ECOTAPWARE

Task 4: Base Case Assessment

September 2011

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1 Background and Approach

1.1 Background

The purpose of this pilot project is to develop a joint evidence base from which EU policy making in the area of water using products can be developed. In this project, EU Ecolabel and Green Public Procurement criteria will be devised for taps and showerheads. As part of the criteria development process, the MEEuP methodology will be used to demonstrate the key environmental life cycle impacts. The MEEuP methodology requires identification of a base case for the product group(s) the research. The base case is used to represent a typical product, the characteristics of which are then used as input to the EcoReport tool in order to provide the environmental life cycle impact per product.

For this study, to create a base case, bill of materials information was requested from stakeholders via a questionnaire. Unfortunately limited responses were received and additional detailed information in the public domain is not available. Consequently the work is based on this limited information and the composition of example products which were kindly provided by CEIR[1].

Feedback from stakeholders indicated they consider water consumption in the in-use phase to be the main life cycle impact and the materials used to manufacture the product of lesser importance. Establishing a base case for taps and showerheads is a challenge given the range of products on the market and the different materials used.

In addition to the questionnaire, additional requests for information have been made to other ecolabel and product labelling scheme organisations to identify material composition data and identify the basis upon which they decided the focus for their label ought to be upon the use phase. To date responses have indicated that they have focused on in use water consumption, and therefore do not have material composition information. No previous LCA studies for taps or showerheads have been identified by the research.

Given the paucity of data, a revised approach has been devised to address the base case assessment as outlined in Section 1.2 below.

In developing ecolabel criteria, the entire life cycle needs to be considered; therefore it is important to understand the key impacts and where they occur throughout the product life cycle in order to inform the focus for criteria development.

1.2 Approach

All label schemes identify in use water consumption as being the most significant environmental impact for the product group. Within this energy use for water heating is particularly important given that water efficiency improvements result in energy savings. Our approach was to determine the extent to which this holds true by using the EcoReport tool to explore the influence of material choice, amounts of material used, user behaviour and product lifetime.

In the absence of detailed composition data, we adopted different scenarios whereby the base case description could be perturbed to study the effects of changing any one or more

[1] CEIR – The European Committee for the Valve Industry

input variables such as material choice or product lifetime. The outputs from EcoReport would then provide us with an understanding of the relative importance of the specific input parameters which would in turn suggest where the ecolabel should focus its attention.

In terms of the input parameters, the following were studied with information as could best be obtained from product catalogues or from stakeholders, including CEIR who provided composition information for the taps and showerheads base-cases.

- Identification of typical materials used in their manufacture, for example:
    - Brass
    - Chrome plate
    - Rubber washers
    - Steel (nuts, screws etc)
    - Plastic

- The development of a typical user profile, to calculate in use water consumption. This will be based on the information collected and presented in the Scoping Document and Task 2 and 3 reports.

- Understand the environmental impacts of different materials, by comparing the life cycle impact of 1kg of different materials. This will help inform changes to the material composition variables and interpretation of the EcoReport outputs.

- The following parameters will then be varied e.g. +/- 50% to understand their influence on life cycle impacts:

    - Material Composition
    - Weight
    - Lifetime
    - In use water consumption i.e. used behaviour

  Only one parameter at a time will be varied against the starting scenario.

- Scenarios will be run to provide initial results, which will then be used to inform structured runs to provide a clear indication of the influences the different parameters have on life cycle impacts.

- The results will be interpreted, discussed and the implications for ecolabel proposals detailed.

2 Technical Analysis of Existing Products

2.1 Introduction

This chapter presents an overview of the different types of taps and showerheads available, the typical components they are made of and key technical issues relating to the use of the products and in particular those relevant to developing European Ecolabel criteria. It also includes details of the technical inputs for the EcoReport model for taps and showerheads. This comprises the following life cycle phases; production, distribution, in use and end of life.

EcoReport is a life cycle assessment tool developed for use as part of the European Commission's MEEuP Methodology for Preparatory Studies. The tool allows inputs to be varied, but all calculations/factors used by the tool are fixed. Full background information relating to the EcoReport methodology, a copy of the tool and example product cases is available from the European Commission's website[2]. The methodology report provides details of the various parameters included in the tool e.g. total energy and the environmental parameters. At the time of writing this report the EcoReport tool is being revised, however the calculations have been carried out with the initial version.

2.2 Product Description

Taps and showerheads for the domestic and non-domestic sectors come 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 different types of tap available have been summarised previously in Section 1.2.4 of the Task 1 report and Section 2.3 of the Task 2/3 report. They include for example mono bloc mixer taps and pillar taps. These reports are available from the project website[3].

In addition to these product descriptions, further technical information relating to the key components and mechanisms used in taps and showerheads is described below.

2.2.1 Taps

There are two main types of mechanisms used on taps currently available in the market; ceramic disc taps and traditional/conventional valve taps. In the main the key components are similar for both types, except for the valve mechanism. The sections below outline these two types of taps and their key components.

Traditional Spindle Taps:

Previously spindle taps were the only type of tap available, therefore their use is common across the EU as they can be used for both high and low pressure systems. The principle on which they operate is simple, with the flow rate controlled by turning the tap head. The tap

[2] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm
[3] http://susproc.jrc.ec.europa.eu/ecotapware/stakeholders.html

consists of a spindle with a valve seat attached to the bottom of the spindle. A washer is attached to the end of the valve seat and it is positioned over the hole through which water flows. As the handle is turned it moves the valve seat up or down to adjust the flow. This mechanism is shown in Figure 1.

