4:1984[298]
	Slide bar	A fixture mounted in the shower enclosure consisting of a vertically mounted tube or bar and a clampable handset holder which allows the height of a shower handset to be varied to the user's particular needs	BS 6340-4:1984[298]
	Spray plate	Device with orifices through which water passes and forms a spray of water with separate, definable jets or water droplets	EN 1112:2008[19] and EN 13904:2003[20]
		A plate containing holes or slots through which water passes and thereby forms a spray of water with separate, definable jets or water droplets	BS 6340-4:1984[298]
	Body showers	Shower outlets fixed to the vertical wall and direct water laterally onto the user	EN 1112:2008[19] and EN 13904:2003[20]
	Flexible hose	A flexible tube, which connects the outlet of the mixing valve to the shower handset	BS 6340-4:1984[298]
	Shower hose	A flexible supply pipe which connects sanitary tapware to a shower handset	EN 1113:2008[300]
	Rigid riser	A pipe connecting the outlet of the mixing valve to the shower arm or head	BS 6340-4:1984[298]

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[298] BS 6340-4:1984. Shower units – Part 4: Specifications for showerheads and related equipment. British Standards Institution, London 1984

[299] EN 1113:2008. Sanitary tapware – Shower hoses for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

[300] EN 1113:2008. Sanitary tapware – Shower hoses for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

Table A1.3 CEN technical committees and working groups in the areas of sanitary appliances, water supply, and waste water engineering

Technical committee		Working groups
163	Sanitary appliances	1 Terminology - Classification
		2 Materials - Testing
		3 Closet bowls, flushing cisterns, urinals, bidets and kitchen sinks
		4 Baths (W/Pools) - Shower trays (Performance testing)
164	Water supply	1 External systems and components
		2 Internal systems and components
		3 Effects of materials in contact with drinking water
		5 Concrete pipes
		8 Sanitary tapware
		9 Drinking water treatment
		10 Hot water and cold water storage within dwellings
		12 Flexible hoses assemblies
		13 Water conditioning equipment inside buildings
		14 Valves and fitting for buildings and devices to prevent pollution by backflow
		15 Security of drinking water supply
165	Waste water engineering	1 General requirements for pipes
		2 Vitrified clay pipes
		4 Covers, gratings, drainage channels and other ancillary components for use outside buildings
		7 Steel pipes
		8 Separators
		9 Concrete pipes
		10 Installation of buried pipes for gravity drain and sewer systems
		11 Gratings, covers and other ancillary components for use inside buildings
		12 Structural design of buried pipelines
		13 Renovation and repair of drains and sewers
		21 Drainage systems inside buildings
		22 Drainage outside buildings
		30 Terminology in the field of waste water engineering
		40 Waste water treatment plants > 50 PT
		41 Small type sewage treatment plants (< 50 inhabitants)

Table A1.4 CEN standards for taps and showers and product testing procedures

Standard	Title	Content and scope	Product test methods
EN 200:2008[301]	Sanitary tapware – Single taps and combination taps for water supply systems of type 1 and type 2 – General technical specification	Specifies the field of application for pillar taps, bib taps, single and multi-hole combination taps, for supply systems of types 1 and 2.[(a)] Specifies the dimensional, leak tightness, pressure resistance, hydraulic (flow rate), mechanical strength, endurance and acoustic characteristics of nominal size ½ and ¾ single taps and combination taps.	Leak tightness: test procedure described (different pressure exposure cycles are defined). Pressure resistance: test procedure described (different pressure regimes applied). Hydraulic characteristics: flow rate is determined at reference pressure (when tap is fully opened). Mechanical strength and endurance: test procedures described (e.g. 200 000 opening and closing cycles for taps). Acoustic characteristics: measurement according to EN ISO 3822 series[302,303,304,305]
EN 246:2003[306]	Sanitary tapware – General specifications for flow rate regulators	Applies to aerators intended to be mounted on tapware used with sanitary appliances. Specifies the dimensional, mechanical, hydraulic and acoustic characteristics with which aerators should comply.	Defines classes according to the flow rate of the aerator, the lower class (class Z) corresponds to a 9 l/min flow rate regulator (at 3 bar) while class D is for a flow rate of about 38 l/min. The standard also includes testing methods to evaluate jet formation and mechanical performance. Acoustic characteristics are measured according to EN ISO 3822-1[302] and 3822-4[305]
EN 248:2002[307]	Sanitary tapware – General specification for electrodeposited coatings of Ni-Cr	Specifies the condition of the exposed surfaces of tapware, the characteristics (resistance to corrosion, adherence) of the surface coating and the tests for verifying these characteristics. Applies to all sanitary fittings (supply or waste fittings) which have a metallic Ni-Cr coating.	Corrosion resistance: neutral saline-spray test according to ISO 9227[308]. Coating adherence: subjecting sample to a series of thermal shocks (temperature cycles are defined).

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[301] EN 200:2008. Sanitary tapware – Single taps and combination taps for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

[302] EN ISO 3822-1:1999(+A1:2008). Acoustics – Laboratory tests on noise emission from appliances and equipment used in water supply installations – Part 1: Method of measurement. International Organization for Standardization, Geneva 2008

[303] EN ISO 3822-2:1995. Acoustics – Laboratory tests on noise emission from appliances and equipment used in water supply installations – Part 2: Mounting and operating conditions for draw-off taps and mixing valves. International Organization for Standardization, Geneva 1995

[304] EN ISO 3822-3:1997. Acoustics – Laboratory tests on noise emission from appliances and equipment used in water supply installations – Part 3: Mounting and operating conditions for in-line valves and appliances. International Organization for Standardization, Geneva 1999

[305] EN ISO 3822-4:1997. Acoustics – Laboratory tests on noise emission from appliances and equipment used in water supply installations – Part 4: Mounting and operating conditions for special appliances. International Organization for Standardization, Geneva 199

[306] EN 246:2003. Sanitary tapware – General specifications for flow rate regulators. European Committee for Standardization, Brussels 2003

[307] EN 248:2002. Sanitary tapware – General specification for electrodeposited coatings of Ni-Cr. European Committee for Standardization, Brussels 2002

Standard	Title	Content and scope	Product test methods
EN 806-1:2000[309] EN 806-2:2005[310] EN 806-3:2006[311] EN 806-4:2010 EN 806-5:2012	Specifications for installations inside buildings conveying water for human consumption.	EN 806-1 specifies requirements and gives recommendations on the design, installation, alteration, testing, maintenance and operation of potable water installations within buildings. It covers pipes, fittings and connected appliances. En 806-2 gives recommendations, and specifies requirements, on the design of potable water installations within buildings. It applies to new installations, alterations and repairs. EN 806-3 describes a method to calculate the dimensioning of pipes for drinking water installations. EN 806-4/5 deal with installation and operation and maintenance	
EN 816:1997[312]	Sanitary tapware – Automatic shut-off valves PN 10	Applies to single and mixer taps with automatic shut-off for use with sanitary appliances installed in washrooms. Specifies the marking, identification, chemical/hygiene, dimensional, leak tightness, pressure resistance, hydraulic, mechanical endurance, and acoustical characteristics of automatic shut-off tapware	Includes test procedures for these characteristics: leak tightness, pressure resistance, hydraulic characteristics (e.g. flow rate, shape of flow, sensitivity of mixers), and mechanical endurance. Acoustic characteristics are measured according to EN ISO 3822-1[302] and 3822-2[303]
EN 817:2008[313]	Mechanical mixing valves (PN 10) - General technical specifications	Specifies dimensional, leak tightness, pressure resistance, hydraulic performance, mechanical strength, endurance and acoustic characteristics for mechanical mixing valves. Applies to PN 10 mechanical mixing valves for use with sanitary appliances installed in rooms used for bodily hygiene (cloakrooms, bathrooms, etc.) and in kitchens, i.e. for use with baths, wash basins, bidets, showers and sinks.	

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[308] ISO 9227:2012. Corrosion tests in artificial atmospheres - Salt spray tests. International Organization for Standardization, Geneve 2012

[309] EN 806-1:2000. Specifications for installations inside buildings conveying water for human consumption – Part 1: General. European Committee for Standardization, Brussels 2000

[310] EN 806-2:2005. Specifications for installations inside buildings conveying water for human consumption – Part 2: Design. European Committee for Standardization, Brussels 2005

[311] EN 806-3:2006. Specifications for installations inside buildings conveying water for human consumption – Part 3: Pipe sizing – Simplified method. European Committee for Standardization, Brussels 2006

[312] EN 816:1997. Sanitary tapware – Automatic shut-off valves PN 10. European Committee for Standardization, Brussels 1997

[313] EN 817:2008. Sanitary tapware – Mechanical mixing valves (PN 10). General technical specifications. European Committee for Standardization, Brussels 2008

Standard	Title	Content and scope	Product test methods
EN 1111:1998[314]	Sanitary tapware – Thermostatic mixing valves (PN 10) – General technical specification	Specifies the dimensional, leak tightness, pressure resistance, hydraulic performance, mechanical strength, endurance and acoustic characteristics for thermostatic mixing valves	Leak tightness: test procedures described for different parts of the mixing valve. Hydraulic characteristics: test procedures are included for flow rate, sensitivity, safety (cold water failure), and temperature stability. Mechanical strength and endurance testing procedures are described. Acoustic characteristics: measurement according to EN ISO 3822-1[302], 3822-2[303] and 3822-3[304]
EN 1112:2008[315]	Shower outlets for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification	Specifies the dimensional, leak tightness, mechanical, hydraulic and acoustic characteristics with which shower outlets shall comply.	Leak tightness: test procedure described (5 minutes at 0.5 or 0.2 MPa). Mechanical strength: test procedures described (applying a force of 60 N for 5 minutes). Thermal resistance: test procedure described (temperature cycles defined). Hydraulic characteristics: flow rate is determined at reference pressure. Acoustic characteristics are measured according to EN ISO 3822-1[302] and 3822-4[305]
EN 1113:2008[316]	Shower hoses for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification	Specifies the dimensional, leak tightness, mechanical, hydraulic and acoustic characteristics with which shower hoses shall comply.	Includes testing procedures for tensile strength (500 N longitudinal force for 5 minutes) and flexing durability. Testing leak tightness is included as well

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[314] EN 1111:1998. Sanitary tapware – Thermostatic mixing valves (PN 10) – General technical specification. European Committee for Standardization, Brussels 1998

[315] EN 1112:2008. Sanitary tapware – Shower outlets for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

[316] EN 1113:2008. Sanitary tapware – Shower hoses for sanitary tapware for water supply systems of type 1 and type 2 – General technical specification. European Committee for Standardization, Brussels 2008

Standard	Title	Content and scope	Product test methods
EN 1286:1999[317]	Sanitary tapware – Low pressure mechanical mixing valves - General technical specification	Specifies the dimensional, leak tightness, mechanical, and hydraulic characteristics with which low-pressure mechanical mixing valves shall comply.	A method for testing leak tightness is described for the different parts of the valve. The flow rate is determined at 0.01 MPa for different temperatures. Testing methods for mechanical endurance and performance under pressure are included.
EN 1287:1999[318]	Sanitary tapware – Low pressure thermostatic mixing valves - General technical specifications	Specifies the dimensional, leak tightness, mechanical, and hydraulic characteristics with which low-pressure thermostatic mixing valves shall comply.	A method for testing leak tightness is described for the different parts of the valve. The flow rate is determined at 0.01 MPa for different temperatures. Testing methods for mechanical endurance and performance under pressure are included.

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[317] EN 1286:1999. Sanitary tapware – Low pressure mechanical mixing valves – General technical specification. European Committee for Standardization, Brussels 1999

[318] EN 1287:1999. Sanitary tapware – Low pressure thermostatic mixing valves – General technical specification. European Committee for Standardization, Brussels 1999

Standard	Title	Content and scope	Product test methods
EN 3822-1:1999 (+A1:2008)[302] EN 3822-2:1995[303] EN 3822-3:1997[304] EN 3822-4:1997[305]	Acoustics – Laboratory tests on noise emission from appliances and equipment used in water supply installations Part 1: Method of measurement Part 2: Mounting and operating conditions for draw-off taps and mixing valves Part 3: Mounting and operating conditions for in-line valves and appliances Part 4: Mounting and operating conditions for special appliances	Allow laboratory measurement of the noise emitted by valves and hydraulic equipment used in water supply systems. Part 1 specifies the method of noise measurement. Items covered are: draw-off taps, in-line valves, and special appliances (e.g. pressure reducers). Part 2 specifies the mounting and operating conditions for draw-off taps and mixing valves when measuring noise emissions. It applies to all types of draw-off taps and mixing valves with a flow range between 0.1 MPa to 0.5 MPa. Part 3 specifies the mounting and operating conditions to be used for in-line valves and appliances which control the flow, pressure or temperature of the water in water supply installations. This part applies to in-line valves and appliances of maximum nominal size DN 32 and to systems with a maximum water flow rate of 2 L/s. Part 4 specifies the mounting and operating conditions for special appliances (e.g. showerheads, valves, water heating appliances) when measuring noise emissions from eater flow.	Part 1. Noise emission: test procedure described (e.g. definition of test room and water supply pipe). Water pressure (up to 0.5 MPa) and flow rate (up to 2 l/s) are defined. Part 2. Mounting (installation and connection) procedures are described. The noise emissions measurements are performed according to EN ISO 3822-1. Water temperature shall not exceed 25 °C. Test should be performed at 0.3 MPa and 0.5 MPa. Part 3. Mounting (installation and connection) procedures are described. The noise emissions measurements are performed according to EN ISO 3822-1. Water temperature shall not exceed 25 °C. Part 4. Mounting (installation and connection) procedures are described. The noise emissions measurements are performed according to EN ISO 3822-1. For showerheads, the noise emissions are measured at a water pressure of and 0.5 MPa
EN 12056-1;-2;-3;-4;-5	Gravity drainage systems inside buildings	Covers waste water drainage systems which operate under gravity. It is applicable for drainage systems inside dwellings, commercial, institutional and industrial buildings. This standard sets out principles to be followed for both layout and calculation. It makes limited provision for drainage systems conveying trade effluent and also makes limited provision for fluids removed by pumps.	

Standard	Title	Content and scope	Product test methods
EN 12541:2002	Sanitary tapware. Pressure flushing valves and automatic closing urinal valves PN 10		
EN 13618:2011	Flexible hose assemblies in drinking water installations. Functional requirements and test methods		
EN 14124:2004	Inlet valves for flushing cisterns with internal overflow		
EN 15091:2006[319]	Sanitary tapware – Electronic opening and closing sanitary tapware	Specifies the requirements for marking, identification, leak tightness, electrical and operational safety and mechanical resistance for sanitary tapware with opening and closing controlled electronically. The tapware has to comply with electrical safety standards (e.g. EN 60355-1, EN 61000-6-1). The standard does not cover flow and temperature regulation devices installed either upstream or downstream of the tapware.	
EN 16145	Extractable outlets for sink and basin mixers — General technical specification		

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[319] EN 15091:2006. Sanitary tapware – Electronic opening and closing sanitary tapware. European Committee for Standardization, Brussels 2006

Standard	Title	Content and scope	Product test methods
EN 16146:2013	Extractable shower hoses for sanitary tapware for supply systems type 1 and type 2 — General technical specification	Applies to hoses for extractable outlets of any material intended for equipping sanitary tapware for sinks and basins. Such hoses will only be connected downstream of the obturator of the tapware. The tapware will comply with EN 200, EN 817, EN 1111, EN 1286 or EN 1287. Hoses intended to connect sanitary tapware to the water supplies are not covered by this standard. Specifies: the dimensional, mechanical and hydraulic characteristics with which the hose for extractable outlets shall comply; the procedures for testing these characteristics.	
EN 60335-1	Household and Similar Electrical Appliances		
EN 60335-2-35	Household and Similar Electrical Appliances, Safety, Particular Requirements for Instantaneous Water heaters		

Table A1.5. Standards for taps and showers and product testing procedures at Member State and Third Country level

Country	Standards	Comments
Austria	ÖNORM EN 817; ÖNORM EN 1111; ÖNORM EN 246	Considering quality and longevity, tapware has to conform to the following standards: • Single-lever mixers have to comply with ÖNORM EN 817; • Thermo-mixers have to comply with ÖNORM EN 1111; • Aerators have to comply with ÖNORM EN 246.
Germany	DIN 1988-100;-200;-300;-8;-500;-600;-7	National standards, recommendations and guidelines have been developed in Germany by VDI (Association of German Engineers) and DVGW (German Technical and Scientific Association for Gas and Water).
Sweden	SS 82000:2010[320] Sanitary tapware – Method for determination of energy efficiency of mechanical basin and sink mixing valves SS820001:2011 Sanitary tapware – Method for determination of energy efficiency of thermostatic mixing valves with shower	Standard methods for determining the energy efficiency of mechanical mixing valves and thermostatic mixing taps with showerheads are applied in Sweden (SS 820000:2010 and SS820001:2011). Both standards describe a series of activity tests in which the consumption and temperature of warm, cold and mixed water are measured over a fixed time with different device settings. The activities are chosen to simulate different moments in normal daily use. In one of the activities a dirty test dishcloth is rinsed with different settings. Based on the measured time, water consumption and temperature, the energy usage for each activity is calculated. The energy use of the tap or water device is calculated by summing the energy use for each activity.
UK	BS 417-2:1987 Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders. Metric units. Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders. Metric units	

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[320] SS 82000:2010. Sanitary tapware - Method for determination of energy efficiency of mechanical basin and sink mixing valves. Swedish Standards Institute, Stockholm 2010