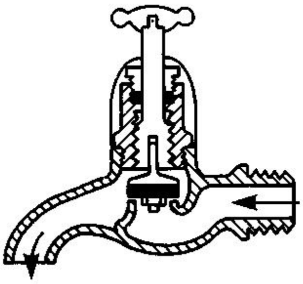


Figure 1: Spindle Tap Mechanism (*From: http://www.click4bathrooms.com/bathroom-images/bib-tap.JPG)*

Spindle taps typically consist of a number of common components which are shown in Figure 2 for a pillar tap:

Figure 2: *Components of a Spindle Tap (From: http://www.diydoctor.org.uk/projects/dripping_tap.htm)*

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 is the tap washer, o rings or regrinding of the valve seat where this has been eroded[4].

Using a spindle mechanism restricts the type of tap design it can be used with. For example it cannot be used with lever taps, as repetitive turning is required to open and close the tap.

Ceramic Disc Tap:

Ceramic disc taps operate differently to spindle taps in that there are two ceramic discs in the body allowing water to flow as they are separated when the handle is turned or lifted. This mechanism means the tap can be turned fully on and off by a quarter turn of the handle. Many components of a ceramic disc tap are the same as those of a spindle tap, however the mechanisms differ. The components of a ceramic disc tap are listed below, with Figure 3 illustrating an example for a single lever mixer tap:

- Spout (A)
- Tap cartridge (see below for further description of this part) (B)
- Handle (C)
- Retaining Screw (D)
- Screw cover/hot-cold indicator (E)

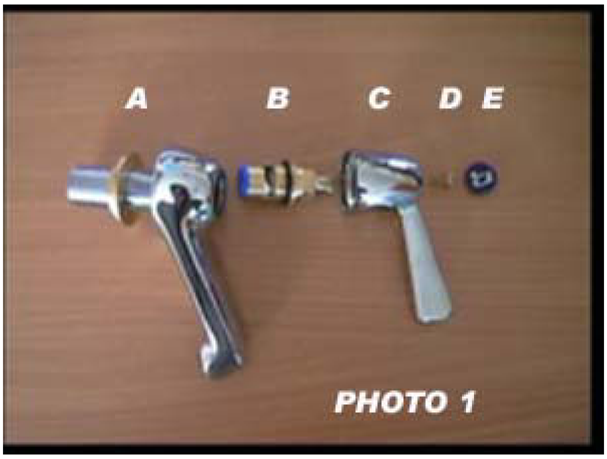


Figure 3: Components of a ceramic disc tap *(From: http://www.diydoctor.org.uk/projects/ceramic_disc_taps.htm)*

The tap cartridge consists of a number of parts itself, these are summarised below and shown in Figure 4:

- Disc retaining washer (A)
- Ceramic discs (B)
- O ring (C)
- Valve retaining nut (D)
- Spindle, on which the handle sits (E)

[4] http://www.diydoctor.org.uk/projects/dripping_tap.htm

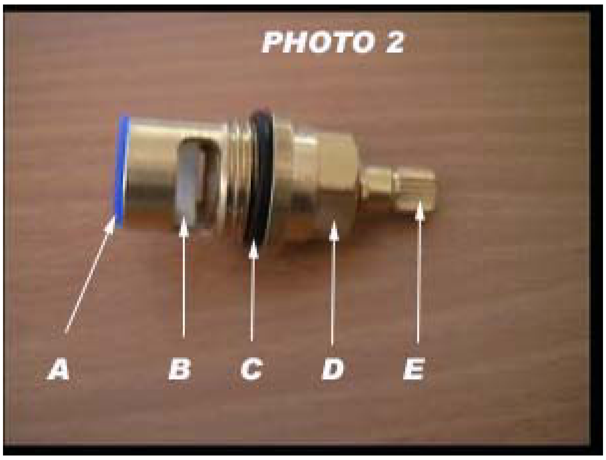


Figure 4: Components of a tap cartridge from a ceramic disc tap *(From: http://www.diydoctor.org.uk/projects/ceramic_disc_taps.htm)*

As with spindle taps, ceramic disc taps are designed to be hard wearing. The key component that wears is the ceramic discs; however they are designed to be durable and it is unusual for them to wear out completely and need replacing during the taps lifetime. If the ceramic discs do wear out and need replacing then it is usual for the tap cartridge to be replaced instead of the individual discs.

In general ceramic disc taps require a certain pressure at which to operate in order to provide an acceptable flow rate for the end user. However there isn't a single given pressure that can be stated at which ceramic disc taps will operate, as it will also depend on the design of the tap itself, for example the size and alignment of the discs, the diameter of the opening for which water can pass through and the resistance provided.

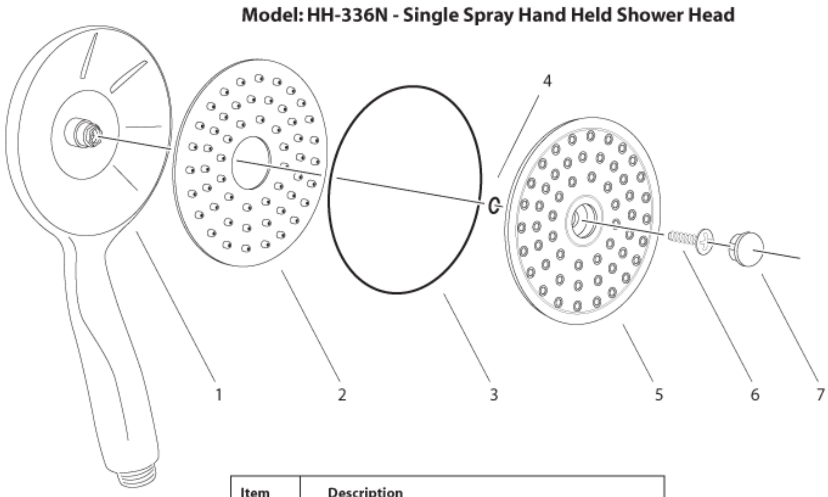
This means that ceramic disc taps can be designed to operate to low pressures e.g. 0.1 bar as well as higher pressure such as 0.5 bar or 1.0 bar and above, however given that the main low pressure market is the UK and pillar taps are still widely used in the UK in comparison to mainland Europe, the majority of ceramic disc taps are designed for higher pressure systems and not the low pressure systems. The important point to ensure an acceptable flow rate is achieved is to use a tap that is designed for the pressure system it is to be used with. It is therefore important the product information states the min/max pressure at which the tap can be used so the consumer can make an informed choice.

2.2.2 Showerheads

This project is focused on showerheads themselves, which form part of the overall shower system, which will also include aspects such as the valve e.g. mixer/thermostatic or electric shower unit.

The showerhead delivers water to the end user and is usually connected to the valve via a hose or if wall mounted a shower arm. There are many different designs and the components vary depending on the type and complexity of the showerhead, for example where they aerate the water or have built in flow regulators.

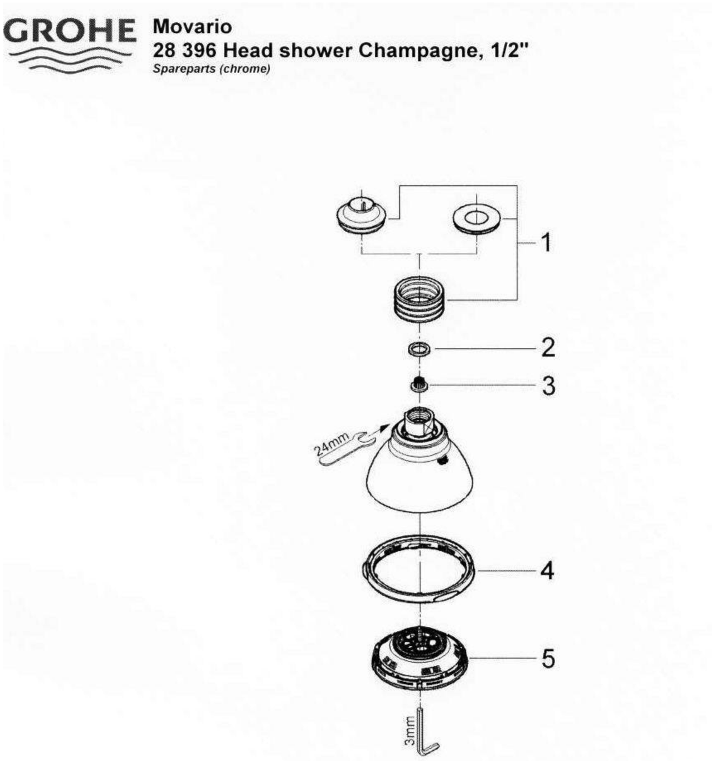
The components of some example products are shown below (Figure 5 to Figure 7) to provide an indication of the types of components used in showerheads.



Supplier:
Flowpoint
PO Box 42
Letchworth Garden City
SG6 1HQ
Tel: 01462 670566

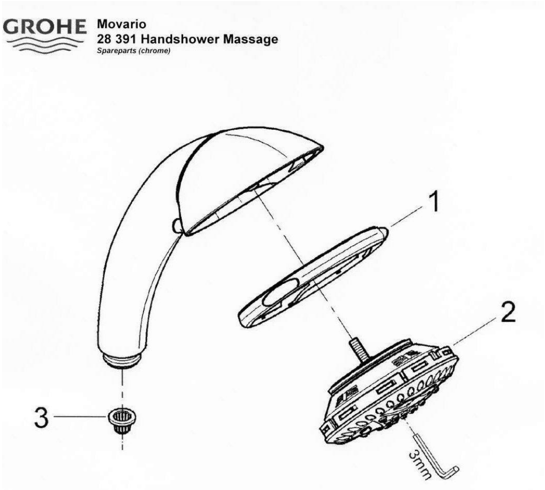
Item	Description
1.	Shower Handle & Head
2.	Inner Soft Rubber Moulding with Nozzles
3.	Large 86mm x 2mm Nitrile Seal
4.	Small 10mm x 1.5mm Nitrile Seal
5.	Plastic Rose Face
6.	Screw (Stainless Steel 'A2' 'Plastite Self Tapping 20mm)
7.	Plastic Cap

Figure 5: *Single Spray Showerhead (From: http://www.wayneansell.com/portfolio/hh-336n_diagram_lrg.png)*