Country	Standards	Comments
UK	BS 1212-1:1990 Float operated valves. Specification for piston type float operated valves (copper alloy body) (excluding floats) BS 1212-2:1990 Float operated valves. Specification for diaphragm type float operated valves (copper alloy body) (excluding floats) BS 1212-3:1990 Float operated valves. Specification for diaphragm type float operated valves (plastics bodied) for cold water services only (excluding floats) BS 1212-4:1991 Float operated valves. Specification for compact type float operated valves for WC flushing cisterns (including floats)	
UK	BS 1566-2:1984 Copper indirect cylinders for domestic purposes. Specification for single feed indirect cylinders	
UK	BS 1968:1953 Specification for floats for ballvalves (copper)	
UK	BS 2456:1990 Specification for floats (plastics) for float operated valves for cold water services	
UK	BS 2879:1980 Specification for draining taps (screw-down pattern)	
UK	BS 3198:1981 Specification for copper hot water storage combination units for domestic purposes	
UK	BS 5388:1976[321] Specification for spray taps	Specifies the requirements for the materials, design, construction, dimensions and testing of two forms of spray taps: pillar spray taps and bib spray taps. Includes testing specification for flow rate and spray form (divergence). Includes requirements for maximum flow rate and spray form (divergence).
UK	BS 5412:1996 Specification for low-resistance single taps and combination tap assemblies (nominal size 1/2 and 3/4) suitable for operation at PN 10 max. and a minimum flow pressure of 0.01 MPa (0.1 bar)	

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[321] BS 5388:1976. Specification for spray taps. British Standards Institution, London 1976

Country	Standards	Comments
UK	BS 5433:1976 Specification for underground stop valves for water services	
UK	BS 5779:1979 Specification for spray mixing taps	
UK	BS 5834-1:2009 Surface boxes, guards and underground chambers for the purposes of utilities. Specification for guards and plinths BS 5834-2:2011 Surface boxes, guards and underground chambers for the purposes of utilities. Specification for surfaces boxes BS 5834-4:2011 Surface boxes, guards and underground chambers for the purposes of utilities. Specification for utility chambers	
UK	BS 6100-7:2008 [322] Building and civil engineering. Vocabulary. Services	
UK	BS 6280:1982 Method of vacuum (backsiphonage) test for water-using appliances	
UK	BS 6283-2:1991 Safety and control devices for use in hot water systems. Specifications for temperature relief valves for pressures from 1 bar to 10 bar	
UK	BS 6340-4:1984[323] Shower units – Part 4: Specifications for showerheads and related equipment	Specifies the requirements for the materials, dimensions and functional testing of domestic showerheads and related equipment. Includes testing specification for spray pattern/form and spray trajectory.
UK	BS 6456-1:2006 Sanitary Installations – Part 1: Code of practice for the design of sanitary facilities and scale of provision of sanitary and associated appliances	
UK	BS 6675:1986 Specification for servicing valves (copper alloy) for water services	
UK	BS 7181:1989 Specification for storage cisterns up to 500 L actual capacity for water supply for domestic purposes	

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[322] BS 6100-7:2008. Building and civil engineering. Vocabulary. Services. British Standards Institution, London 2008

[323] BS 6340-4:1984. Shower units – Part 4: Specifications for showerheads and related equipment. British Standards Institution, London 1984.

Country	Standards	Comments
UK	BS 7942:2011 Thermostatic mixing valves for use in care establishments. Requirements and test methods	Specifies performance and material requirements for thermostatic mixing valves for use in care establishments. The standard includes testing specifications for leaktightness, durability, and performance (e.g. flow rate, temperature sensitivity, thermal shut-off, temperature stability).
UK	BS 8000-15:1990 Workmanship on building sites. Code of practice for hot and cold water services (domestic scale)	
UK	BS 8427:2004 Jug water filter systems. Specification	
UK	BS 8542:2011 Calculating domestic water consumption in non-domestic buildings. Code of practice	
Australia and New Zealand	AS/NZS 3662:2005[324] Performance of showers for bathing	Specifies requirements for the performance of showers for bathing. Applies to showerheads fastened to fixed arms and pivotal arms as well as to hand-held showers. Performance requirements include flow rate, spread angle, temperature drop. Test methods are provided for the measurement of flow rate, mean spray spread angle, temperature drop, integrity of shower hoses (tensile strength and water tightness, temperature resistance, thermal shock resistance, effectiveness of rotary connection), endurance testing of flow controllers.
Australia and New Zealand	AS/NZS 3718:2005[325] Water supply – Tap ware	Specifies requirements for metallic taps, plastic taps, mixing taps, sensor taps, lever taps, timed flow taps, mixing taps mechanical (non-thermostatic), and tap sets. Includes performance requirements concerning e.g. hydraulic strength, water tightness, endurance. Test methods are provided for parameters such as resistance to chemical degradation (for plastic-bodies taps), hydraulic strength, determination of watertightness, determination of flow rate, torque testing, endurance.

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[324] AS/NZS 3662:2005. Performance of showers for bathing. Standards Australia & Standards New Zealand, Sydney/Wellington, 2005

[325] AS/NZS 3718:2005. Water Supply – Tap Ware. Standards Australia & Standards New Zealand, Sydney/Wellington, 2005

Country	Standards	Comments
Australia and New Zealand	AS/NZS 6400:2005[326] Water efficient products – Rating and labelling	Specifies requirements for the rating of products for water efficiency, and includes the associated registration, labelling and, where applicable, minimum performance requirements. Applies to showers, dishwashers, clothes washing machines, lavatory equipment, urinal equipment, tap equipment, and flow controllers. Is the basis for the rating and labelling of a range of products under the Australian WELS scheme. Product testing is performed according to other standards (e.g. AS/NZS 3662:2005 or AS/NZS 3718:2005)
Honk Kong	AS/NZS 3662:2005[327]	Used in Hong Kong's WELS for water flow rates of showerheads
Singapore	SS 448-3:1998 BS 5412:1996 (replaced by EN 200:2008) N 817:2008[328] AS/NZS 3662:2005[327]	Test standards applied in Singapore are developed internally or are adopted from other countries[329]: • For taps, either SS 448-3:1998 (very similar to EN 200:2008) or BS 5412:1996 (replaced by EN 200:2008) apply. • For mixers, N 817:2008[330] applies. • AS/NZS 3662:2005[327] is the reference for water flow rates of showerheads.
South Korea	KS B 2331:2009	Korean test standards related to taps and showerheads are specified in the Korean eco-label legislation. Only one standard for taps has been found (KS B 2331:2009). Korean standards for showers have not been identified.
Switzerland		Most EN standards apply, too. In addition, the SIA (Swiss society of engineers and architects) has issued guidelines for efficient water use in buildings.

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[326] AS/NZS 6400:2005. Water efficient products – Rating and labelling. Standards Australia & Standards New Zealand, Sydney/Wellington, 2005

[327] AS/NZS 3662:2005. Performance of showers for bathing. Standards Australia & Standards New Zealand, Sydney/Wellington, 2005

[328] EN 817:2008. Sanitary tapware – Mechanical mixing valves (PN 10). General technical specifications. European Committee for Standardization, Brussels 2008

[329] Public Utilities Board: Water Efficiency Labelling Scheme (voluntary & mandatory). PUB. Republic of Singapore. 2009. Available at: http://www.pub.gov.sg/wels/rating/Documents/WELS_Guidebook.pdf

[330] EN 817:2008. Sanitary tapware – Mechanical mixing valves (PN 10). General technical specifications. European Committee for Standardization, Brussels 2008

Table A1.6 Mandatory, voluntary legislation and labelling covering taps and showers in EU Member States

Country	Scheme	Type	Comments
EU level	EU Ecolabel of sanitary tapware	Voluntary	
Austria	Ecolabel for water efficient sanitary tapware[331]	Voluntary	Maximum flow rate: 6 L/min for bathroom/toilet taps 9 L/min for kitchen taps 12 L/min for bathtub taps and showerheads Presence of water flow barrier (preset at 60% of the maximum flow rate) and hot water barrier.
	Ecolabel for tourist accommodation services	Voluntary	Maximum flow rate: 12 L/min for taps and showerheads Maximum average flow rate: 8.5 L/min for taps and showerheads Water temperature and flow rate control for at least 80 % of taps Kitchen taps and taps and showers used in common areas equipped with time control devices
	Ecolabel for campsites	Voluntary	Maximum flow rate: 10 L/min for taps and showerheads Maximum average flow rate: 8 L/min for taps and showerheads Kitchen taps equipped with time control devices
Czech Republic	Ecolabel for tourist accommodation services and campsites[332]	Voluntary	Maximum flow rate for campsites: 9 L/min for taps and showerheads Maximum flow rate for tourist accommodation services: 8 L/min for taps and showerheads

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[331] http://www.umweltzeichen.at

[332] http://www.ekoznacka.cz

Country	**Scheme**	**Type**	**Comments**
France	Marque NF	Voluntary	Products are tested and ranked according to nominal flow rate and some technical features such as flow and temperature management
Germany	Blue Angel: RAL-UZ 158 - Sanitary Tapware and RAL-UZ 180 - Energy-Efficient and Water-Saving Hand-Held and Overhead Showerheads[333] [334]	Voluntary	
	WELL , Water Efficiency Label from EUnited Valves	Voluntary	Classification systems (A to D) based on water flow and temperature control.
Italy	Legislation for reduction of water consumption applied in some municipalities, e.g. Avigliana (Piedmont district)[335] and Sassari (Sardinia)[336].	Mandatory	Maximum flow rates equal to 8-12 L/min in Avigliana for all bathroom and shower taps with the exception of bathtub taps. Mandatory installation of aerators in all bathrooms and kitchen taps (with the exception of bathtub taps) in Sassari in order to reduce the maximum water flow to 8 L/min.
Latvia	Green Certificate for accommodation services[337] [338]	Voluntary	Maximum flow rate for taps: 8 L/min Maximum flow rate for showerheads: 10 L/min Taps must not have any leaks. Taps and showerheads are equipped with water flow control devices.
Luxembourg	Ecolabel for tourist accommodation services[339]	Voluntary	Maximum flow rate for taps:10 L/min Maximum flow rate for showerheads: 12 L/min

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[333] http://www.blauer-engel.de/en/products_brands/vergabegrundlage.php?id=220

[334] http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=707

[335] Città di Avigliana: Regolamento Edilizio. Testo Integrato cos'i come emendato in C.C. del 10 Aprile 2007. Allegato energetico – ambientale al Regolamento Edilizio della città di Avigliana. Available at: http://www.comune.avigliana.to.it/comune/risorse/regolamenti/area_ed_priv/ALLEGATOENERGETICO.pdf

[336] Città di Sassari: Regolamento energetico – ambientale 2008. Available at: http://www.comune.sassari.it/comune/regolamenti/energetico_ambientale.htm

[337] http://www.celotajs.lv/cont/prof/quality/certificates_en.html.

[338] http://www.celotajs.lv/Hotel/.

[339] See http://www.oeko.lu/index.php?idusergroup=12 for more information.

Country	Scheme	Type	Comments
			Taps must be single-lever taps
Nordic Countries (Denmark, Finland, Iceland, Norway, Sweden)	Nordic Swan for restaurants[340]	Voluntary	Rinsing taps equipped with dead man's handle to shut off when the lever is released or sensor controlled
	Nordic Swan for hotels and youth hostels[341]	Voluntary	Water flow lower than 8L/min for 90% of mixer taps for wash basins Water flow lower than 10L/min for 90% of showerheads of guest rooms 90% of mixer taps must be single-lever taps or sensor-equipped
Portugal	General Regulation for Water and Drainage of Residual Waters in Public and Residential Building Systems[342]		Establishes requirements for the design of water supply systems
	ANQIP (National Association for Quality in Building Installations) water efficiency labelling scheme[343] [344]	Voluntary	Criteria for showers and shower systems, bathroom taps and kitchen taps Classification system (A++ to E), different criteria for kitchen taps, bathroom taps, and showerheads Water efficiency of products is rated from E (lowest performance) to A++ (highest performance).
Slovakia	Ecolabel for accommodation services[345][346]	Voluntary	Maximum flow rate of 12 L/min for taps and showerheads Average flow from taps and showerheads excluding bath taps must not exceed 8.5 L/min Temperature control for at least 80% of taps Showers should be equipped with an automatic system to stop the water flow automatically when

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[340] http://www.svanen.nu/sismabmodules/criteria/getfile.aspx?fileid=102149001

[341] http://www.svanen.nu/sismabmodules/criteria/getfile.aspx?fileid=102149001

[342] Regulamento Geral dos Sistemas Públicos e Prediais de Distribuição de Água e de Drenagem de Águas Residuais. Decreto Regulamentar nº 23/95 de 23-08-1995. Diário da República nº 194 Série I Parte B de 23/08/1995, Lisboa. Available at: http://dre.pt/pdfgratis/1995/08/194B00.pdf

[343] Silva-Afonso A & Pimentel-Rodrigues C: Water efficiency of products. The Portuguese system of certification and labelling. Coimbra 2010

[344] http://www.anqip.pt/

[345] http://www.enviro.gov.sk/

[346] http://www.sazp.sk/public/index/open_file.php?file=CEM/EVP/RegisterOznameni/Oznamenie_c01-08.doc

Country	Scheme	Type	Comments
			not in use.
Spain	Spanish national building codes (Código Técnico de Edificación) of March 2006[347]	Mandatory	Water-saving measures[348]: Water meters for both cold and hot water; Return tube in the domestic hot sanitary water piping when distance between boiler and farthest final discharge point is more than 15 m; Water-saving devices In buildings with access for the public.
	Regulations at regional and/or local level exist, e.g. Catalonia[349], Madrid[350], San Cristóbal de Segovia[351]. A list of other Spanish municipalities or autonomous communities which have legislation in place to save water is available [352].		In general, in public buildings, taps must be equipped with timers or other devices to stop the water flow automatically. In some regions, the same also applies to public showers. In new or reformed buildings of Catalonia, water-using products (taps, showerheads, bidets, wash basins, sinks, and toilets) have to include devices that allow for water saving. In Madrid, the maximum water flow rate for taps and showers for new buildings is 10 L/min. In San Cristóbal de Segovia, new buildings should have only single-lever mixers equipped with aerators or other water-saving devices that allow for a maximum flow rate of 8 L/min only. For showers, a maximum water flow of 10 l/min is allowed.

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347 Ministerio de Vivienda: Real Decreto 314/2006, de 17 de marzo, por el que se aprueba el Código Técnico de la Edificación. Boletín Oficial del Estado 74 (2006) 11816-11831. Available at: http://www.boe.es/boe/dias/2006/03/28/pdfs/A11816-11831.pdf

348 Ministerio de la Vivienda: El Código Técnico de la Edificación. Documento Básico HS. Salubridad. 2009. Available at: http://www.codigotecnico.org/fileadmin/Ficheros_CTE/Documentos/CTEabr09/DB%20HS%20abril%202009.pdf

349 Decreto 202/1998, de 30 de julio, por el que se establecen medidas de fomento para el ahorro de agua en determinados edificios y viviendas. Diari Oficial de la Generalitat de Catalunya 2697 (1998) 10052. Available at:
http://mediambient.gencat.net/binLegis/983829e.pdf

350 Ordenanza de Gestión y Uso Eficiente del Agua en la Ciudad de Madrid. Boletín oficial del Ayuntamiento de Madrid 5709 (2006) 2410-2443. Available at:
http://www.munimadrid.es/UnidadesDescentralizadas/UDCBOAM/Contenidos/Boletin/2006/Ficheros/22062006.pdf

351 Ordenanza municipal para el ahorro en el consumo de agua en San Cristóbal de Segovia. Boletín oficial de la provincia de Segovia 20 (2005). Available at: http://www.dipsegovia.es/uploads/bops/N20_160205.pdf

352 Ecología y Desarrollo: Lo público debe ser ejemplar. Ecología y Desarrollo, Zaragoza 2009. Available at: http://www.agua-dulce.org/htm/legislacion/legislacion_efic_espana_1.asp

Country	Scheme	Type	Comments
	Distintiu de Garantia de Qualitat Ambiental (emblem of guarantee of environmental quality) of Catalonia for water-saving products[353] [354]	Voluntary	Maximum flow rate: 8 L/min for taps 10 L/min for showers Same criteria for accommodation services[355] [356] [357] [358] and office buildings[359]. For public offices: 50 % of the basin taps with a flow rate lower than 12 L/min, additional points for taps which use less than 8 L/min[360].
Sweden	Building regulations[361]	Mandatory	Design of water pipes and placement of water heaters in such a way that "hot tap water can be obtained within approximately 10 seconds with a flow of 0.2 L/s" (12 L/min).
	Swedish Standard 820000:2010[362]	Voluntary	Includes a testing scheme for a proposed energy labelling of taps. An energy certification scheme

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[353] Resolució de 15 de gener de 2001, per la qual s'estableixen els criteris mediambientals per a l'atorgament del distintiu de garantia de qualitat ambiental als productes i als sistemes que afavoreixen l'estalvi d'aigua. Diari Oficial de la Generalitat de Catalunya 3321 (2001). Available at: http://mediambient.gencat.net/cat/el_departament/actuacions_i_serveis/legislacio/ecoprod/resoluci__15_01_2001.jsp?ComponentID=2307&SourcePageID=3872[

[354] Resolución MAH/2407/2009, de 29 de abril, por la que se establecen los criterios ambientales para el otorgamiento del distintivo de garantía de calidad ambiental a los productos y a los sistemas que favorecen el ahorro de agua. Diari Oficial de la Generalitat de Catalunya 5460 (2009) 66627-66632. Available at: http://www.mediambient.gencat.cat/cat/empreses/ecoproductes_i_ecoserveis/pdf/criteris_ambientals/cast/040.pdf

[355] Resolución MAH/1239/2007, de 11 abril, por la que se establecen los criterios ambientales para el otorgamiento del distintivo de garantía de calidad ambiental en los campings. Diari Oficial de la Generalitat de Catalunya 4876 (2007) 15654-15657. Available at: http://www.mediambient.gencat.cat/cat/empreses/ecoproductes_i_ecoserveis/pdf/criteris_ambientals/cast/090.pdf

[356] Resolución MAH/4041/2007, de 30 de noviembre, por la que se establecen los criterios ambientales para el otorgamiento del distintivo de garantía de calidad ambiental a los establecimientos hoteleros. Diari Oficial de la Generalitat de Catalunya 5053 (2008) 5558-5570. Available at: http://www.mediambient.gencat.cat/cat/empreses/ecoproductes_i_ecoserveis/pdf/criteris_ambientals/cast/140.pdf