1 – Bellow, 2 – Sealing Washer, 3 – Strainer, 4 – Adjusting Ring 5 – Spray Faceplate

Figure 6: Example showerhead (From: http://www.showerdoc.com/shower-spares/grohe/GROHE-PARENT-37-Grohe- movario-Head-Shower-Champagne-1-2in-28-396)



1 – Adjusting Ring, 2 – Spray faceplate, 3 – Strainer

Figure 7: *Example Showerhead (From: http://www.showerdoc.com/shower-spares/grohe/GROHE-PARENT-32-Grohe-Movario-Handshower-Massage-28-391)*

The following components are common in different showerhead designs:

- Showerhead Body
- Spay disc/plate
- Seals e.g. Nitrile seals
- Flow Regulator / Aerator mechanisms depending on the product design

Further details regarding flow regulator and aerator mechanisms for both taps and showerheads are included in the Task 5 BAT/BNAT Report for this project.

2.3 Technical Inputs for EcoReport

EcoReport requires a number of technical inputs across the different life cycle phases; production, distribution, in use and end of life. These are described in the following sections.

2.3.1 Production Phase

Insight into the material composition of taps and showerheads has been provided through stakeholder engagement, including questionnaire responses and direct contact through telephone conversations and meetings.

Taps and showerheads on the European market come in a variety of designs, using a range of materials. Earlier reports in this project for Task 1 Product Definition and Tasks 2 and 3 Economic and Market analysis and User Behaviour analysis provide further details regarding the types of taps and showerhead available, for example pillars, mono-blocs etc. These reports are available through the project website[5].

Stakeholder feedback has indicated that taps are mostly of brass construction with a chrome plating finish, and this is unlikely to change in the short to medium term. This is also confirmed by a review of the type of taps available through retailers. For basin taps stakeholders indicated that the market trend is towards mixer taps over pillar taps, although this possibly varies between different member states.

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

In addition to brass/chrome plated taps, there is a trend towards stainless steel taps, however stakeholder feedback suggested that these are currently a very low percentage of the market, although an exact figure is not provided.

Product specific information relating to material composition for taps and showerheads has been provided by industry and specifically CEIR who discussed and then provided the base case information used in this report. The composition for two example taps, one brass, one stainless steel and two showerheads, one mainly plastic, the other metal has been provided.

Due to the wide range of materials and designs the composition information provided is not typical of all products on the markets, but provides examples of products that are commonly available.

2.3.2 Distribution Phase

Bill of material information has not been secured for specific products; however the indication from retail stores is that taps and showerheads are predominately supplied in cardboard packaging together with smaller amounts of plastic e.g. LDPE bags.

2.3.3 Use Phase

The purpose of this section is to identify the resource consumption associated with taps and showerheads throughout their lifetime.

The two main resources consumed during the use phase of taps and showerheads are water and energy for the heating of water. In order to calculate the consumption for these two resources a number of assumptions have been made, these are presented below as a series of steps. Both domestic and non-domestic use of taps and showerheads is considered.

It is important to note that the impacts related to the use of taps and showerheads will also be influenced by the type of system they are used within.

Step 1: Calculation of total water use for taps and showerheads

The calculation of water use for taps and showerheads is split into domestic and non domestic and is based on the data presented in the IPTS Scoping Report (February 2010).

Domestic:

The domestic EU 27 average water consumption uses the data presented in the scoping report. The following water use accordingly to purpose are included to calculate total water use through **taps and showerheads**, together with the assumptions outlined. These are based on information presented in the Scoping Report.

- Personal hygiene (bathing and showering): 60% for showering and other personal hygiene e.g. hand washing, washing and teeth brushing, the remaining 40% is assumed to be for bathing.
- Washing clothes: 5% of water consumption is from taps i.e. hand washing
- Dish washing: 75% of water consumption is from taps i.e. hand washing
- Room cleaning, garden irrigation and car wash: 77% of water consumption is from taps
- Drinking and cooking: 100% of water consumption is from taps
- Other: 100% of water consumption is from taps

Based on this data and assumptions, the average EU27 water consumption from taps and showerheads is approximately 75 litres / person / day.

The following assumptions are made for **taps** to calculate water consumption per tap per year:

- 76% of the combined water use is for taps – see Note 1 below
- 5 taps per household are assumed, based on stakeholder/questionnaire information
- The average number of people per household is 2.5. This is the same factor as used in the EuP Boilers Study – Task 3, Section 3.6

Based on these assumptions, domestic water consumption per tap per year is 10,402 litres.

The following assumptions are made for **showerheads** to calculate water consumption per showerhead per year:

- 24% of the combined water use is for showerheads – see Note 1 below
- An average of 1.25 showerheads per household is assumed, based on stakeholder/questionnaire information
- The average number of people per household is 2.5. This is the same factor as used in the EuP Boilers Study – Task 3, Section 3.

Based on these assumptions, domestic water consumption per showerhead per year is 13,140 litres.

Note 1:

Information from the Anglian100 project[6] indicates a split of water use between taps and showerheads as[7] shown in Table 1.