[357] Resolución MAH/2107/2009, de 29 de abril, por la que se establecen los criterios ambientales para el otorgamiento del distintivo de garantía de calidad ambiental a las instalaciones juveniles. Diari Oficial de la Generalitat de Catalunya 5429 (2009) 59273-59285. Available at: http://www.mediambient.gencat.cat/cat/empreses/ecoproductes_i_ecoserveis/pdf/criteris_ambientals/cast/130.pdf

[358] Resolución MAH/2151/2009, de 15 de julio, por la que se establecen los criterios ambientales para el otorgamiento del distintivo de garantía de calidad ambiental en los establecimientos de turismo rural. Diari Oficial de la Generalitat de Catalunya 5431 (2009) 60093-60103. Available at: http://www.mediambient.gencat.cat/cat/empreses/ecoproductes_i_ecoserveis/pdf/criteris_ambientals/cast/160.pdf

[359] Resolución MAH/1390/2006, de 24 de abril, por la que se establecen los criterios ambientales para el otorgamiento del distintivo de garantía de calidad ambiental a los edificios de uso de oficinas. Diari Oficial de la Generalitat de Catalunya 4632 (2006) 21411-21415. Available at: http://www.mediambient.gencat.cat/cat/empreses/ecoproductes_i_ecoserveis/pdf/criteris_ambientals/cast/250.pdf

[360] Resolución MAH/1389/2006, de 27 de abril, por la que se establecen los criterios ambientales para el otorgamiento del distintivo de garantía de calidad ambiental a las redes de oficinas con atención al público. Diari Oficial de la Generalitat de Catalunya 4632 (2006) 21408-21411. Available at: http://www.mediambient.gencat.cat/cat/empreses/ecoproductes_i_ecoserveis/pdf/criteris_ambientals/cast/240.pdf

[361] Building Regulations. Mandatory provisions and general recommendations. Section 6 Hygiene, health and the environment. Swedish Board of Housing, Building and Planning, 2006. Available at: http://www.boverket.se/Global/Webbokhandel/Dokument/2008/BBR_English/6_Hygiene_health_and_the_environment.pdf

[362] SS 82000:2010. Sanitary tapware - Method for determination of energy efficiency of mechanical basin and sink mixing valves. Swedish Standards Institute, Stockholm 2010

Country	Scheme	Type	Comments
			based on the standard was proposed[363].
United Kingdom	Building Regulations[364]	Mandatory	Applies to building works (e.g. construction or renovation of buildings). Requirements for structure, fire safety, ventilation, electrical safety, etc. are set. Part G on hygiene sets minimum requirements concerning the equipment of bathrooms with sanitary fixtures and cleaning devices (e.g. rooms containing water closets should be equipped with washbasins).
	The Water Supply (Water Fittings) Regulations 1999[365].	Mandatory	Applies to all water fittings installed or used. Sets minimum standards for the water use of WCs, washing machines, dishwashers, and washer driers. Requires that no water fitting is installed that is likely to cause waste of water. No specific definition or flow rate requirements are given. Total water use limited to 80-120 l/min and person.

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[363] Wahlström Å: Test methods and scheme rules for energy labelling of tap water devices. ECEEE 2009 Summer Study, 1-6 June 2009, La Colle sur Loup, France. Available at: http://www.energy-management.se/attachments/documents/40/4033_wahlstrom.pdf

[364] Statutory Instrument 2000 No. 2531. The Building Regulations 2000. Office of Public Sector Information, London. Available at: http://www.opsi.gov.uk/si/si2000/uksi_20002531_en.pdf

[365] The Water Supply (Water Fittings) Regulations 1999. Statutory Instrument 1999 No. 1148. Available at: http://www.opsi.gov.uk/si/si1999/19991148.htm

Country	**Scheme**	**Type**	**Comments**
	Code for Sustainable Homes [366]	Voluntary	Rates the sustainability of a house. Criteria include minimum standards for energy and water use in all new builds. The water consumption per person and day is rated and limited to 80 to 125 L per person and day depending on efficiency level [367]. Water use of the building has to be assessed using the water efficiency calculator[368].
UK and rest of Europe	Bathroom Manufacturers Association of the United Kingdom's water labelling scheme[369] [370]	Voluntary	Now referred to as the European Water Label[371], it applies to a whole range of water-using (and -delivering) products. To date the scheme covers about 6500 and more products across 32 EU, EFTA and surrounding countries. 12 categories are covered including taps, showers and handsets. Products ranked in 5 classes based on their water flow (0-6 L/min; 6-8 L/min; 8-10 L/min; 10-13 L/min; >13 L/min)

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[366] Department for Communities and Local Government: The Code for Sustainable Homes. Setting the standard in sustainability for new homes. February 2008. Department for Communities and Local Government, London 2008. Available at: http://www.communities.gov.uk/documents/planningandbuilding/pdf/codesustainhomesstandard.pdf

[367] Department for Communities and Local Government: Code for Sustainable Homes. Technical Guide. May 2009. Version 2. Department for Communities and Local Government, London 2009. Available at: http://www.planningportal.gov.uk/uploads/code_for_sustainable_homes_techguide.pdf

[368] Department for Communities and Local Government: The Water Efficiency Calculator for new dwellings. The Government's national calculation methodology for assessing water efficiency in new dwellings in support of: The Code for Sustainable Homes, May 2009 and subsequent versions; The Building Regulations 2000 (as amended); The Building (Approved Inspector etc) Regulations 2000 (as amended). Department for Communities and Local Government, London 2009. Available at: http://www.planningportal.gov.uk/uploads/br/water_efficiency_calculator.pdf

[369] See http://www.water-efficiencylabel.org.uk/.

[370] As of 18 February 2010.

[371] http://www.europeanwaterlabel.eu/

Table A1.7 Mandatory, voluntary legislation and labelling covering taps and showers in Third Countries

Country	Scheme	Type	Comments
Australia	Water Efficiency Labelling and Standards (WELS) scheme[372]	Mandatory	Rating criteria for water efficiency based on the Australian and New Zealand standard AS/NZS 6400:2005
Canada	BuiltGreen programme for the certification of green buildings[373] [374] Depending on the rating achieved, the label is awarded in a bronze, silver, gold, or platinum version.	Voluntary	Kitchen Taps: < 6 L/min and hand-free control Bathroom Taps: < 4 L/min Showerheads: < 7.5 L/min
	British Columbia's Building Codes[375] [376].	Mandatory	Taps: < 8.3 L/min Showerheads < 9.5 L/min
China	Water conservation certification scheme for several water products (including taps, showerheads and showers) [377]	Voluntary	
Hong Kong	WELS Hong Kong based on AS/NZS 3662:2005[378] [379] [380]	Voluntary	Between: < 9 L/min (grade 1) to > 16 L/min (grade 4)
Japan	Ecomark Japan[381]	Voluntary	Water-saving top (or tap equipped with water-saving top): discharge rate 70 % when handle is fully opened; Flow-control valve (or faucet with built-in flow control valve): 5-8 L/min when handle is fully opened;

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[372] Water Efficiency Labelling and Standards Act 2005. No. 4/2005. An Act to provide for water efficiency labelling and the making of water efficiency standards, and for related purposes. Available at: http://www.comlaw.gov.au/ComLaw/Legislation/Act1.nsf/0/B0C04F6D12927C49CA256FB000131478/$file/004-2005.pdf

[373] See http://www.builtgreencanada.ca/ for more information.

374 BuiltGreen: BuiltGreen Checklist. Effective April 1, 2010. Built Green, Edmonton 2010. Available at: http://builtgreencanada.ca/uploads/files/2010_Built_Green_Checklist_-_For_Release_V2010-3.xls

[375] See http://www.housing.gov.bc.ca/building/green/.

[376] Webb C: Changes to the Building Code, Effective September 5, 2008. Ministry for Housing and Social Development, Building and Safety Standards Branch, Victoria 2008.Available at: http://www.housing.gov.bc.ca/building/docs/TextofCodechanges.pdf

[377] See http://www.cecp.org.cn/former/englishhtml/products.asp#ewater.

378 Water Supplies Department: Water Supplies Department launches Voluntary Water Efficiency Labelling Scheme. Press release 10 September 2009. Water Supplies Department, Hong Kong 2009. Available at: http://www.info.gov.hk/gia/general/200909/10/P200909100158.htm

[379] See http://www.wsd.gov.hk/en/plumbing_and_engineering/wels/introduction_to_wels/index.html.

380 Water Supplies Department: The Hong Kong Voluntary Water Efficiency Labelling Scheme on Showers for Bathing. Water Supplies Department, Hong Kong 2009. Available at: http://www.puntofocal.gov.ar/notific_otros_miembros/hkg32_t.pdf

381 Japan Environment Association: Eco Mark Product Category No.116 “Water-saving Equipment Version 2.2”. Japan Environment Association, Eco Mark Office, Tokyo 2006. Available at: http://www.ecomark.jp/english/pdf/116eC22.pdf

			Aerator cap: 80 % of water flow compared to w/o cap; minimum water flow rate not below 5 L/min; Flow control valve: 80 % of water flow compared to w/o flow control valve; minimum water flow rates not below 5 L/min and 8 L/min (kitchen and bathroom taps and shower rooms, respectively). Taps: feature devices for control of discharge and temperature Showerheads: feature devices for temporarily switch off the water flow
New Zealand	WELS New Zealand (proposed) [382] for washing machines, dishwashers, toilets, showers, tap equipment and urinal equipment[383].	Mandatory	Showers: From 7.5 - 9 l/min (3 stars) to > 16 l/min (0 stars) Taps: From < 4.5 l/min (6 stars) to > 16 l/min (0 stars)
Singapore	WELS Singapore[384] [385] [386]	Mandatory for taps and mixers, voluntary for other products (750 shower taps and mixers, 1297 basin taps and mixers, 1423 sink taps and mixers and 209 showerheads have been labelled[387])	Showerheads: < 5 l/min (excellent) to 7-9 l/min (good) Shower taps and mixers: > 9 l/min (zero) to < 5 l/min (excellent) Basin taps and mixers: > 6 l/min (zero) to < 2 l/min (excellent) Sink taps and mixers: > 8 l/min (zero) to < 4 l/min (excellent)

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[382] See http://www.mfe.govt.nz/issues/water/wels-scheme.html for more information.

[383] Ministry of Consumer Affairs: Proposed Implementation of Mandatory Water Efficiency Labelling. Discussion document for consultation under the Fair Trading Act 1986. Ministry of Consumer Affairs, Wellington 2007. Available at: http://www.consumeraffairs.govt.nz/policylawresearch/water-eff-label/discussion-document/dp-wel.pdf

[384] See http://www.pub.gov.sg/wels/Pages/default.aspx for more information.

[385] Public Utilities Act (Chapter 261). Public utilities (water supply) (amendment) Regulations 2008. Government Gazette (Electronic Edition) S703/2008. Available at: http://www.pub.gov.sg/wels/links/Documents/MWELS%20Regulations_31Dec08.pdf

[386] Public Utilities Board: Water Efficiency Labelling Scheme (voluntary & mandatory). PUB. Republic of Singapore. 2009. Available at: http://www.pub.gov.sg/wels/rating/Documents/WELS_Guidebook.pdf

[387] As of 18 February 2010. The list of all products is at: http://www.pub.gov.sg/wels/products/Pages/default.aspx.

South Korea	Ecolabel for different water-using products, including faucets, showerheads, toilets, thermostatic valves [388] [389] [390]	Voluntary	Taps: < 9 l/min for kitchen taps, < 7.5 l/min for sink taps, < 9.5 l/min for other taps Showerheads: < 9.5 l/min Thermostatic valves: < 3.5 W in operate mode
Switzerland	Swiss energy label for sanitary tapware[391] including showerheads, taps and water-saving equipment[392].	Voluntary (about 530 products were awarded the label[393])	Showerheads: < 12 l/min Single-lever mixers: < 9 l/min for sink/washbasin and bidet mixers, < 12 l/min for shower mixers Thermostatic mixers: < 9 l/min for washbasin and < 12 l/min for shower mixers Shut-off valves: Have to be equipped with automatic shut-off device Flow rate regulators: < 9 l/min for washbasin and < 12 l/min for shower
Taiwan	Greenmark Taiwan for different water-using products, including water-saving faucets/devices[394]	Voluntary	Taps < 9 l/min Water-saving devices for taps < 9 l/min
Thailand	Ecolabel Thailand for different water using products,	Voluntary (14 products in the product group of faucets and showerheads have	Manual taps

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[388] See http://www.koeco.or.kr/eng/business/business01_03.asp?search=1_3 for the full list of covered products.

[389] Korea Eco-Label: EL221. Water-saving Faucets [EL221-1992/5/2004-58]. Available at: http://www.koeco.or.kr/eng/business/cover_document/EL221.pdf

[390] Korea Eco-Label: EL222. Water-saving Showerheads or Faucet Appendages [EL222-2000/2/2002-96]. Available at: http://www.koeco.or.kr/eng/business/cover_document/EL222.pdf

[391] See http://www.gealabel.org/home.htm.

[392] Reglement zur Kennzeichnung energiesparender Warmwasser-Komponenten. Referenz: WW-CH0600. EnergieSchweiz, 2002. Available at: http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=de&name=de_542721262.pdf

[393] SVGW: Marktüberwachung Energy-Label – Expertise. Schweizerischer Verein des Gas- und Wasserfaches SVGW, Zurich 2007. Available at: http://www.bfe.admin.ch/energielabel/index.html?lang=de&dossier_id=02108

[394] See full list of product groups at: http://greenliving.epa.gov.tw/GreenLife/greenlife-v2/E_Criteria.aspx.

	including faucets and sanitary accessories[395] [396].	been awarded the ecolabel[397])	< 6 l/min Automatic taps < 5 l/min Showerheads < 5 l/min
United States	Energy Policy Act 1992[398] [399].	Mandatory	Showerheads < 9.5 l/min at 0.55 MPa Faucets and aerators < 9.5 l/min at 0.55 MPa Metering faucets < 1 l per cycle
	EPA WaterSense scheme[400] for bathroom taps[401] and showerheads with a maximum flow rate of 2 gallons per minute (about 7.6 l/min) at 20, 45 and 80 psi[402] [403].	Mandatory in some of the States of USA	Bathroom taps < 5.7 l/min at 60 psi Showerheads < 7.6 l/min at 20, 45, and 80 psi Spray force > 0.56 N at 20 psi
	Californian CalGreen program[404]	Mandatory	Residential measures for lowering the flow rates of kitchen taps

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[395] See http://www.tei.or.th/greenlabel/ for more information.

[396] Thailand Environment Institute: TGL-11-R1-03. Faucets and Sanitary Accessories. Office of The Green Label Secretariat, Thailand Environment Institute (TEI), Nonthaburi 2003. Available at: http://www.tei.or.th/greenlabel/Eng%20PDF/Tgl-11-R1-03.pdf

[397] As of March 2009 (http://www.tei.or.th/greenlabel/pdf/2009-03-31-Name-TGL-eng.pdf).

[398] Energy Policy Act of 1992. The Library of Congress. Available at: http://thomas.loc.gov/cgi-bin/query/z?c102:H.R.776.ENR:

[399] McMahon JE, Whitehead CD, Biermayer P: Saving Water Saves Energy. In: Bertoldi P, Kiss B, Atanasiu B (eds.): Energy Efficiency in Domestic Appliances and Lighting. Proceedings of the 4th International Conference EEDAL'06. 21-23 June 2006, London. Available at: http://re.jrc.ec.europa.eu/energyefficiency/pdf/EEDAL06/EEDAL06%20Proceedings-Volume1.pdf

[400] See http://www.epa.gov/watersense/about_us/watersense_label.html for more information.

[401] EPA WaterSense FAQ: WaterSense Labeled High-Efficiency Lavatory (Bathroom Sink) Faucet specification. US EPA, Washington DC, 2007. Available at: http://www.epa.gov/watersense/docs/ws_faq_faucet508.pdf

[402] EPA WaterSense: Draft Specifications for Showerheads. US EPA, Washington DC, 2009. Available at: http://www.epa.gov/watersense/docs/showerhead_draftspec508.pdf

[403] EPA WaterSense: WaterSense Specification for Showerheads. US EPA, Washington DC, 2010. Available at: http://www.epa.gov/watersense/docs/showerheads_finalspec508.pdf

[404] See http://www.bsc.ca.gov/Home/CALGreen.aspx

	Florida Water Star label for residential and commercial buildings[405] [406] [407]: (silver/gold label for new buildings and bronze label for existing buildings).	Voluntary	Showerhead: < 9.5 l/min Sink taps: < 6.1 l/min or < 3.8 l/min (points depend on flow rate and number of taps meeting the requirements)
	LEED (Leadership in Energy and Environmental Design) certification scheme for green buildings[408] [409] [410] [411].	Voluntary	Total water use in new buildings (through closets, urinals, lavatory faucets, showers, kitchen sinks, and pre-rinse spray valves) should be reduced by 20 % compared to a baseline[412].

Others (worldwide)	Green Key label for hotels, youth hostels, conference and holiday centres, campsites, holiday houses and leisure facilities[413] [414] [415] [416].	Voluntary	50% showers: < 9 l/min 50% Taps: < 8 l/min (not for campsites)

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[405] See http://floridaswater.com/floridawaterstar/

[406] Florida Water Star Residential Criteria. Qualification Points List Silver/Gold. Florida Water Star, Palatka 2009. Available at: http://floridaswater.com/floridawaterstar/pdfs/Silver-Gold_registration_form-points_list.pdf

[407] Florida Water Star Residential Criteria. Qualification Points List Bronze. Florida Water Star, Palatka 2010. Available at: http://floridaswater.com/floridawaterstar/pdfs/Bronze_registration_form-points_list.pdf

[408] See http://www.usgbc.org/DisplayPage.aspx?CategoryID=19 for more information.