Table 1: Water Use spilt between taps and showerheads

Anglian100 Data	***Device***	***Litres/property/day***	
	Kitchen tap hot	*35*	
	Kitchen tap cold	*24*	
	Basin tap hot	*22*	
	Basin tap cold	*20*	
	Shower	*32*	
	TOTAL	*133*	
Calculation for the split of water use between taps and showerheads	***Device***	***Litres/property/day***	***% split***
	Taps	*101*	*76*
	Showers	*32*	*24*
	TOTAL	*133*	*100*

[6] From Appendix 2, Table 16 of Clarke A., Grant, N. and Thornton, J. (2009) Quantifying the energy and carbon effects of water saving – final report http://www.environment-agency.gov.uk/static/documents/Business/EA_EST_Water_Report_Full.pdf

[7] A similar split is also calculated when analysing the taps and shower information in Table 18 of WaterWise (2009) A Review – The Water and Energy Implications of Bathing and Showering Behaviours and Technologies http://www.waterwise.org.uk/images/site/Research/final%20water%20and%20energy%20implications%20of%20personal%20bathing%20-%20for%20est%20apr%2009.pdf

Non-Domestic

Data availability means that the water consumption from taps and showerheads for non-domestic use needs to be calculated in a different way.

The Scoping Report (Table 23) indicates the following:

- Total non domestic water consumption from basin and kitchen taps is 3615000 million litres per year.
- Total non domestic water consumption from bathtub/showerheads is 723000 million litres per year.

To calculate non domestic water consumption from showerheads only i.e. excluding bathtubs, it is assumed the split is 50:50 between showerheads and bathtubs[8].

Based on the stock figures (2007) for non domestic taps and showerheads calculated in the Economic and Market Analysis Task the amount of water used per tap and showerhead can be calculated.

- Non domestic stock of taps = 69810000 units
- Non domestic stock of showerheads = 27908000 units

Calculated non domestic water consumption per year for taps and showerheads is:

- **Taps: 51,783 litres per tap per year**
- **Showerheads: 12,953 litres per showerhead per year**

Step 2: Calculation of hot water use

Taps:
The amount of domestic and non domestic hot water use per year from taps can be calculated based on the following assumption regarding stock and the split between hot and cold water.

The proportion of hot and cold water consumption will be estimated as follows:

- Cold water consumption: 44%
- Hot water consumption: 56%

This assumption is based on Anglian100 information, summarised in Table 2[9]:

Table 2: Hot and cold water consumption from taps

Anglian100 Data	**Device**	**Litres/property/day**	
	Kitchen tap hot	35	
	Kitchen tap cold	24	

[8] This assumption has been made in the absence of data to provide an alternative split.
[9] From Appendix 2, Table 16 of Clarke A., Grant, N. and Thornton, J. (2009) Quantifying the energy and carbon effects of water saving – final report http://www.environment-agency.gov.uk/static/documents/Business/EA_EST_Water_Report_Full.pdf

	Basin tap hot	22	
	Basin tap cold	20	
Calculation for the split of hot and cold water use from taps	**Device**	**Litres/property/day**	**% split**
	Total Cold	44	44
	Total Hot	57	56
	TOTAL	101	100

This is based on domestic water use, however in the absence of other data this assumption will also be used for calculating hot water consumption from non domestic use.

Calculated hot water use in domestic and non domestic taps is as follows:

- **Domestic Taps: 5,825 litres per tap per year**
- **Non Domestic Taps: 28,999 litres per tap per year**

Showerheads:
A mixer shower has been assumed as these are most prevalent in Europe. It is assumed the water is heated using a boiler with 70% efficiency. It is assumed that the hot and cold water mix ratio is 70:30, as suggested by guidance from Australia[10]. Similar guidance for the EU was not identified.

Using this assumption and the total water consumption for showerheads calculated in step 1, hot water use is calculated as follows:

- **Domestic Showerheads = 9198 per showerhead per year**
- **Non Domestic Showerheads = 9067 per showerhead per year**

Step 3: Calculation of Energy Consumption

The inputs for EcoReport with respect to energy consumption in the use phase are entered into EcoReport as electricity in kWh. This input has been calculated using the approach described below and is in respect to heating of water used by taps and showerheads,

The impact of the energy use is based on factors that were developed by VHK for EcoReport. These are built into the EcoReport tool and cannot be changed. Section 5.3.8 (page 97) of VHK's methodology report[11] outlines the assumptions made with regards the emissions and fuel mix for power generation.

Taps:

Based on the hot water consumption calculated in Steps 1 and 2, the following assumptions are used to quantify the in use energy consumption from tap hot water use. The same assumptions are used for domestic and non domestic use.

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[10] http://www.energy.wa.gov.au/cproot/2311/2/choose_hot_water.pdf
[11] Available from: http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm

- It is assumed energy use per litre is 0.092 kWh. This is based on the following:
    - 4200 (J/deg C/litre) * temperature increase (deg C) / energy efficiency / 3,600,000
    - Temperature increase is 55 deg C (from 5 to 60 deg C). This is based on guidance that a boiler should be set to operate at a minimum 60 deg C to kill legionella bacteria[12].
    - Boiler efficiency is assumed as 70%[13]

- The energy use per litre is used together with the hot water consumption calculated in step 2 to provide an input figure for the EcoReport tool, in kWh per year.

Table 3 summarises the EcoReport input figures.

Table 3: EcoReport Inputs for Use Phase Electricity for Taps

Use Type	kWh per tap per year
Domestic	536
Non Domestic	2668

Showerheads:

Based on the hot water consumption for a mixer shower, the same assumptions as for taps are used with respect to the heating of the water:

- It is assumed energy use per litre is 0.092 kWh. This is based on the following:
    - 4200 (J/deg C/litre) * temperature increase (deg C) / energy efficiency / 3,600,000
    - Temperature increase is 55 deg C (from 5 to 60 deg C). This is based on guidance that a boiler should be set to operate at a minimum of 60 deg C to kill legionella bacteria[14].
    - Boiler efficiency is assumed as 70%[15]

- The energy use per litre is used together with the hot water consumption calculated in step 2 to provide an input figure for the EcoReport tool, in kWh per year.

Table 4 summarises the EcoReport input figures.

[12] http://www.hse.gov.uk/pubns/indg376.pdf

[13] From Table 11 of Critchley, R. and Phipps, D (2007) Water and Energy Efficient Showers: Project Report http://www.unitedutilities.com/Documents/UULJMUwaterenergyefficientshowerFinalreport23rdMay2007.pdf

[14] http://www.hse.gov.uk/pubns/indg376.pdf

[15] From Table 11 of Critchley, R. and Phipps, D (2007) Water and Energy Efficient Showers: Project Report http://www.unitedutilities.com/Documents/UULJMUwaterenergyefficientshowerFinalreport23rdMay2007.pdf

Table 4 EcoReport Inputs for Use Phase Electricity for Showerheads

Use Type	kWh per showerhead per year
Domestic	846
Non Domestic	834

Other in Use Inputs

The use phase of taps and showerheads will, in addition to the water and energy use outlined above, require maintenance and repair during their life time. This may include replacement valves and washers. The frequency of the replacement of parts for taps and showerheads is not known, however information collected as part of the Economic and Market Analysis (Task 2) regarding the cost of the product, installation, repair/maintenance and utility prices i.e. for water and electricity are used in the analysis and in particular for the life cycle costs assessment.

2.3.4 End of Life Phase

Information in relation to consumer behaviour was examined as part of User Behaviour analysis task. The results of this analysis are included in the report for this task, which is available from the project website.

In summary the trends for end of life taps and showerheads are not clearly understood, with little research being undertaken in this area. Stakeholders have indicated that taps are generally recycled, due to their metal content which has value. This is also the case for metal showerheads; however the position is less clear for plastic showerheads. It is thought that many of these will be sent to landfill.

3 Base Cases

3.1 Taps – Setting up the Base Case

To understand where in the product life cycle the impacts occur example products have been used to generate an indication of the life cycle impacts over the different life cycle phases i.e. Production, Distribution, Use, End of Life.

As noted above, CEIR have provided information relating to material composition for two example taps, one mainly brass and the other stainless steel. Although brass, chrome plated taps are understood to be the dominant market type, there is some indication from stakeholders that stainless steel tap sales are growing within the market. In order to compare these two types of taps the information provided by CEIR has been used to undertake the base case assessment using the EcoReport Tool.

These two examples are considered typical products currently available on the market, although it should be noted that some products will use other materials depending on their design or application. A picture of the brass tap product is shown in Figure 8. A picture of the stainless steel base case was not available from CEIR. It is important to note that CEIR highlighted that stainless steel taps do not constitute a significant share of the market at the current time.

Figure 8: Image of the base case brass tap

3.2 Product Specific Inputs - Taps

3.2.1 Bill of Materials

The composition of the brass and stainless steel taps shown in Table 5 uses information provided by CEIR. These bills of material are used to represent both domestic and non-domestic taps.

Table 5 Bill of Materials - Brass Tap and Stainless Steel Tap

Product Type	Material	Weight (g)	Material code in EcoReport
Brass Tap	Brass (Body)	842	31-CuZn38 cast
	Nickel Chrome Plating	2	40-Cu/Ni/Cr plating
	Plastic	63	10-ABS
	Ceramic	21	24-Ferrite[16]
	Zinc	209	
Stainless Steel Tap	Stainless Steel (Body, including handle)	720	25-Stainless 18/8 Coil
	Nickel Chrome Plating	2	40-Cu/Ni/Cr plating
	Plastic	63	10-ABS
	Ceramic	21	24-Ferrite

3.2.2 Volume of packaged product

Limited information has been provided in relation to the volume of the packaged product. Therefore the packaging dimensions/volume for the purchased product has been used as a default. These are summarised in Table 6.

Table 6 Packaging dimensions and volume for taps

Dimensions (cm)	Volume (m3)
38.5(l)x18(w)x13(h)	0.009009

[16] Ceramic does not appear in the EcoReport's list of material. The Product Cases report written by the developers of EcoReport indicates 24 – Ferrite has been used to represent ceramic in other product group e.g. Room Air Conditioners and Central Heating Circulators. The report is available here: http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm

3.2.3 Use Phase

The inputs for the use phase are shown in Table 7. The same use phase inputs have been used for both the brass and stainless steel tap. The inputs differ for domestic and non domestic taps.

Table 7 Use Phase Water and Energy Inputs for taps

Parameter	Domestic Tap	Non Domestic Tap
Lifetime (years)	16	10
Electricity consumption (kWh/year)	536	2668
Water consumption (m3/year)	10.4	51.8

The inputs for water and energy are based on the assumptions outlined in Section 2.3.3.