409 USGBC: LEED 2009 for core and shell development. USGBC Member Approved November 2008. U.S. Green Building Council, Washington DC 2009. Available at: http://www.usgbc.org/ShowFile.aspx?DocumentID=5544

410 USGBC: LEED 2009 for commercial interiors. USGBC Member Approved November 2008. U.S. Green Building Council, Washington DC 2009. Available at: http://www.usgbc.org/ShowFile.aspx?DocumentID=5543

411 USGBC: LEED 2009 for schools new constructions and major renovations. USGBC Member Approved November 2008. U.S. Green Building Council, Washington DC 2009. Available at: http://www.usgbc.org/ShowFile.aspx?DocumentID=5547

412 USGBC: LEED 2009 for new constructions and major renovations. USGBC Member Approved November 2008. U.S. Green Building Council, Washington DC 2009. Available at: http://www.usgbc.org/ShowFile.aspx?DocumentID=5546

[413] See http://green-key.org/

414 The Green Key: The Green Key: An Eco-Label for Leisure Organisations. Baseline Criteria for hotels, youth hostels, conference and holiday centres 2009-2010. Available at: http://www.kmvk.nl/cmslib/www.kmvk.nl/greenkeyorg/files/International_baseline_criteria_HOTELS_V1.doc

415 The Green Key: The Green Key: An Eco-Label for Leisure Organisations. Baseline Criteria for attractions 2009-2010. Available at: http://www.kmvk.nl/cmslib/www.kmvk.nl/greenkeyorg/files/International_baseline_criteria_ATTRACTIONS.pdf

416 The Green Key: The Green Key: An Eco-Label for Leisure Organisations. Baseline Criteria for camp sites 2009-2010. Available at: http://www.kmvk.nl/cmslib/www.kmvk.nl/greenkeyorg/files/International_baseline_criteria_CAMP_SITES_v1.doc

ANNEX II: SUPPORTING INFORMATION FOR MARKET ANALYSIS

Table A2.1 Production in volume sold and value in 1995

Country	PRODCOM 28.14.12.33		PRODCOM 28.14.12.35	
	(10^3 kg)	(M EUR)	(10^3 kg)	(M EUR)
EU-15*	76,388	1,315	126,283	1,884
Austria	:C	:C	:C	:C
Belgium	0	0	:C	5
Bulgaria	n.a.	n.a.	n.a.	n.a.
Cyprus	n.a.	n.a.	n.a.	n.a.
Czech Republic	n.a.	n.a.	n.a.	n.a.
Denmark	:E	55	:E	27
Estonia	n.a.	n.a.	n.a.	n.a.
Finland	CE	:C	:E	73
France	2,428	109	671	88
Germany	32,877	664	68,579	1,241
Greece	:C	:C	:C	:C
Hungary	n.a.	n.a.	n.a.	n.a.
Ireland	0	0	0	:C
Italy	27,649	320	30,699	203
Latvia	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.
Luxembourg	0	0	0	0
Malta	n.a.	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	n.a.	n.a.
Portugal	657	9	1,932	9
Romania	n.a.	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.	n.a.
Spain	4,131	41	9,317	82
Sweden	:E	:E	:E	:E
The Netherlands	:C	:C	CE	:C
United Kingdom	2,772	78	8,029	136
Croatia[a]	n.a.	n.a.	n.a.	n.a.

* Note that the EU-15 total includes estimates and confidential data not published here.
(:C)=Confidential, (:CE)=Confidential Estimated, (:E)=Estimated
n.a. = not available
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures..

Table A2.2 Production in volume sold and value in 2012

Country	PRODCOM 28.14.12.33		PRODCOM 28.14.12.35	
	(10^3 kg)	(M EUR)	(10^3 kg)	(M EUR)
EU-27*	98,896	2,316	300,000	2,400
Austria	:C	:C	:C	:C
Belgium	0	0	:C	:C
Bulgaria	:C	:C	520	:C
Cyprus	0	0	0	0
Czech Republic	2,125	25	:C	11
Denmark	1,815	56	885	40
Estonia	0	0	20	1
Finland	3,353	81	:E	6
France	2,084	:E	2,628	122
Germany	31,079	1,000	:C	:C
Greece	0	0	0	0
Hungary	:C	:C	345	9
Ireland	0	0	:C	:C
Italy	25,551	503	64,429	823
Latvia	0	0	0	0
Lithuania	193	4	571	:E
Luxembourg	0	0	0	0
Malta	0	0	0	0
Poland	2,442	33	3,196	36
Portugal	11,907	169	:C	:C
Romania	0	0	:C	:C
Slovakia	0	0	:C	:C
Slovenia	:C	:C	:C	:C
Spain	3,822	60	6,104	49
Sweden	3,805	94	0	0
The Netherlands	:C	:C	:C	:C
United Kingdom	372	63	2,779	94
Croatia[a]	0	0	82	1

* Note that the EU-27 total includes estimates and confidential data not published here.

(:C)=Confidential, (:E)=Estimated

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.3 Production in volume sold and value in 1995

Country	Taps		Shower valves		Shower outlets
	(10^3 kg)	(M EUR)	(10^3 kg)	(M EUR)	(10^3 kg)
EU-15*	158,010	2,494	44,662	705	24,377
Austria	:C	:C	:C	:C	n.a.
Belgium	:C	4	:C	1	n.a.
Bulgaria	n.a.	n.a.	n.a.	n.a.	n.a.
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.
Czech Republic	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	:E	64	:E	18	n.a.
Estonia					n.a.
Finland	:CE	57**	:E	16**	n.a.
France	2,416	:E	683	43	373
Germany	79,099	1,485	22,357	420	n.a.
Greece	:C	:C	0	:C	n.a.
Hungary	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	0	:C	:C	:C	n.a.
Italy	45,491	407	12,858	115	7,018
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	2,018	14	570	4	n.a.
Romania	n.a.	n.a.	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	10,484	95	2,963	27	1,617
Sweden	:E	:E	:E	:E	n.a.
The Netherlands	:C	:C	:C	:C	n.a.
United Kingdom	8,421	167	2,380	47	1,299
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.

* Note that the EU-15 total includes estimates and confidential data not published here.
** *Incomplete data (data available for only one out of the two PRODCOM codes).*
(:C)=Confidential, (:CE)=Confidential Estimated, (:E)=Estimated n.a. = not available
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.4 Production in volume sold and value in 2012

Country	Taps		Shower valves		Shower outlets
	(10^3 kg)	(M EUR)	(10^3 kg)	(M EUR)	(10^3 kg)
EU-27*	310,994	3,677	87,903	1,039	47,978
Austria	:C	:C	:C	:C	:C
Belgium	:C	:C	:C	:C	:C
Bulgaria	405**	:C	115**	:C	63**
Cyprus	0	0	0	0	0
Czech Republic	1,657**	28	468**	8	256**
Denmark	2,105	75	595	21	325
Estonia	16	1	4	0	2
Finland	2,614**	67	739**	19	403
France	3,674	95	1,038	27	567
Germany	24,231**	780**	6,849**	220**	3,738**
Greece	0	0	0	0	0
Hungary	269**	7**	76**	2**	41**
Ireland	:C	:C	:C	:C	:C
Italy	70,151	1,034	19,828	292	10,823
Latvia	0	0	0	0	0
Lithuania	596	3	168	1	92
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.
Poland	4,396**	54**	1,242**	15**	678**
Portugal	9,283	132	2,624	37	1,432
Romania	0	:C	:C	:C	:C
Slovakia	:C	:C	:C	:C	:C
Slovenia	:C	:C	:C	:C	:C
Spain	7,739	85	2,187	24	1,194
Sweden	2,966	73	838	21	458
The Netherlands	:C	:C	:C	:C	:C
United Kingdom	2,456	123	694	35	379
Croatia[a]	64	1	18	0	10

* Note that the EU-27 total includes estimates and confidential data not published here.
** *Incomplete data (data available for only one out of the two PRODCOM codes)*
(:C)=Confidential n.a. = not available
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.5 Calculated Production in 1995

Country	Taps (10^3 units)	Shower valves (10^3 units)	Shower outlets (10^3 units)
EU-15	87,783	15,401	24,377
Austria	:C	:C	:C
Belgium	:C	:C	:C
Bulgaria	n.a.	n.a.	n.a.
Cyprus	n.a.	n.a.	n.a.
Czech Republic	n.a.	n.a.	n.a.
Denmark	:E	:E	:E
Estonia	n.a.	n.a.	n.a.
Finland	:E	:E	:E
France	1,342	235	373
Germany	43,944	:C	:C
Greece	:C	:C	:C
Hungary	n.a.	n.a.	n.a.
Ireland	:C	:C	:C
Italy	25,273	4,434	7,018
Latvia	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.
Luxembourg	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	n.a.
Portugal	1,121	:C	:C
Romania	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.
Spain	5,825	1,022	1,617
Sweden	:E	:E	:E
The Netherlands	:C	:C	:C
United Kingdom	4,678	821	1,299
Croatia[a]	n.a.	n.a.	n.a.

Incomplete data (data available for only one out of the two PRODCOM codes)
(:C)=Confidential, (:E)=Estimated
n.a. = not available
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

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Table A2.6 Calculated production in 2012

Country	Taps (10^3 units)	Shower valves (10^3 units)	Shower outlets (10^3 units)
EU-27	172,774	30,311	47,978
Austria	:C	:C	:C
Belgium	:C	:C	:C
Bulgaria	:C	39	63
Cyprus	0	0	0
Czech Republic	920	161	256
Denmark	1,169	205	325
Estonia	9	2	2
Finland	1,452	255	403
France	2,041	358	567
Germany	13,461	2,362	3,738
Greece	n.a.	n.a.	n.a.
Hungary	:C	26	41
Ireland	:C	:C	:C
Italy	38,973	6,837	10,823
Latvia	0	0	0
Lithuania	331	58	92
Luxembourg	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.
Poland	2,442	428	678
Portugal	5,157	905	1,432
Romania	:C	:C	:C
Slovakia	:C	:C	:C
Slovenia	:C	:C	:C
Spain	4,299	754	1,194
Sweden	1,648	289	458
The Netherlands	:C	:C	:C
United Kingdom	1,364	239	379
Croatia[a]	36	6	10

** Incomplete data (data available for only one out of the two PRODCOM codes)*

(:C)=Confidential, (:E)=Estimated

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.7 Total import/exports in volume and value in 1995

Country	CN 8481 80 11				CN 8481 80 19			
	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)
EU-15	38,676	52,309	579	843	26,494	59,245	305	350
Austria	2,912	1,838	54	30	1,755	3,410	19	28
Belgium	2,039	285	39	7	1,137	128	22	3
Bulgaria	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Czech Republic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	977	1,512	15	38	616	772	9	19
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	271	1,968	4	33	357	57	4	1
France	6,868	779	101	13	4,662	1,761	66	34
Germany	10,450	21,274	151	409	5,319	3,934	48	60
Greece	3,390	87	24	1	1,269	32	10	0
Hungary	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	387	3	7	0	347	5	3	0
Italy	3,873	17,139	72	199	1,156	19,025	20	168
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Luxemburg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	1,088	342	10	4	221	27,592	3	5
Romania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	536	3,639	7	47	1,629	1,627	26	19
Sweden	571	2,523	11	42	371	69	5	2
The Netherlands	2,721	244	54	5	604	85	9	3
United Kingdom	2,594	676	29	15	7,052	748	60	8
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not available; a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.8 **Total import/exports in volume and value in 2012**

Country	CN 8481 80 11				CN 8481 80 19			
	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)
EU-27	135,535	115,439	1,968	2,183	58,585	37,141	701	642
Austria	4,801	3,985	86	59	1,830	676	31	10
Belgium	7,033	3,908	120	49	2,981	752	49	10
Bulgaria	1,021	6,800	14	91	338	42	3	0
Cyprus	295	0	5	0	57	0	1	0
Czech Republic	2,856	4,797	44	65	1,191	877	14	11
Denmark	2,131	2,379	35	53	595	886	13	27
Estonia	328	111	5	2	91	21	1	1
Finland	1,316	1,161	29	32	219	158	6	11
France	25,400	1,390	388	36	5,153	2,275	60	57
Germany	38,756	34,022	543	864	7,739	8,451	90	187
Greece	1,513	139	16	2	2,529	170	15	2
Hungary	1,086	663	15	11	595	109	6	2
Ireland	481	24	6	0	692	72	6	1
Italy	8,194	25,555	105	474	4,508	11,466	61	175
Latvia	1,081	1,383	14	8	127	31	2	0
Lithuania	1,157	887	14	12	295	680	3	18
Luxemburg	494	14	9	0	137	10	3	0
Malta	214	1	2	0	45	50	1	0
Poland	6,117	2,579	83	42	3,976	820	29	8
Portugal	1,900	11,572	22	156	805	1,621	10	15
Romania	3,208	74	19	1	1,014	147	8	1
Slovakia	839	118	15	2	660	22	8	0
Slovenia	815	998	10	13	473	1,290	5	13
Spain	6,470	7,443	88	89	4,613	4,155	42	38
Sweden	2,815	2,554	36	54	848	137	17	4
The Netherlands	4,956	1,509	98	16	2,865	535	26	9
United Kingdom	10,261	1,375	147	50	14,210	1,689	192	43
Croatia[a]	999	29	13	0	288	40	4	0

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.9 Total import/exports of taps, shower valves and shower outlets in volume and value in 1995

Country	Taps				Shower valves				Shower outlets*	
	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)	Imports (M EUR)	Exports (M EUR)	Imports (M EUR)	Exports (M EUR)	Imports (10^3 kg)	Exports (10^3 kg)
EU-15	50,808	86,971	689	930	14,361	24,582	195	263	7,838	13,417
Austria	3,639	4,092	57	45	1,028	1,157	16	13	561	631
Belgium	2,476	322	47	7	700	91	13	2	382	50
Bulgaria	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Czech Republic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	1,242	1,781	19	44	351	503	5	13	192	275
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	489	1,579	7	27	138	446	2	8	75	244
France	8,989	1,981	130	37	2,541	560	37	10	1,387	306
Germany	12,294	19,653	155	366	3,475	5,555	44	103	1,897	3,032
Greece	3,632	93	27	1	1,027	26	8	0	560	14
Hungary	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	572	6	8	0	162	2	2	0	88	1
Italy	3,921	28,195	72	286	1,108	7,969	20	81	605	4,350
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Luxemburg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	1,020	21,778	10	7	288	6,156	3	2	157	3,360
Romania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	1,688	4,105	26	51	477	1,160	7	14	260	633
Sweden	734	2,021	13	34	208	571	4	10	113	312
The Netherlands	2,593	256	49	6	733	72	14	2	400	39
United Kingdom	7,520	1,110	69	18	2,125	314	20	5	1,160	171
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures; * For shower outlets: Imports and Exports (M EUR) are not available

Table A2.10 Total import/exports of taps, shower valves and shower outlets in volume and value in 2012

Country	Taps				Shower valves				Shower outlets*	
	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)	Imports (10^3 kg)	Exports (10^3 kg)	Imports (M EUR)	Exports (M EUR)	Imports (10^3 kg)	Exports (10^3 kg)
EU-27	151,342	118,957	2,081	2,203	42,777	33,623	588	623	23,348	18,352
Austria	5,170	3,633	91	54	1,461	1,027	26	15	798	561
Belgium	7,807	3,634	132	46	2,207	1,027	37	13	1,204	561
Bulgaria	1,059	5,334	13	71	299	1,508	4	20	163	823
Cyprus	275	0	4	0	78	0	1	0	42	0
Czech Republic	3,155	4,424	46	60	892	1,250	13	17	487	682
Denmark	2,126	2,545	37	62	601	719	11	18	328	393
Estonia	327	102	5	2	92	29	1	1	50	16
Finland	1,196	1,028	27	33	338	291	8	9	185	159
France	23,820	2,857	349	73	6,733	808	99	21	3,675	441
Germany	36,249	33,114	494	820	10,246	9,360	140	232	5,592	5,109
Greece	3,151	241	24	3	891	68	7	1	486	37
Hungary	1,310	602	16	10	370	170	5	3	202	93
Ireland	914	75	9	1	258	21	3	0	141	12
Italy	9,903	28,862	129	506	2,799	8,158	37	143	1,528	4,453
Latvia	941	1,103	12	6	266	312	3	2	145	170
Lithuania	1,131	1,222	13	23	320	345	4	7	175	188
Luxemburg	492	19	10	1	139	5	3	0	76	3
Malta	202	39	2	0	57	11	1	0	31	6
Poland	7,869	2,650	88	39	2,224	749	25	11	1,214	409
Portugal	2,109	10,285	24	133	596	2,907	7	38	325	1,587
Romania	3,292	172	21	2	931	49	6	0	508	27
Slovakia	1,169	109	18	2	330	31	5	1	180	17
Slovenia	1,004	1,784	12	20	284	504	3	6	155	275
Spain	8,641	9,042	101	99	2,442	2,556	29	28	1,333	1,395
Sweden	2,855	2,098	42	45	807	593	12	13	441	324
The Netherlands	6,097	1,594	97	20	1,723	451	27	6	941	246
United Kingdom	19,078	2,389	264	73	5,392	675	75	21	2,943	369
Croatia[a]	1,003	54	13	0	284	15	4	0	155	8
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures; * For shower outlets: Imports and Exports (M EUR) are not available										

Table A2.11 Calculated imports and exports of taps, shower valves and shower outlets in 1995

Country	Imports (10^3 units)			Exports (10^3 units)		
	Taps	Shower valves	Shower outlets	Taps	Shower valves	Shower outlets
EU-15	28,227	4,952	7,838	48,317	8,477	13,417
Austria	2,021	355	561	2,273	399	631
Belgium	1,375	241	382	179	31	50
Bulgaria	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Czech Republic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	690	121	192	989	174	275
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	272	48	75	877	154	244
France	4,994	876	1,387	1,100	193	306
Germany	6,830	1,198	1,897	10,918	1,916	3,032
Greece	2,018	354	560	51	9	14
Hungary	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	318	56	88	3	1	1
Italy	2,178	382	605	15,664	2,748	4,350
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Luxemburg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	567	99	157	12,099	2,123	3,360
Romania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	938	165	260	2,281	400	633
Sweden	408	72	113	1,123	197	312
The Netherlands	1,440	253	400	142	25	39
United Kingdom	4,178	733	1,160	616	108	171
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.12 Calculated imports and exports of taps, shower valves and shower outlets in 2012

Country	Imports (10^3 units)			Exports (10^3 units)		
	Taps	Shower valves	Shower outlets	Taps	Shower valves	Shower outlets
EU-27	84,079	14,751	23,348	66,087	11,594	18,352
Austria	2,872	504	798	2,019	354	561
Belgium	4,337	761	1,204	2,019	354	561
Bulgaria	589	103	163	2,963	520	823
Cyprus	153	27	42	0	0	0
Czech Republic	1,753	307	487	2,458	431	682
Denmark	1,181	207	328	1,414	248	393
Estonia	182	32	50	57	10	16
Finland	665	117	185	571	100	159
France	13,233	2,322	3,675	1,587	278	441
Germany	20,138	3,533	5,592	18,397	3,227	5,109
Greece	1,751	307	486	134	23	37
Hungary	728	128	202	334	59	93
Ireland	508	89	141	42	7	12
Italy	5,502	965	1,528	16,035	2,813	4,453
Latvia	523	92	145	613	107	170
Lithuania	629	110	175	679	119	188
Luxemburg	273	48	76	10	2	3
Malta	112	20	31	22	4	6
Poland	4,371	767	1,214	1,472	258	409
Portugal	1,172	206	325	5,714	1,002	1,587
Romania	1,829	321	508	96	17	27
Slovakia	649	114	180	61	11	17
Slovenia	558	98	155	991	174	275
Spain	4,800	842	1,333	5,023	881	1,395
Sweden	1,586	278	441	1,166	204	324
The Netherlands	3,387	594	941	886	155	246
United Kingdom	10,599	1,859	2,943	1,327	233	369
Croatia[a]	557	98	155	30	5	8
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.						

Table A.2.13 EU apparent consumption in 1995

Country	Taps (10^3 units)	Shower valves (10^3 units)	Shower outlets (10^3 units)
EU-15	67,693	11,876	18,798
Austria	n.a.	n.a.	n.a.
Belgium	n.a.	n.a.	n.a.
Bulgaria	n.a.	n.a.	n.a.
Cyprus	n.a.	n.a.	n.a.
Czech Republic	n.a.	n.a.	n.a.
Denmark	n.a.	n.a.	n.a.
Estonia	n.a.	n.a.	n.a.
Finland	n.a.	n.a.	n.a.
France	5,235	918	1,454
Germany	39,855	n.a.	n.a.
Greece	n.a.	n.a.	n.a.
Hungary	n.a.	n.a.	n.a.
Ireland	n.a.	n.a.	n.a.
Italy	11,787	2,068	3,273
Latvia	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.
Luxembourg	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	n.a.
Portugal	-10,411*		
Romania	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.
Spain	4,482	786	1,245
Sweden	n.a.	n.a.	n.a.
The Netherlands	n.a.	n.a.	n.a.
United Kingdom	8,239	1,446	2,288
Croatia[a]	n.a.	n.a.	n.a.

* The estimates suggest that some Member States are net exporters; these are shown as negative values.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.14 EU apparent consumption in 2012

Country	Taps (10^3 units)	Shower valves (10^3 units)	Shower outlets (10^3 units)
EU-27	190,766	33,468	52,975
Austria	n.a.	n.a.	n.a.
Belgium	n.a.	n.a.	n.a.
Bulgaria	n.a.	-377*	-597*
Cyprus	152	27	42
Czech Republic	215	n.a.	n.a.
Denmark	937	164	:C
Estonia	134	23	37
Finland	1,546	n.a.	n.a.
France	13,687	2,401	3,801
Germany	15,203	2,667	n.a.
Greece	1,617	284	n.a.
Hungary	n.a.	95	151
Ireland	n.a.	n.a.	n.a.
Italy	28,440	4,989	7,898
Latvia	-90*	-16*	-25*
Lithuania	281	49	78
Luxembourg	263	46	73
Malta	90	16	25
Poland	5,341	937	1,483
Portugal	615	n.a.	n.a.
Romania	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.
Spain	4,077	715	1,132
Sweden	2,069	363	n.a.
The Netherlands	n.a.	n.a.	n.a.
United Kingdom	10,636	1,866	2,954
Croatia[a]	563	99	156

* The estimates suggest that some Member States are net exporters; these are shown as negative values.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.15 Stock of taps in the domestic sector

Country	EU-27 stock (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	1,193	1,196	1,197	1,203	1,207	1,210
Austria	19	19	19	19	19	19
Belgium	25	25	25	25	26	26
Bulgaria	20	20	20	20	20	20
Cyprus	22	22	22	22	22	22
Czech Republic	1	1	1	2	2	2
Denmark	14	14	14	14	14	14
Estonia	3	3	3	3	3	3
Finland	14	15	15	15	15	15
France	168	168	168	169	170	170
Germany	204	205	205	206	207	207
Greece	28	28	28	28	28	28
Hungary	22	22	22	22	22	22
Ireland	8	8	8	9	9	9
Italy	147	148	148	149	149	150
Latvia	7	7	7	7	7	7
Lithuania	7	7	7	7	7	7
Luxembourg	1	1	1	1	1	1
Malta	1	1	1	1	1	1
Poland	68	68	68	68	68	69
Portugal	30	30	30	30	31	31
Romania	43	43	43	43	43	43
Slovakia	9	9	9	9	9	9
Slovenia	4	4	4	4	4	4
Spain	128	128	128	129	129	129
Sweden	23	23	23	23	23	23
The Netherlands	36	37	37	37	37	37
United Kingdom	140	140	141	141	142	142
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.16 Forecasts for the stock of taps in the domestic sector

Country	EU-27 stock (M units)			
	2020	2025	2030	2050
EU-27	1,225	1,236	1,244	1,248
Austria	19	19	19	19
Belgium	26	26	26	26
Bulgaria	20	20	21	21
Cyprus	23	23	23	23
Czech Republic	2	2	2	2
Denmark	14	15	15	15
Estonia	3	3	3	3
Finland	15	15	15	15
France	172	174	175	176
Germany	210	212	213	214
Greece	29	29	29	29
Hungary	22	23	23	23
Ireland	9	9	9	9
Italy	151	153	154	154
Latvia	8	8	8	8
Lithuania	7	7	7	7
Luxembourg	1	1	1	1
Malta	1	1	1	1
Poland	70	70	71	71
Portugal	31	31	32	32
Romania	44	44	44	45
Slovakia	9	9	9	9
Slovenia	4	4	4	4
Spain	131	132	133	133
Sweden	23	24	24	24
The Netherlands	37	38	38	38
United Kingdom	144	145	146	147
Croatia[a]	n.a.	n.a.	n.a.	n.a.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.17 Stock of shower valves in the domestic sector

Country	EU-27 stock (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	398	399	399	401	402	403
Austria	6	6	6	6	6	6
Belgium	8	8	8	8	9	9
Bulgaria	7	7	7	7	7	7
Cyprus	7	7	7	7	7	7
Czech Republic	0	0	0	1	1	1
Denmark	5	5	5	5	5	5
Estonia	1	1	1	1	1	1
Finland	5	5	5	5	5	5
France	56	56	56	56	57	57
Germany	68	68	68	69	69	69
Greece	9	9	9	9	9	9
Hungary	7	7	7	7	7	7
Ireland	3	3	3	3	3	3
Italy	49	49	49	50	50	50
Latvia	2	2	2	2	2	2
Lithuania	2	2	2	2	2	2
Luxembourg	0	0	0	0	0	0
Malta	0	0	0	0	0	0
Poland	23	23	23	23	23	23
Portugal	10	10	10	10	10	10
Romania	14	14	14	14	14	14
Slovakia	3	3	3	3	3	3
Slovenia	1	1	1	1	1	1
Spain	43	43	43	43	43	43
Sweden	8	8	8	8	8	8
The Netherlands	12	12	12	12	12	12
United Kingdom	47	47	47	47	47	47
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.18 Forecasts for the stock of shower valves in the domestic sector

Country	EU-27 stock (M units)			
	2020	2025	2030	2050
EU-27	408	412	415	416
Austria	6	6	6	6
Belgium	9	9	9	9
Bulgaria	7	7	7	7
Cyprus	8	8	8	8
Czech Republic	1	1	1	1
Denmark	5	5	5	5
Estonia	1	1	1	1
Finland	5	5	5	5
France	57	58	58	59
Germany	70	71	71	71
Greece	10	10	10	10
Hungary	7	8	8	8
Ireland	3	3	3	3
Italy	50	51	51	51
Latvia	3	3	3	3
Lithuania	2	2	2	2
Luxembourg	0	0	0	0
Malta	0	0	0	0
Poland	23	23	24	24
Portugal	10	10	11	11
Romania	15	15	15	15
Slovakia	3	3	3	3
Slovenia	1	1	1	1
Spain	44	44	44	44
Sweden	8	8	8	8
The Netherlands	12	13	13	13
United Kingdom	48	48	49	49
Croatia[a]	n.a.	n.a.	n.a.	n.a.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.19 Stock of shower outlets in the domestic sector

Country	EU-27 stock (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	398	399	399	401	402	403
Austria	6	6	6	6	6	6
Belgium	8	8	8	8	9	9
Bulgaria	7	7	7	7	7	7
Cyprus	7	7	7	7	7	7
Czech Republic	0	0	0	1	1	1
Denmark	5	5	5	5	5	5
Estonia	1	1	1	1	1	1
Finland	5	5	5	5	5	5
France	56	56	56	56	57	57
Germany	68	68	68	69	69	69
Greece	9	9	9	9	9	9
Hungary	7	7	7	7	7	7
Ireland	3	3	3	3	3	3
Italy	49	49	49	50	50	50
Latvia	2	2	2	2	2	2
Lithuania	2	2	2	2	2	2
Luxembourg	0	0	0	0	0	0
Malta	0	0	0	0	0	0
Poland	23	23	23	23	23	23
Portugal	10	10	10	10	10	10
Romania	14	14	14	14	14	14
Slovakia	3	3	3	3	3	3
Slovenia	1	1	1	1	1	1
Spain	43	43	43	43	43	43
Sweden	8	8	8	8	8	8
The Netherlands	12	12	12	12	12	12
United Kingdom	47	47	47	47	47	47
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.20 Forecasts for the stock of shower outlets in the domestic sector

Country	EU-27 stock (M units)			
	2020	2025	2030	2050
EU-27	408	412	415	416
Austria	6	6	6	6
Belgium	9	9	9	9
Bulgaria	7	7	7	7
Cyprus	8	8	8	8
Czech Republic	1	1	1	1
Denmark	5	5	5	5
Estonia	1	1	1	1
Finland	5	5	5	5
France	57	58	58	59
Germany	70	71	71	71
Greece	10	10	10	10
Hungary	7	8	8	8
Ireland	3	3	3	3
Italy	50	51	51	51
Latvia	3	3	3	3
Lithuania	2	2	2	2
Luxembourg	0	0	0	0
Malta	0	0	0	0
Poland	23	23	24	24
Portugal	10	10	11	11
Romania	15	15	15	15
Slovakia	3	3	3	3
Slovenia	1	1	1	1
Spain	44	44	44	44
Sweden	8	8	8	8
The Netherlands	12	13	13	13
United Kingdom	48	48	49	49
Croatia[a]	n.a.	n.a.	n.a.	n.a.

n.a. = not available

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.21 Stock of taps in the non-domestic sector

Country	EU-27 stock (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	70.6	70.8	70.8	71.1	71.4	71.6
Austria	1.7	1.7	1.7	1.7	1.7	1.7
Belgium	1.2	1.2	1.2	1.2	1.2	1.2
Bulgaria	1.0	1.0	1.0	1.0	1.0	1.0
Cyprus	0.2	0.2	0.2	0.2	0.2	0.2
Czech Republic	1.5	1.5	1.5	1.5	1.5	1.5
Denmark	0.9	0.9	0.9	0.9	0.9	0.9
Estonia	0.2	0.2	0.2	0.2	0.2	0.2
Finland	0.7	0.7	0.7	0.7	0.7	0.8
France	10.0	10.0	10.0	10.1	10.1	10.1
Germany	12.4	12.4	12.4	12.5	12.5	12.6
Greece	1.6	1.6	1.6	1.6	1.6	1.6
Hungary	1.2	1.2	1.2	1.2	1.2	1.2
Ireland	0.6	0.6	0.6	0.6	0.6	0.6
Italy	8.1	8.1	8.1	8.2	8.2	8.2
Latvia	0.3	0.3	0.3	0.3	0.3	0.3
Lithuania	0.4	0.4	0.4	0.4	0.4	0.4
Luxembourg	0.1	0.1	0.1	0.1	0.1	0.2
Malta	1.4	1.4	1.4	1.4	1.5	1.5
Poland	3.5	3.5	3.5	3.5	3.5	3.5
Portugal	1.5	1.5	1.5	1.5	1.5	1.5
Romania	1.9	1.9	1.9	1.9	1.9	1.9
Slovakia	0.6	0.6	0.6	0.6	0.6	0.6
Slovenia	0.3	0.3	0.3	0.3	0.3	0.3
Spain	6.7	6.8	6.8	6.8	6.8	6.8
Sweden	1.7	1.7	1.7	1.7	1.7	1.7
The Netherlands	1.4	1.4	1.4	1.4	1.4	1.4
United Kingdom	2.7	2.7	2.7	2.8	2.8	2.8
Croatia[a]	0.4	0.4	0.4	0.4	0.4	0.4

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.22 Forecasts for the stock of taps in the non-domestic sector

Country	EU-27 stock (M units)			
	2020	2025	2030	2050
EU-27	72.5	73.1	73.6	73.8
Austria	1.8	1.8	1.8	1.8
Belgium	1.3	1.3	1.3	1.3
Bulgaria	1.0	1.0	1.0	1.0
Cyprus	0.2	0.2	0.2	0.2
Czech Republic	1.6	1.6	1.6	1.6
Denmark	0.9	0.9	1.0	1.0
Estonia	0.2	0.2	0.2	0.2
Finland	0.8	0.8	0.8	0.8
France	10.3	10.4	10.4	10.5
Germany	12.7	12.8	12.9	13.0
Greece	1.7	1.7	1.7	1.7
Hungary	1.2	1.2	1.2	1.2
Ireland	0.6	0.6	0.6	0.6
Italy	8.3	8.4	8.5	8.5
Latvia	0.3	0.3	0.3	0.3
Lithuania	0.4	0.4	0.4	0.4
Luxembourg	0.2	0.2	0.2	0.2
Malta	1.5	1.5	1.5	1.5
Poland	3.5	3.6	3.6	3.6
Portugal	1.6	1.6	1.6	1.6
Romania	1.9	1.9	1.9	1.9
Slovakia	0.6	0.6	0.6	0.6
Slovenia	0.3	0.3	0.3	0.3
Spain	6.9	7.0	7.0	7.0
Sweden	1.7	1.7	1.7	1.7
The Netherlands	1.4	1.5	1.5	1.5
United Kingdom	2.8	2.8	2.9	2.9
Croatia[a]	0.4	0.4	0.4	0.4
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.				

Table A.2.23 Stock of shower valves in the non-domestic sector

Country	EU-27 stock (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	23.9	23.9	23.9	24.1	24.1	24.2
Austria	0.8	0.8	0.8	0.8	0.8	0.8
Belgium	0.3	0.3	0.3	0.3	0.3	0.3
Bulgaria	0.3	0.3	0.3	0.3	0.3	0.3
Cyprus	0.1	0.1	0.1	0.1	0.1	0.1
Czech Republic	0.4	0.4	0.4	0.4	0.4	0.4
Denmark	0.3	0.3	0.3	0.3	0.3	0.3
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.2	0.2	0.2	0.2	0.2	0.2
France	4.2	4.2	4.2	4.2	4.2	4.2
Germany	3.1	3.1	3.1	3.1	3.1	3.1
Greece	0.9	0.9	0.9	0.9	0.9	0.9
Hungary	0.3	0.3	0.3	0.3	0.3	0.3
Ireland	0.2	0.2	0.2	0.2	0.2	0.2
Italy	3.8	3.8	3.8	3.8	3.9	3.9
Latvia	0.0	0.0	0.0	0.0	0.0	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
Luxembourg	0.1	0.1	0.1	0.1	0.1	0.1
Malta	0.1	0.1	0.1	0.1	0.1	0.1
Poland	0.7	0.7	0.7	0.7	0.7	0.7
Portugal	0.4	0.4	0.4	0.4	0.4	0.4
Romania	0.4	0.4	0.4	0.4	0.4	0.4
Slovakia	0.2	0.2	0.2	0.2	0.2	0.2
Slovenia	0.1	0.1	0.1	0.1	0.1	0.1
Spain	2.7	2.7	2.7	2.7	2.8	2.8
Sweden	0.7	0.7	0.7	0.7	0.7	0.7
The Netherlands	1.0	1.0	1.0	1.0	1.0	1.0
United Kingdom	2.6	2.6	2.6	2.6	2.6	2.6
Croatia[a]	0.3	0.3	0.3	0.3	0.3	0.3
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.						