The product life time is based on information gathered during the research for Task 2 and 3 - Economic and Market Analysis and User Behaviour.

3.3 Taps - Environmental Impact Assessment

A summary of the data generated by the EcoReport Tool, based on the inputs described in Section 3.2 is provided in Appendix 1. The impacts per product are illustrated graphically in Figure 9 to Figure 23). The graphs are plotted by base case type and life cycle phase to illustrate the comparison between the brass and stainless steel taps for the different environmental impact categories, together with commentary as appropriate.

It should be noted that for the majority of the environmental impact categories the use phase clearly has the highest impact, dominating the life cycle impact of the product. The results presented are in the main in relation to the domestic sector base case for taps. The same material composition for the non-domestic base case has been used; therefore the main difference in the results for domestic and non domestic taps is in relation to water use and energy used for the heating of water. Where these differences have an impact on the results for specific environmental indicators it has been highlighted in the discussion of the results below.

3.3.1 Resources and Waste

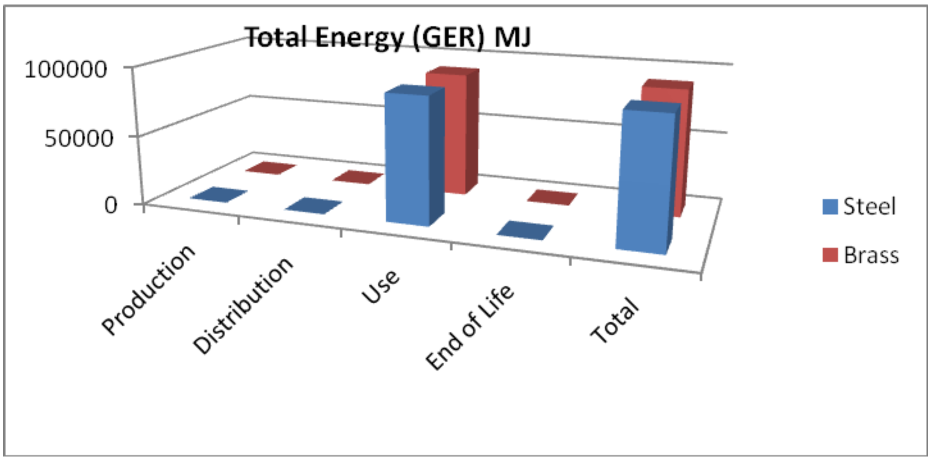

Figure 9 - Total Energy for Domestic Taps

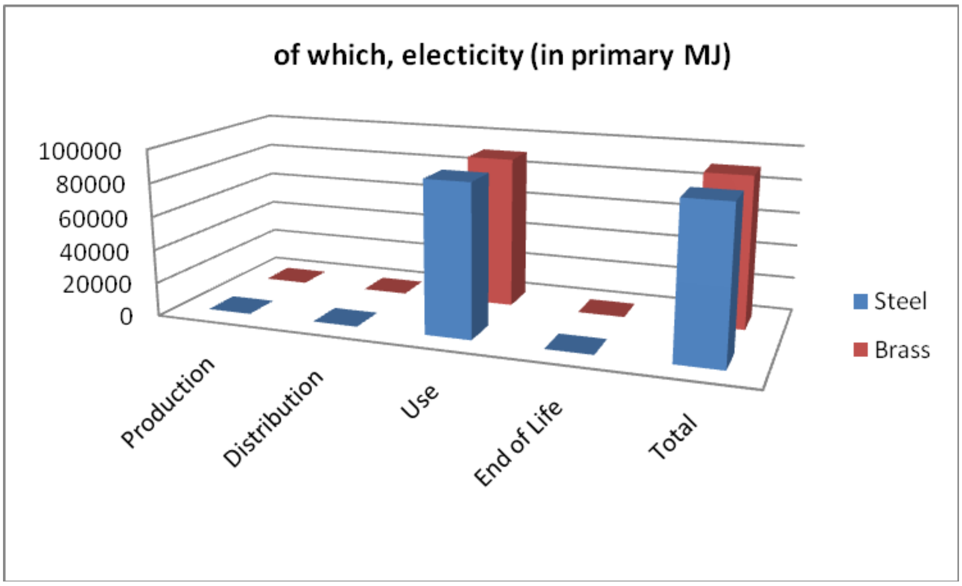

Figure 10 - Electricity for Domestic Taps

The total energy use is dominated by the energy used for the heating of water in the use phase. The in use impact includes not only the direct energy used to heat the water, but also non-product related energy use associated with aspects such as the fuel mix and electricity distribution losses which are predefined by EcoReport. Additional information regarding the assumption behind the environmental impact unit indicators can be found in the EcoReport methodology report[17]. Total energy in the production and manufacturing phase is dominated by the metals i.e. brass or steel used; however this is minor in comparison to the use phase total energy consumption.

The electricity element of the energy use in the production phase relates mainly to the material extraction and production of chrome plating for the brass tap and the material extraction and production of the chrome plating and metal manufacturing of the stainless steel for the steel tap.

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

The energy use in the distribution phase is focused on total energy, rather than electricity and will relate to the transportation associated with the distribution of the product.

Figure 9 and Figure 10 present the results for domestic taps. The same observations can be made for non-domestic taps, and even more so due to the higher water consumption and therefore energy consumption for heating water for non-domestic use.