Table A.2.24 Forecasts for stock of showers valves in the non-domestic sector

Country	EU-27 stock (M units)			
	2020	2025	2030	2050
EU-27	24.3	24.4	24.5	24.5
Austria	0.8	0.8	0.8	0.8
Belgium	0.4	0.4	0.4	0.4
Bulgaria	0.3	0.3	0.3	0.3
Cyprus	0.1	0.1	0.1	0.1
Czech Republic	0.4	0.4	0.4	0.4
Denmark	0.3	0.3	0.3	0.3
Estonia	0.0	0.0	0.0	0.0
Finland	0.2	0.2	0.2	0.2
France	4.3	4.3	4.3	4.3
Germany	3.1	3.1	3.1	3.1
Greece	0.9	0.9	0.9	0.9
Hungary	0.3	0.3	0.3	0.3
Ireland	0.2	0.2	0.2	0.2
Italy	3.9	3.9	3.9	3.9
Latvia	0.0	0.0	0.0	0.0
Lithuania	0.0	0.0	0.1	0.1
Luxembourg	0.1	0.1	0.1	0.1
Malta	0.1	0.1	0.1	0.1
Poland	0.7	0.7	0.7	0.7
Portugal	0.4	0.4	0.4	0.4
Romania	0.4	0.4	0.4	0.4
Slovakia	0.2	0.2	0.2	0.2
Slovenia	0.1	0.1	0.1	0.1
Spain	2.8	2.8	2.8	2.8
Sweden	0.7	0.7	0.7	0.7
The Netherlands	1.0	1.0	1.0	1.0
United Kingdom	2.6	2.7	2.7	2.7
Croatia[a]	0.4	0.4	0.4	0.4
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.				

Table A.2.25 Stock of showers outlets in the non-domestic sector

Country	EU-27 stock (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	23.9	23.9	23.9	24.1	24.1	24.2
Austria	0.8	0.8	0.8	0.8	0.8	0.8
Belgium	0.3	0.3	0.3	0.3	0.3	0.3
Bulgaria	0.3	0.3	0.3	0.3	0.3	0.3
Cyprus	0.1	0.1	0.1	0.1	0.1	0.1
Czech Republic	0.4	0.4	0.4	0.4	0.4	0.4
Denmark	0.3	0.3	0.3	0.3	0.3	0.3
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.2	0.2	0.2	0.2	0.2	0.2
France	4.2	4.2	4.2	4.2	4.2	4.2
Germany	3.1	3.1	3.1	3.1	3.1	3.1
Greece	0.9	0.9	0.9	0.9	0.9	0.9
Hungary	0.3	0.3	0.3	0.3	0.3	0.3
Ireland	0.2	0.2	0.2	0.2	0.2	0.2
Italy	3.8	3.8	3.8	3.8	3.9	3.9
Latvia	0.0	0.0	0.0	0.0	0.0	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
Luxembourg	0.1	0.1	0.1	0.1	0.1	0.1
Malta	0.1	0.1	0.1	0.1	0.1	0.1
Poland	0.7	0.7	0.7	0.7	0.7	0.7
Portugal	0.4	0.4	0.4	0.4	0.4	0.4
Romania	0.4	0.4	0.4	0.4	0.4	0.4
Slovakia	0.2	0.2	0.2	0.2	0.2	0.2
Slovenia	0.1	0.1	0.1	0.1	0.1	0.1
Spain	2.7	2.7	2.7	2.7	2.8	2.8
Sweden	0.7	0.7	0.7	0.7	0.7	0.7
The Netherlands	1.0	1.0	1.0	1.0	1.0	1.0
United Kingdom	2.6	2.6	2.6	2.6	2.6	2.6
Croatia[a]	0.3	0.3	0.3	0.3	0.3	0.3

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A.2.26 Forecasts for stock of shower outlets in the non-domestic sector

Country	EU-27 stock (M units)			
	2020	2025	2030	2050
EU-27	24.3	24.4	24.5	24.5
Austria	0.8	0.8	0.8	0.8
Belgium	0.4	0.4	0.4	0.4
Bulgaria	0.3	0.3	0.3	0.3
Cyprus	0.1	0.1	0.1	0.1
Czech Republic	0.4	0.4	0.4	0.4
Denmark	0.3	0.3	0.3	0.3
Estonia	0.0	0.0	0.0	0.0
Finland	0.2	0.2	0.2	0.2
France	4.3	4.3	4.3	4.3
Germany	3.1	3.1	3.1	3.1
Greece	0.9	0.9	0.9	0.9
Hungary	0.3	0.3	0.3	0.3
Ireland	0.2	0.2	0.2	0.2
Italy	3.9	3.9	3.9	3.9
Latvia	0.0	0.0	0.0	0.0
Lithuania	0.0	0.0	0.1	0.1
Luxembourg	0.1	0.1	0.1	0.1
Malta	0.1	0.1	0.1	0.1
Poland	0.7	0.7	0.7	0.7
Portugal	0.4	0.4	0.4	0.4
Romania	0.4	0.4	0.4	0.4
Slovakia	0.2	0.2	0.2	0.2
Slovenia	0.1	0.1	0.1	0.1
Spain	2.8	2.8	2.8	2.8
Sweden	0.7	0.7	0.7	0.7
The Netherlands	1.0	1.0	1.0	1.0
United Kingdom	2.6	2.7	2.7	2.7
Croatia[a]	0.4	0.4	0.4	0.4
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.				

Table A2.27 Estimated sales of taps in the domestic sector

Country	EU-27 sales (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	74.6	74.8	74.8	75.2	75.4	75.7
Austria	1.2	1.2	1.2	1.2	1.2	1.2
Belgium	1.6	1.6	1.6	1.6	1.6	1.6
Bulgaria	1.2	1.2	1.2	1.2	1.2	1.2
Cyprus	1.4	1.4	1.4	1.4	1.4	1.4
Czech Republic	0.1	0.1	0.1	0.1	0.1	0.1
Denmark	0.9	0.9	0.9	0.9	0.9	0.9
Estonia	0.2	0.2	0.2	0.2	0.2	0.2
Finland	0.9	0.9	0.9	0.9	0.9	0.9
France	10.5	10.5	10.5	10.6	10.6	10.6
Germany	12.8	12.8	12.8	12.9	12.9	13.0
Greece	1.7	1.7	1.7	1.8	1.8	1.8
Hungary	1.4	1.4	1.4	1.4	1.4	1.4
Ireland	0.5	0.5	0.5	0.5	0.5	0.5
Italy	9.2	9.2	9.2	9.3	9.3	9.3
Latvia	0.5	0.5	0.5	0.5	0.5	0.5
Lithuania	0.4	0.4	0.4	0.4	0.4	0.4
Luxembourg	0.1	0.1	0.1	0.1	0.1	0.1
Malta	0.0	0.0	0.0	0.0	0.0	0.0
Poland	4.2	4.2	4.2	4.3	4.3	4.3
Portugal	1.9	1.9	1.9	1.9	1.9	1.9
Romania	2.7	2.7	2.7	2.7	2.7	2.7
Slovakia	0.6	0.6	0.6	0.6	0.6	0.6
Slovenia	0.3	0.3	0.3	0.3	0.3	0.3
Spain	8.0	8.0	8.0	8.0	8.1	8.1
Sweden	1.4	1.4	1.4	1.4	1.4	1.4
The Netherlands	2.3	2.3	2.3	2.3	2.3	2.3
United Kingdom	8.8	8.8	8.8	8.8	8.9	8.9
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.						

Table A2.28 Forecasts for sales of taps in the domestic sector

Country	EU-27 sales (M units)			
	2020	2025	2030	2050
EU-27	76.6	77.3	77.8	78.0
Austria	1.2	1.2	1.2	1.2
Belgium	1.6	1.6	1.6	1.7
Bulgaria	1.3	1.3	1.3	1.3
Cyprus	1.4	1.4	1.4	1.4
Czech Republic	0.1	0.1	0.1	0.1
Denmark	0.9	0.9	0.9	0.9
Estonia	0.2	0.2	0.2	0.2
Finland	0.9	0.9	0.9	0.9
France	10.8	10.9	10.9	11.0
Germany	13.1	13.2	13.3	13.4
Greece	1.8	1.8	1.8	1.8
Hungary	1.4	1.4	1.4	1.4
Ireland	0.5	0.5	0.6	0.6
Italy	9.5	9.5	9.6	9.6
Latvia	0.5	0.5	0.5	0.5
Lithuania	0.4	0.4	0.4	0.4
Luxembourg	0.1	0.1	0.1	0.1
Malta	0.0	0.0	0.0	0.0
Poland	4.3	4.4	4.4	4.4
Portugal	1.9	2.0	2.0	2.0
Romania	2.7	2.8	2.8	2.8
Slovakia	0.6	0.6	0.6	0.6
Slovenia	0.3	0.3	0.3	0.3
Spain	8.2	8.3	8.3	8.3
Sweden	1.5	1.5	1.5	1.5
The Netherlands	2.3	2.4	2.4	2.4
United Kingdom	9.0	9.1	9.1	9.2
Croatia[a]	n.a.	n.a.	n.a.	n.a.
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.				

Table A2.29 Estimated sales of shower valves in the domestic sector

Country	EU-27 sales (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	24.9	24.9	24.9	25.1	25.1	25.2
Austria	0.4	0.4	0.4	0.4	0.4	0.4
Belgium	0.5	0.5	0.5	0.5	0.5	0.5
Bulgaria	0.4	0.4	0.4	0.4	0.4	0.4
Cyprus	0.5	0.5	0.5	0.5	0.5	0.5
Czech Republic	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.3	0.3	0.3	0.3	0.3	0.3
Estonia	0.1	0.1	0.1	0.1	0.1	0.1
Finland	0.3	0.3	0.3	0.3	0.3	0.3
France	3.5	3.5	3.5	3.5	3.5	3.5
Germany	4.3	4.3	4.3	4.3	4.3	4.3
Greece	0.6	0.6	0.6	0.6	0.6	0.6
Hungary	0.5	0.5	0.5	0.5	0.5	0.5
Ireland	0.2	0.2	0.2	0.2	0.2	0.2
Italy	3.1	3.1	3.1	3.1	3.1	3.1
Latvia	0.2	0.2	0.2	0.2	0.2	0.2
Lithuania	0.1	0.1	0.1	0.1	0.1	0.1
Luxembourg	0.0	0.0	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.0	0.0	0.0
Poland	1.4	1.4	1.4	1.4	1.4	1.4
Portugal	0.6	0.6	0.6	0.6	0.6	0.6
Romania	0.9	0.9	0.9	0.9	0.9	0.9
Slovakia	0.2	0.2	0.2	0.2	0.2	0.2
Slovenia	0.1	0.1	0.1	0.1	0.1	0.1
Spain	2.7	2.7	2.7	2.7	2.7	2.7
Sweden	0.5	0.5	0.5	0.5	0.5	0.5
The Netherlands	0.8	0.8	0.8	0.8	0.8	0.8
United Kingdom	2.9	2.9	2.9	2.9	3.0	3.0
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.						

Table A2.30 Forecasts for the sales of shower valves in the domestic sector

Country	EU-27 sales (M units)			
	2020	2025	2030	2050
EU-27	25.5	25.8	25.9	26.0
Austria	0.4	0.4	0.4	0.4
Belgium	0.5	0.5	0.5	0.6
Bulgaria	0.4	0.4	0.4	0.4
Cyprus	0.5	0.5	0.5	0.5
Czech Republic	0.0	0.0	0.0	0.0
Denmark	0.3	0.3	0.3	0.3
Estonia	0.1	0.1	0.1	0.1
Finland	0.3	0.3	0.3	0.3
France	3.6	3.6	3.6	3.7
Germany	4.4	4.4	4.4	4.5
Greece	0.6	0.6	0.6	0.6
Hungary	0.5	0.5	0.5	0.5
Ireland	0.2	0.2	0.2	0.2
Italy	3.2	3.2	3.2	3.2
Latvia	0.2	0.2	0.2	0.2
Lithuania	0.1	0.1	0.1	0.1
Luxembourg	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.0
Poland	1.4	1.5	1.5	1.5
Portugal	0.6	0.7	0.7	0.7
Romania	0.9	0.9	0.9	0.9
Slovakia	0.2	0.2	0.2	0.2
Slovenia	0.1	0.1	0.1	0.1
Spain	2.7	2.8	2.8	2.8
Sweden	0.5	0.5	0.5	0.5
The Netherlands	0.8	0.8	0.8	0.8
United Kingdom	3.0	3.0	3.0	3.1
Croatia[a]	n.a.	n.a.	n.a.	n.a.
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.				

Table A2.31 Estimated sales of shower outlets in the domestic sector

Country	EU-27 sales (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	39.8	39.9	39.9	40.1	40.2	40.3
Austria	0.6	0.6	0.6	0.6	0.6	0.6
Belgium	0.8	0.8	0.8	0.8	0.9	0.9
Bulgaria	0.7	0.7	0.7	0.7	0.7	0.7
Cyprus	0.7	0.7	0.7	0.7	0.7	0.7
Czech Republic	0.0	0.0	0.0	0.1	0.1	0.1
Denmark	0.5	0.5	0.5	0.5	0.5	0.5
Estonia	0.1	0.1	0.1	0.1	0.1	0.1
Finland	0.5	0.5	0.5	0.5	0.5	0.5
France	5.6	5.6	5.6	5.6	5.7	5.7
Germany	6.8	6.8	6.8	6.9	6.9	6.9
Greece	0.9	0.9	0.9	0.9	0.9	0.9
Hungary	0.7	0.7	0.7	0.7	0.7	0.7
Ireland	0.3	0.3	0.3	0.3	0.3	0.3
Italy	4.9	4.9	4.9	5.0	5.0	5.0
Latvia	0.2	0.2	0.2	0.2	0.2	0.2
Lithuania	0.2	0.2	0.2	0.2	0.2	0.2
Luxembourg	0.0	0.0	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.0	0.0	0.0
Poland	2.3	2.3	2.3	2.3	2.3	2.3
Portugal	1.0	1.0	1.0	1.0	1.0	1.0
Romania	1.4	1.4	1.4	1.4	1.4	1.4
Slovakia	0.3	0.3	0.3	0.3	0.3	0.3
Slovenia	0.1	0.1	0.1	0.1	0.1	0.1
Spain	4.3	4.3	4.3	4.3	4.3	4.3
Sweden	0.8	0.8	0.8	0.8	0.8	0.8
The Netherlands	1.2	1.2	1.2	1.2	1.2	1.2
United Kingdom	4.7	4.7	4.7	4.7	4.7	4.7
Croatia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.						

Table A2.32 Forecasts for the sales of shower outlets in the domestic sector

Country	EU-27 sales (M units)			
	2020	2025	2030	2050
EU-27	40.8	41.2	41.5	41.6
Austria	0.6	0.6	0.6	0.6
Belgium	0.9	0.9	0.9	0.9
Bulgaria	0.7	0.7	0.7	0.7
Cyprus	0.8	0.8	0.8	0.8
Czech Republic	0.1	0.1	0.1	0.1
Denmark	0.5	0.5	0.5	0.5
Estonia	0.1	0.1	0.1	0.1
Finland	0.5	0.5	0.5	0.5
France	5.7	5.8	5.8	5.9
Germany	7.0	7.1	7.1	7.1
Greece	1.0	1.0	1.0	1.0
Hungary	0.7	0.8	0.8	0.8
Ireland	0.3	0.3	0.3	0.3
Italy	5.0	5.1	5.1	5.1
Latvia	0.3	0.3	0.3	0.3
Lithuania	0.2	0.2	0.2	0.2
Luxembourg	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.0
Poland	2.3	2.3	2.4	2.4
Portugal	1.0	1.0	1.1	1.1
Romania	1.5	1.5	1.5	1.5
Slovakia	0.3	0.3	0.3	0.3
Slovenia	0.1	0.1	0.1	0.1
Spain	4.4	4.4	4.4	4.4
Sweden	0.8	0.8	0.8	0.8
The Netherlands	1.2	1.3	1.3	1.3
United Kingdom	4.8	4.8	4.9	4.9
Croatia[a]	n.a.	n.a.	n.a.	n.a.

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.33 Estimated sales of taps in the non-domestic sector

Country	EU-27 sales (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	7.06	7.08	7.08	7.11	7.14	7.16
Austria	0.17	0.17	0.17	0.17	0.17	0.17
Belgium	0.12	0.12	0.12	0.12	0.12	0.12
Bulgaria	0.10	0.10	0.10	0.10	0.10	0.10
Cyprus	0.02	0.02	0.02	0.02	0.02	0.02
Czech Republic	0.15	0.15	0.15	0.15	0.15	0.15
Denmark	0.09	0.09	0.09	0.09	0.09	0.09
Estonia	0.02	0.02	0.02	0.02	0.02	0.02
Finland	0.07	0.07	0.07	0.07	0.07	0.08
France	1.00	1.00	1.00	1.01	1.01	1.01
Germany	1.24	1.24	1.24	1.25	1.25	1.26
Greece	0.16	0.16	0.16	0.16	0.16	0.16
Hungary	0.12	0.12	0.12	0.12	0.12	0.12
Ireland	0.06	0.06	0.06	0.06	0.06	0.06
Italy	0.81	0.81	0.81	0.82	0.82	0.82
Latvia	0.03	0.03	0.03	0.03	0.03	0.03
Lithuania	0.04	0.04	0.04	0.04	0.04	0.04
Luxembourg	0.01	0.01	0.01	0.01	0.01	0.02
Malta	0.14	0.14	0.14	0.14	0.15	0.15
Poland	0.35	0.35	0.35	0.35	0.35	0.35
Portugal	0.15	0.15	0.15	0.15	0.15	0.15
Romania	0.19	0.19	0.19	0.19	0.19	0.19
Slovakia	0.06	0.06	0.06	0.06	0.06	0.06
Slovenia	0.03	0.03	0.03	0.03	0.03	0.03
Spain	0.67	0.68	0.68	0.68	0.68	0.68
Sweden	0.17	0.17	0.17	0.17	0.17	0.17
The Netherlands	0.14	0.14	0.14	0.14	0.14	0.14
United Kingdom	0.27	0.27	0.27	0.28	0.28	0.28
Croatia[a]	0.04	0.04	0.04	0.04	0.04	0.04

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.34 Forecasts for the sales of taps in the non-domestic sector

Country	EU-27 sales (M units)			
	2020	2025	2030	2050
EU-27	7.25	7.31	7.31	7.31
Austria	0.18	0.18	0.18	0.18
Belgium	0.13	0.13	0.13	0.13
Bulgaria	0.10	0.10	0.10	0.10
Cyprus	0.02	0.02	0.02	0.02
Czech Republic	0.16	0.16	0.16	0.16
Denmark	0.09	0.09	0.09	0.09
Estonia	0.02	0.02	0.02	0.02
Finland	0.08	0.08	0.08	0.08
France	1.03	1.04	1.04	1.04
Germany	1.27	1.28	1.28	1.28
Greece	0.17	0.17	0.17	0.17
Hungary	0.12	0.12	0.12	0.12
Ireland	0.06	0.06	0.06	0.06
Italy	0.83	0.84	0.84	0.84
Latvia	0.03	0.03	0.03	0.03
Lithuania	0.04	0.04	0.04	0.04
Luxembourg	0.02	0.02	0.02	0.02
Malta	0.15	0.15	0.15	0.15
Poland	0.35	0.36	0.36	0.36
Portugal	0.16	0.16	0.16	0.16
Romania	0.19	0.19	0.19	0.19
Slovakia	0.06	0.06	0.06	0.06
Slovenia	0.03	0.03	0.03	0.03
Spain	0.69	0.70	0.70	0.70
Sweden	0.17	0.17	0.17	0.17
The Netherlands	0.14	0.15	0.15	0.15
United Kingdom	0.28	0.28	0.28	0.28
Croatia[a]	0.04	0.04	0.04	0.04

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.35 Estimated sales of shower valves in the non-domestic sector

Country	EU-27 sales (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	2.39	2.39	2.39	2.41	2.41	2.42
Austria	0.08	0.08	0.08	0.08	0.08	0.08
Belgium	0.03	0.03	0.03	0.03	0.03	0.03
Bulgaria	0.03	0.03	0.03	0.03	0.03	0.03
Cyprus	0.01	0.01	0.01	0.01	0.01	0.01
Czech Republic	0.04	0.04	0.04	0.04	0.04	0.04
Denmark	0.03	0.03	0.03	0.03	0.03	0.03
Estonia	0.00	0.00	0.00	0.00	0.00	0.00
Finland	0.02	0.02	0.02	0.02	0.02	0.02
France	0.42	0.42	0.42	0.42	0.42	0.42
Germany	0.31	0.31	0.31	0.31	0.31	0.31
Greece	0.09	0.09	0.09	0.09	0.09	0.09
Hungary	0.03	0.03	0.03	0.03	0.03	0.03
Ireland	0.02	0.02	0.02	0.02	0.02	0.02
Italy	0.38	0.38	0.38	0.38	0.39	0.39
Latvia	0.00	0.00	0.00	0.00	0.00	0.00
Lithuania	0.00	0.00	0.00	0.00	0.00	0.00
Luxembourg	0.01	0.01	0.01	0.01	0.01	0.01
Malta	0.01	0.01	0.01	0.01	0.01	0.01
Poland	0.07	0.07	0.07	0.07	0.07	0.07
Portugal	0.04	0.04	0.04	0.04	0.04	0.04
Romania	0.04	0.04	0.04	0.04	0.04	0.04
Slovakia	0.02	0.02	0.02	0.02	0.02	0.02
Slovenia	0.01	0.01	0.01	0.01	0.01	0.01
Spain	0.27	0.27	0.27	0.27	0.28	0.28
Sweden	0.07	0.07	0.07	0.07	0.07	0.07
The Netherlands	0.10	0.10	0.10	0.10	0.10	0.10
United Kingdom	0.26	0.26	0.26	0.26	0.26	0.26
Croatia[a]	0.03	0.03	0.03	0.03	0.03	0.03

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.36 Forecasts for sales of shower valves in the non-domestic sector

Country	EU-27 sales (M units)			
	2020	2025	2030	2050
EU-27	2.45	2.47	2.49	2.50
Austria	0.08	0.08	0.08	0.08
Belgium	0.04	0.04	0.04	0.04
Bulgaria	0.03	0.03	0.03	0.03
Cyprus	0.01	0.01	0.01	0.01
Czech Republic	0.04	0.04	0.04	0.04
Denmark	0.03	0.03	0.03	0.03
Estonia	0.00	0.00	0.00	0.00
Finland	0.02	0.02	0.02	0.02
France	0.43	0.43	0.44	0.44
Germany	0.31	0.32	0.32	0.32
Greece	0.09	0.09	0.09	0.09
Hungary	0.03	0.03	0.03	0.03
Ireland	0.02	0.02	0.02	0.02
Italy	0.39	0.39	0.40	0.40
Latvia	0.00	0.00	0.00	0.00
Lithuania	0.01	0.01	0.01	0.01
Luxembourg	0.01	0.01	0.01	0.01
Malta	0.01	0.01	0.01	0.01
Poland	0.07	0.07	0.07	0.07
Portugal	0.04	0.04	0.04	0.04
Romania	0.04	0.04	0.04	0.04
Slovakia	0.02	0.02	0.02	0.02
Slovenia	0.01	0.01	0.01	0.01
Spain	0.28	0.28	0.28	0.28
Sweden	0.07	0.07	0.07	0.07
The Netherlands	0.10	0.10	0.10	0.10
United Kingdom	0.27	0.27	0.27	0.27
Croatia[a]	0.04	0.04	0.04	0.04
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.				

Table A2.37 Estimated sales of shower outlets in the non-domestic sector

Country	EU-27 sales (M units)					
	2010	2011	2012	2013	2014	2015
EU-27	3.41	3.42	3.42	3.44	3.45	3.46
Austria	0.11	0.11	0.11	0.11	0.11	0.11
Belgium	0.05	0.05	0.05	0.05	0.05	0.05
Bulgaria	0.04	0.04	0.04	0.04	0.04	0.04
Cyprus	0.01	0.01	0.01	0.01	0.01	0.01
Czech Republic	0.06	0.06	0.06	0.06	0.06	0.06
Denmark	0.05	0.05	0.05	0.05	0.05	0.05
Estonia	0.01	0.01	0.01	0.01	0.01	0.01
Finland	0.03	0.03	0.03	0.03	0.03	0.03
France	0.60	0.60	0.60	0.60	0.60	0.61
Germany	0.44	0.44	0.44	0.44	0.44	0.44
Greece	0.13	0.13	0.13	0.13	0.13	0.13
Hungary	0.04	0.04	0.04	0.04	0.04	0.04
Ireland	0.02	0.02	0.02	0.02	0.02	0.02
Italy	0.54	0.55	0.55	0.55	0.55	0.55
Latvia	0.01	0.01	0.01	0.01	0.01	0.01
Lithuania	0.01	0.01	0.01	0.01	0.01	0.01
Luxembourg	0.01	0.01	0.01	0.01	0.01	0.01
Malta	0.01	0.01	0.01	0.01	0.01	0.01
Poland	0.10	0.10	0.10	0.10	0.10	0.10
Portugal	0.06	0.06	0.06	0.06	0.06	0.06
Romania	0.05	0.05	0.05	0.05	0.05	0.05
Slovakia	0.02	0.02	0.02	0.02	0.02	0.02
Slovenia	0.01	0.01	0.01	0.01	0.01	0.01
Spain	0.39	0.39	0.39	0.39	0.39	0.39
Sweden	0.09	0.09	0.09	0.09	0.09	0.09
The Netherlands	0.14	0.14	0.14	0.14	0.14	0.14
United Kingdom	0.37	0.37	0.37	0.37	0.37	0.38
Croatia[a]	0.05	0.05	0.05	0.05	0.05	0.05

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

Table A2.38 Forecasts for sales of shower outlets in the non-domestic sector

Country	EU-27 sales (M units)			
	2020	2025	2030	2050
EU-27	3.50	3.53	3.56	3.57
Austria	0.11	0.12	0.12	0.12
Belgium	0.05	0.05	0.05	0.05
Bulgaria	0.04	0.04	0.04	0.04
Cyprus	0.01	0.01	0.01	0.01
Czech Republic	0.06	0.06	0.06	0.06
Denmark	0.05	0.05	0.05	0.05
Estonia	0.01	0.01	0.01	0.01
Finland	0.03	0.03	0.03	0.03
France	0.61	0.62	0.62	0.62
Germany	0.45	0.45	0.46	0.46
Greece	0.13	0.13	0.13	0.13
Hungary	0.04	0.04	0.04	0.04
Ireland	0.02	0.02	0.02	0.02
Italy	0.56	0.56	0.57	0.57
Latvia	0.01	0.01	0.01	0.01
Lithuania	0.01	0.01	0.01	0.01
Luxembourg	0.01	0.01	0.01	0.01
Malta	0.01	0.01	0.01	0.01
Poland	0.10	0.10	0.10	0.10
Portugal	0.06	0.06	0.06	0.06
Romania	0.05	0.05	0.05	0.05
Slovakia	0.02	0.02	0.02	0.02
Slovenia	0.01	0.01	0.01	0.01
Spain	0.40	0.40	0.41	0.41
Sweden	0.10	0.10	0.10	0.10
The Netherlands	0.14	0.14	0.14	0.15
United Kingdom	0.38	0.38	0.39	0.39
Croatia[a]	0.05	0.05	0.05	0.05
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.				

Table A2.39 Energy prices without taxes for household and industrial consumers

Country	Gas (2011)[417]		Oil (2011)[418] *		Electricity (2011)[419]	
	Household (EUR/GJ)	Industrial (EUR/GJ)	Household (EUR/1000 litres)	Industrial (EUR/t)	Household (EUR/kWh)	Industrial (EUR/kWh)
EU-27	11.94	8.96	606	437	0.128	0.093
Estimated annual price increase[420]	3%	3%	5%	5%	5%	5%
Austria	14.22	8.97	592	411	0.144	0.092
Belgium	14.08	8.72	590	376	0.157	0.098
Bulgaria	9.96	7.98	593	:	0.069	0.064
Cyprus	:	:	615	549	0.173	0.161
Czech Republic	12.60	8.36	582	321	0.123	0.110
Denmark	16.47	9.43	722	428	0.126	0.088
Estonia	9.07	7.31	608	:	0.070	0.062
Finland	:	9.34	671	:	0.108	0.069
France	13.43	9.86	624	418	0.099	0.072
Germany	12.08	11.58	592	:	0.141	0.090
Greece	:	:	606	459	0.103	0.092
Hungary	12.46	8.26	655	412	0.134	0.098
Ireland	11.69	9.90	708	296	0.158	0.112
Italy	12.25	8.24	643	439	0.140	0.115
Latvia	9.59	8.12	635	:	0.096	0.098
Lithuania	9.98	9.74	607	:	0.100	0.105
Luxembourg	12.72	11.58	587	:	0.145	0.096
Malta	:	:	561	537	0.162	0.180
Poland	10.46	9.11	586	456	0.115	0.096
Portugal	15.75	9.38	618	563	0.102	0.090
Romania	4.14	4.23	493	501	0.085	0.080
Slovakia	10.78	9.22	680	335	0.137	0.123
Slovenia	14.23	11.19	560	436	0.108	0.089
Spain	12.62	8.09	574	410	0.160	0.108
Sweden	18.32	11.71	563	501	0.138	0.089
The Netherlands	11.52	7.55	493	374	0.125	0.082
United Kingdom	11.24	6.47	610	:	0.137	0.094
Croatia[a]	8.48	11.24	:	:	0.092	0.090

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.
* referring to heating gas oil for "households" and to heavy oil for "industrial"

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[417] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00113&plugin=1

[418] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

[419] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00115&plugin=1

[420] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/meerp_methodology_part1_en.pdf

Table A2.40 Inflation rate across Member States (%)[421]

Country	2007	2008	2009	2010	2011	2012
EU-27	2.4	3.7	1	2.1	3.1	2.6
Austria	2.2	3.2	0.4	1.7	3.6	2.6
Belgium	1.8	4.5	0	2.3	3.4	2.6
Bulgaria	7.6	12	2.5	3	3.4	2.4
Cyprus	2.2	4.4	0.2	2.6	3.5	3.1
Czech Republic	3	6.3	0.6	1.2	2.1	3.5
Denmark	1.7	3.6	1.1	2.2	2.7	2.4
Estonia	6.7	10.6	0.2	2.7	5.1	4.2
Finland	1.6	3.9	1.6	1.7	3.3	3.2
France	1.6	3.2	0.1	1.7	2.3	2.2
Germany	2.3	2.8	0.2	1.2	2.5	2.1
Greece	3	4.2	1.3	4.7	3.1	1
Hungary	7.9	6	4	4.7	3.9	5.7
Ireland	2.9	3.1	-1.7	-1.6	1.2	1.9
Italy	2	3.5	0.8	1.6	2.9	3.3
Latvia	10.1	15.3	3.3	-1.2	4.2	2.3
Lithuania	5.8	11.1	4.2	1.2	4.1	3.2
Luxembourg	2.7	4.1	0	2.8	3.7	2.9
Malta	0.7	4.7	1.8	2	2.5	3.2
Poland	2.6	4.2	4	2.7	3.9	3.7
Portugal	2.4	2.7	-0.9	1.4	3.6	2.8
Romania	4.9	7.9	5.6	6.1	5.8	3.4
Slovakia	1.9	3.9	0.9	0.7	4.1	3.7
Slovenia	3.8	5.5	0.9	2.1	2.1	2.8
Spain	2.8	4.1	-0.2	2	3.1	2.4
Sweden	1.7	3.3	1.9	1.9	1.4	0.9
The Netherlands	1.6	2.2	1	0.9	2.5	2.8
United Kingdom	2.3	3.6	2.2	3.3	4.5	2.8
Croatia[a]	2.7	5.8	2.2	1.1	2.2	3.4

(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.

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[421] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00118

Table A2.41 Long-term interest rate (10-year average %)[422]

Country	2007	2008	2009	2010	2011	2012
EU-27	4.56	4.54	4.13	3.82	4.30	3.72
Austria	4.30	4.36	3.94	3.23	3.32	2.37
Belgium	4.33	4.42	3.90	3.46	4.23	3.00
Bulgaria	4.54	5.38	7.22	6.01	5.36	4.50
Cyprus	4.48	4.60	4.60	4.60	5.79	7.00
Czech Republic	4.30	4.63	4.84	3.88	3.71	2.78
Denmark	4.29	4.28	3.59	2.93	2.73	1.40
Estonia	:	:	:	:	:	:
Finland	4.29	4.29	3.74	3.01	3.01	1.89
France	4.30	4.23	3.65	3.12	3.32	2.54
Germany	4.22	3.98	3.22	2.74	2.61	1.50
Greece	4.50	4.80	5.17	9.09	15.75	22.50
Hungary	6.74	8.24	9.12	7.28	7.64	7.89
Ireland	4.31	4.53	5.23	5.74	9.60	6.17
Italy	4.49	4.68	4.31	4.04	5.42	5.49
Latvia	5.28	6.43	12.36	10.34	5.91	4.57
Lithuania	4.55	5.61	14.00	5.57	5.16	4.83
Luxembourg	4.46	4.61	4.23	3.17	2.92	1.82
Malta	4.72	4.81	4.54	4.19	4.49	4.13
Poland	5.48	6.07	6.12	5.78	5.96	5.00
Portugal	4.42	4.52	4.21	5.40	10.24	10.55
Romania	7.13	7.70	9.69	7.34	7.29	6.68
Slovakia	4.49	4.72	4.71	3.87	4.45	4.55
Slovenia	4.53	4.61	4.38	3.83	4.97	5.81
Spain	4.31	4.37	3.98	4.25	5.44	5.85
Sweden	4.17	3.89	3.25	2.89	2.61	1.59
The Netherlands	4.29	4.23	3.69	2.99	2.99	1.93
United Kingdom	5.06	4.50	3.36	3.36	2.87	1.74
Croatia[a]	:	:	:	:	6.54	6.13
(a) Where available, data for Croatia to be added to EU-27 to get EU-28 figures.						

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[422] http://epp.eurostat.ec.europa.eu/portal/page/portal/interest_rates/data/database

ANNEX III. SUPPORTING INFORMATION TO THE ENVIRONMENTAL AND ECONOMIC ASSESSMENT OF BASE CASES

Table A3.1. Environmental information considered for the production of ceramic[423]

Name of environmental impact		Units	Value
Other Resources and Waste	Primary Energy	MJ eq	24.1
	Electrical Energy	MJ eq	3.16
	Feedstock	MJ eq	0
	Water (process)	Litres	20.8
	Water (cooling)	Litres	17.2
	Haz. waste	Kg	0.001
	Non-Haz. waste	Kg	0.17
Air emissions	GWP	kg CO_2 eq	2.62
	AP	g SO_2 eq	3.94
	VOC	g	0.479
	POP	Ng TEQ	0
	Heavy Metals	mg Ni eq	1.6
	PAHs	mg Ni eq	5.58
	PM	g PM10 eq	18.3
Water emissions	Heavy Metals	mg Hg eq	10.1
	EP	g PO_4 eq	1.8

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[423] JRC-IPTS. "Developing an Evidence Base on Toilets and Urinals. Task 4: Base Case Assessment. Draft -Work in progress, European Commission - Joint Research Centre; May 2012.

Table A3.2 Life cycle environmental impacts of the use phase for the domestic taps

BASE CASE 1 – DOMESTIC TAP (16 years)						
UNITS		**USE PHASE (+ Electricity for water supply and waste water treatment)**				
		Energy mix for water heating	**Water consumption**	**Maintenance**	**Electricity for water supply and waste water treatment**	**Total**
Resources & Waste						
Total Energy (GER)	MJ eq	6908.11	646.13	1.16	2116.19	**9671.59**
of which, electricity (in primary MJ)	MJ eq	3982.35	646.13	0.18	2116.19	**6744.85**
Water (process)	l	0.00	142353.28	0.03	0.00	**142353.31**
Water (cooling)	l	176.99	28.72	0.31	94.05	**300.07**
Waste, hazardous/ incinerated	g	2052.24	332.97	0.03	1090.55	**3475.79**
Waste, non-haz./ landfill	g	62.83	10.19	2.02	33.39	**108.43**
Emissions (Air)						
Greenhouse Gases in GWP100	kg CO_2 eq	351.66	27.58	0.05	90.33	**469.63**
Acidification, emissions	g SO_2 eq	879.08	122.05	0.59	399.73	**1401.44**
Volatile Organic Compounds (VOC)	mg	91.65	14.43	0.00	47.26	**153.34**
Persistent Organic Pollutants (POP)	ng TEQ	9.29	1.51	0.48	4.94	**16.22**
Heavy Metals	mg Ni eq	40.27	6.53	0.79	21.40	**68.98**
PAHs	mg Ni eq	9.40	1.51	0.05	4.94	**15.89**
Particulate Matter (PM, dust)	g PM10 eq	18.09	2.58	0.03	8.46	**29.17**
Emissions (Water)						
Heavy Metals	mg Hg eq	17.14	2.78	0.16	9.11	**29.19**
Eutrophication	mg PO_4 eq	0.75	0.12	0.00	0.40	**1.28**

Table A3.3 Life cycle environmental impacts of the use phase for the non-domestic taps

BASE CASE 2 – NON-DOMESTIC TAP (10 years)						
UNITS		**USE PHASE (+ Electricity for water supply and waste water treatment)**				
		Energy mix for water heating	**Water consumption**	**Maintenance**	**Electricity for water supply and waste water treatment**	**Total**
Resources & Waste						
Total Energy (GER)	MJ eq	28930.92	1760.85	1.16	5770.89	**36463.81**
of which, electricity (in primary MJ)	MJ eq	16683.93	1760.85	0.18	5770.89	**24215.85**
Water (process)	l	0.00	387946.00	0.03	0.00	**387946.03**
Water (cooling)	l	741.51	78.26	0.03	256.48	**1076.29**
Waste, hazardous/ incinerated	g	8597.79	907.42	0.31	2973.93	**12479.45**
Waste, non-haz./ landfill	g	263.24	27.78	0.03	91.05	**382.10**
Emissions (Air)						
Greenhouse Gases in GWP100	kg CO_2 eq	1472.63	75.16	2.02	246.34	**1796.15**
Acidification, emissions	g SO_2 eq	3682.40	332.61	0.05	1090.06	**5105.11**
Volatile Organic Compounds (VOC)	mg	383.95	39.33	0.59	128.88	**552.75**
Persistent Organic Pollutants (POP)	ng TEQ	38.93	4.11	0.00	13.47	**56.50**
Heavy Metals	mg Ni eq	168.69	17.80	0.48	58.35	**245.33**
PAHs	mg Ni eq	39.37	4.11	0.79	13.47	**57.74**
Particulate Matter (PM, dust)	g PM10 eq	75.77	7.04	0.05	23.08	**105.95**
Emissions (Water)						
Heavy Metals	mg Hg eq	71.82	7.58	0.03	24.84	**104.27**
Eutrophication	mg PO_4 eq	3.15	0.33	0.00	1.09	**4.57**

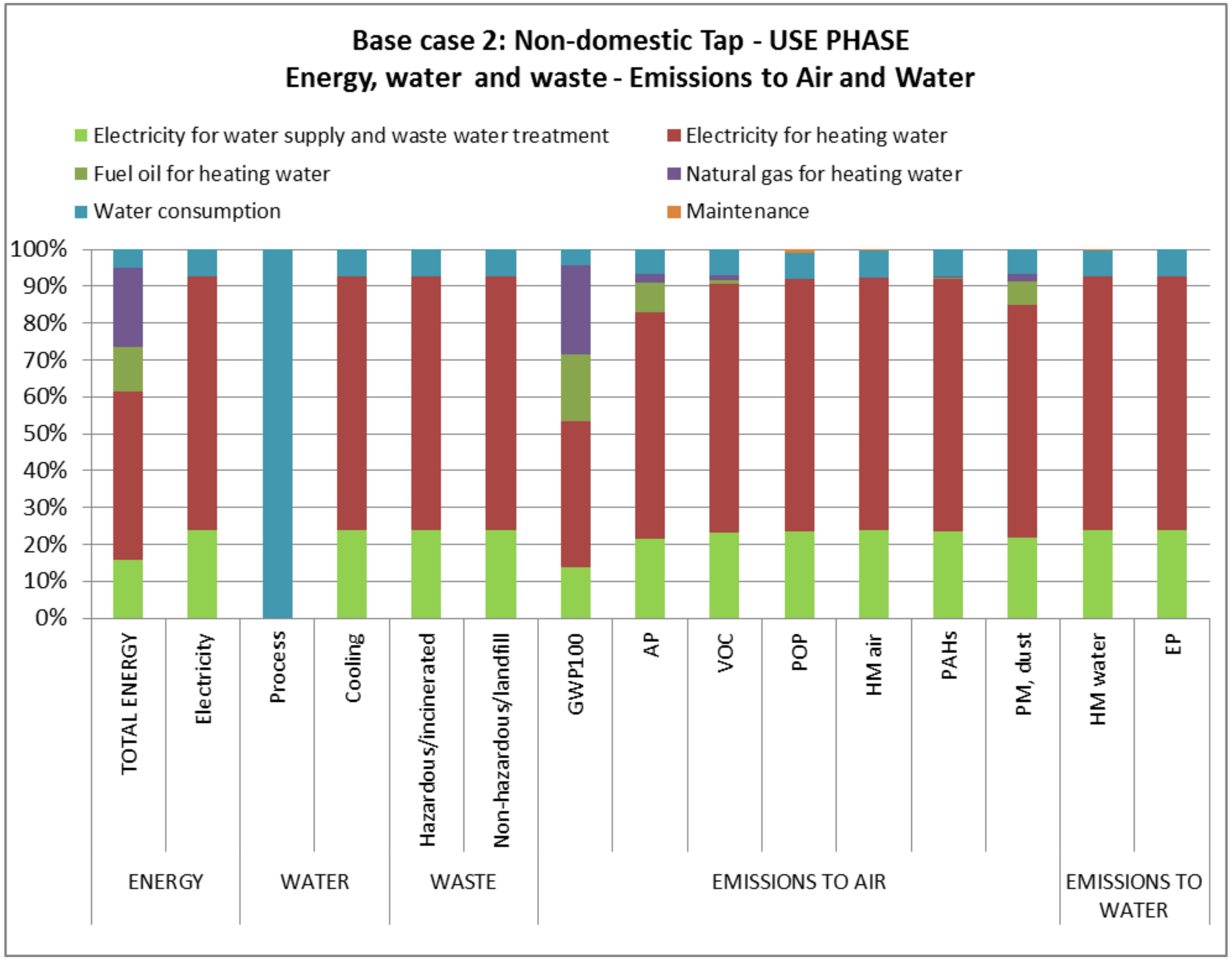

Figure A3.1 **Distribution of the environmental impacts of the use phase for the non-domestic tap**

Table A3.4 Life cycle environmental impacts of the use phase for the domestic shower system

BASE CASE 3 - DOMESTIC SHOWER SYSTEM (16 years)						
UNITS		USE PHASE (+ Electricity for water supply and waste water treatment)				
		Energy mix for water heating	Water consumption	Maintenance	Electricity for water supply and waste water treatment	Total
Resources & Waste						
Total Energy (GER)	MJ eq	85370.83	2011.97	3.38	6585.47	**93971.65**
of which, electricity (in primary MJ)	MJ eq	49223.60	2011.97	0.54	6585.47	**57821.58**
Water (process)	l	0.00	443271.68	0.11	0.00	**443271.79**
Water (cooling)	l	2187.72	89.42	2.09	292.69	**2571.92**
Waste, hazardous/ incinerated	g	25366.56	1036.83	0.13	3393.71	**29797.24**
Waste, non-haz./ landfill	g	776.64	31.74	5.15	103.90	**917.44**
Emissions (Air)						
Greenhouse Gases in GWP100	kg CO_2 eq	4345.70	85.88	0.15	281.11	**4712.85**
Acidification, emissions	g SO_2 eq	10865.17	380.04	1.65	1243.92	**12490.78**
Volatile Organic Compounds (VOC)	mg	1132.82	44.93	0.00	147.08	**1324.83**
Persistent Organic Pollutants (POP)	ng TEQ	114.86	4.69	1.12	15.37	**136.03**
Heavy Metals	mg Ni eq	497.71	20.34	2.08	66.59	**586.72**
PAHs	mg Ni eq	116.17	4.69	0.14	15.37	**136.37**
Particulate Matter (PM, dust)	G PM10 eq	223.56	8.05	0.11	26.34	**258.06**
Emissions (Water)						
Heavy Metals	mg Hg eq	211.89	8.66	0.45	28.35	**249.35**
Eutrophication	mg PO_4 eq	9.30	0.38	0.01	1.24	**10.93**

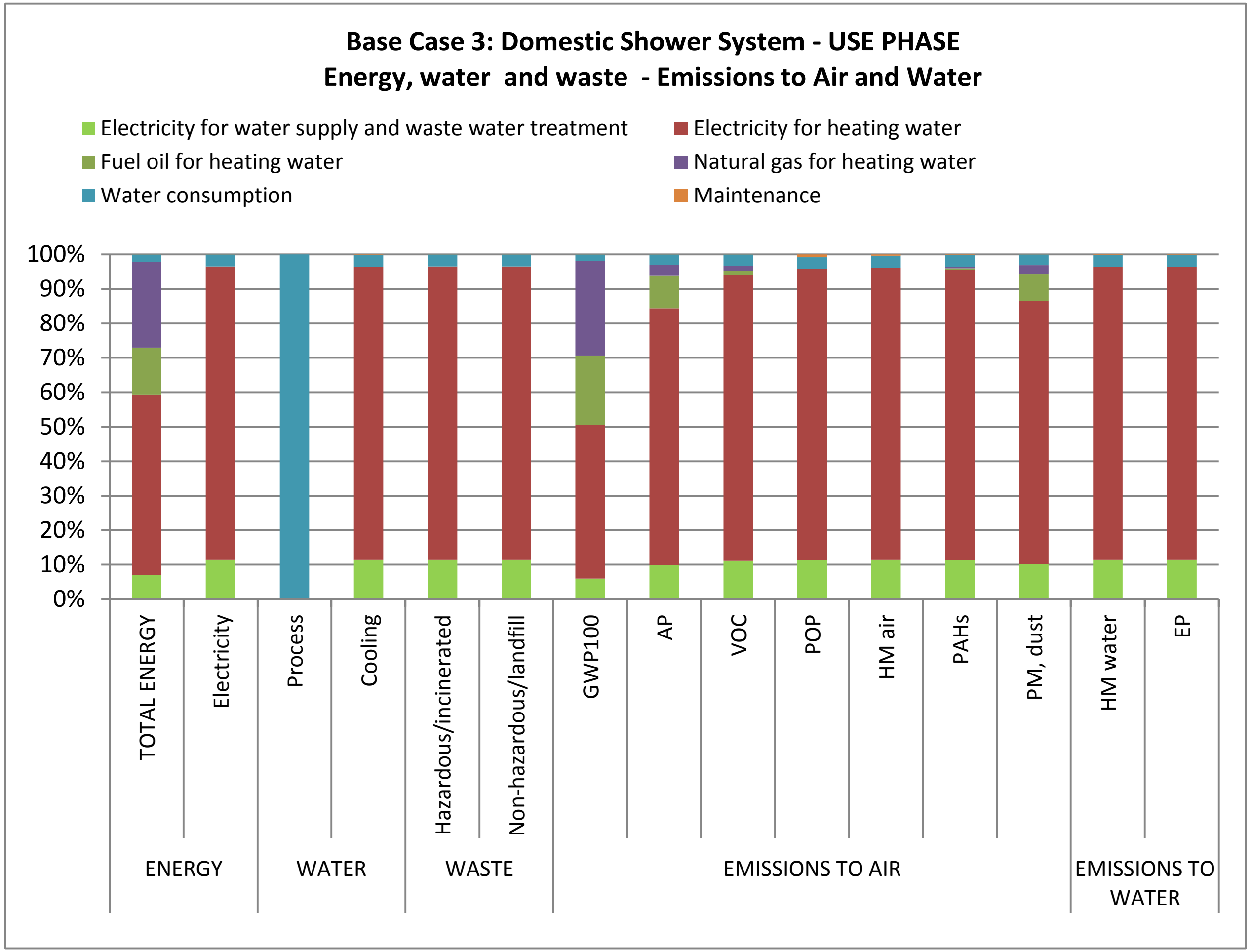

Figure A3.2 Distribution of the environmental impacts of the use phase for the domestic shower system

Table A3.5 Life cycle environmental impacts of the use phase for the non-domestic shower system

BASE CASE 4 - NON-DOMESTIC SHOWER SYSTEM (10 years)						
UNITS		**USE PHASE (+ Electricity for water supply and waste water treatment)**				
		Energy mix for water heating	**Water consumption**	**Maintenance**	**Electricity for water supply and waste water treatment**	**Total**
Resources & Waste						
Total Energy (GER)	MJ eq	38557.68	907.83	3.18	2974.41	**42443.10**
of which, electricity (in primary MJ)	MJ eq	22232.43	907.83	0.50	2974.41	**26115.17**
Water (process)	l	0.00	200010.80	0.11	0.00	**200010.91**
Water (cooling)	l	988.11	40.35	0.11	132.20	**1160.76**
Waste, hazardous/ incinerated	g	11457.11	467.84	1.94	1532.81	**13459.70**
Waste, non-haz./ landfill	g	350.78	14.32	0.12	46.93	**412.15**
Emissions (Air)						
Greenhouse Gases in GWP100	kg CO_2 eq	1962.71	38.75	4.88	126.97	**2133.31**
Acidification, emissions	g SO_2 eq	4907.31	171.48	0.15	561.83	**5640.77**
Volatile Organic Compounds (VOC)	mg	511.65	20.27	1.58	66.43	**599.93**
Persistent Organic Pollutants (POP)	ng TEQ	51.88	2.12	0.00	6.94	**60.94**
Heavy Metals	mg Ni eq	224.79	9.18	1.08	30.07	**265.13**
PAHs	mg Ni eq	52.47	2.12	1.99	6.94	**63.52**
Particulate Matter (PM, dust)	g PM10 eq	100.97	3.63	0.13	11.90	**116.63**
Emissions (Water)						
Heavy Metals	mg Hg eq	95.70	3.91	0.10	12.80	**112.52**
Eutrophication	mg PO_4 eq	4.20	0.17	0.00	0.56	**4.93**

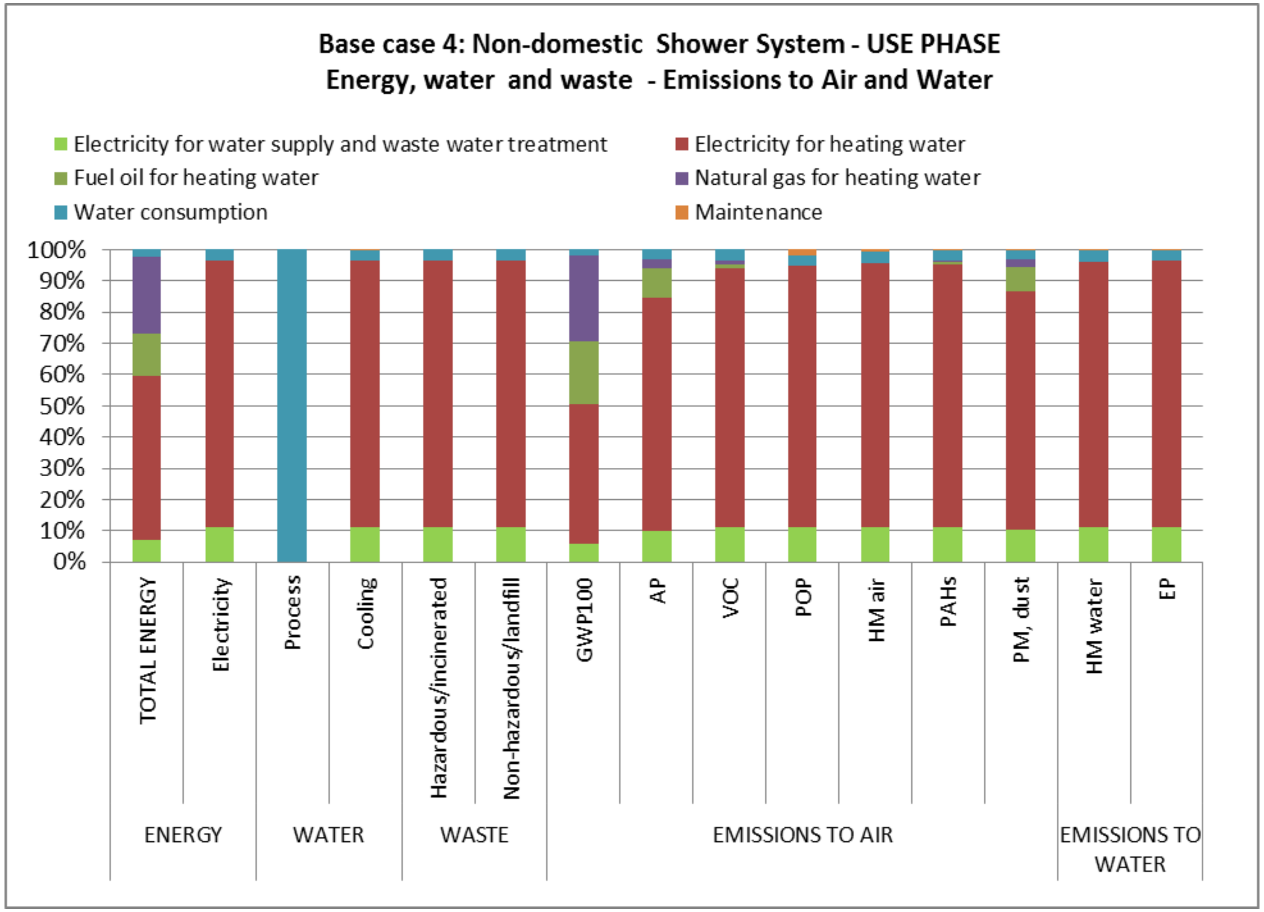

Figure A3.3 **Distribution of the environmental impacts of the use phase for the non-domestic shower system**

European Commission
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