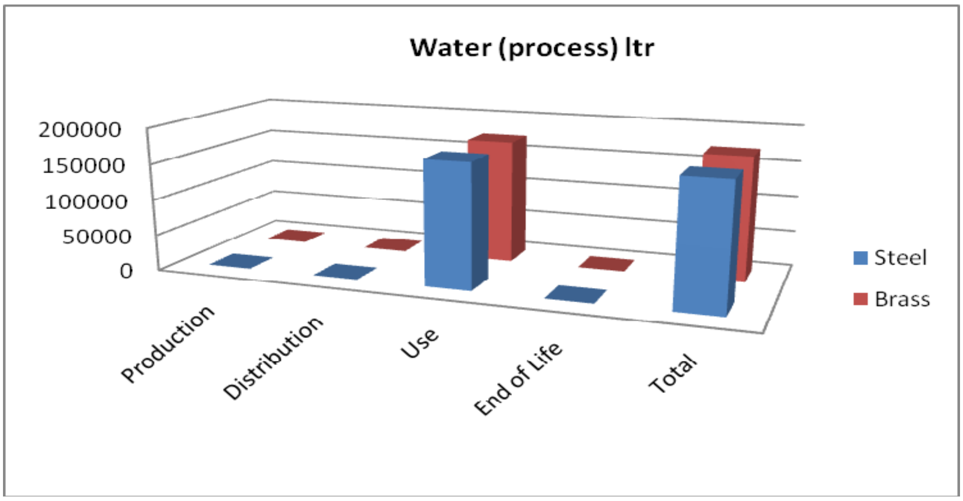

Figure 11 - Water (Process) for Taps

The high amount of process water in the use phase reflects the water consumption by the end user. This will be influenced by flow rate and the behaviour of the end user. Some water is also used in other life cycles phases, for example, during the material extraction and production, however this is insignificant compared to the use phase consumption. Readers should note that the in use water consumption entry in the EcoReport tool takes into account the distribution of the water and also waste water treatment[18]. The use phase water consumption also includes water use associated with the energy consumption in the use phase, however this is mainly cooling water rather than process water, see below.

Although process water is dominated by the use phase, there are some key points to highlight regarding process water in the production phase. Table 8 below shows the relative impact for process water of the different materials in the production phase. It is clear within the example of a product, that using stainless steel has more of an impact with regards process water than brass or chrome plate.

Table 8 Impact for process water in the production phase from different materials

Material	EcoReport Code	1kg of material	Brass Base Case	Stainless Steel Base Case
Brass	31-CuZn38 cast	0.019 litres	0 litres	N/A
Chrome Plate	40-Cu/Ni/Cr plating	187 litres	0.37 litres	0.37 litres
Stainless Steel	25-Stainless 18/8 coil	75.87 litres	N/A	54.53 litres

[18]MEEuP Methodology Report – VHK, November 2005
http://www.pre.nl/EUP/Download/default.htm

These values need to be kept in context so whilst the production water use for the stainless steel base case tap is 55 litres, the in use water consumption is in excess of 170,000 litres – a factor of three thousand times more.

Figure 11 above shows the situation for domestic use. The differences are even greater when the water use inputs for a non domestic tap are considered; this is in excess of 530,000 litres.

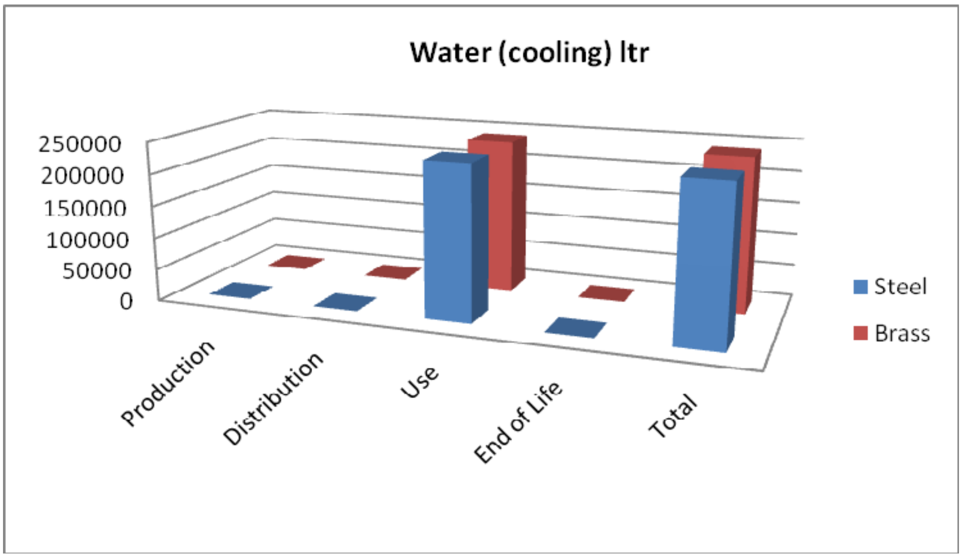

Figure 12 – Water (Cooling) for Taps

The amount of cooling water used throughout the life cycle is focused in the use phase and is again associated with the energy consumption used for the heating of water. Cooling water will be used to as part of the energy production process, and will for example be taken and returned to nearby rivers once it has been used for cooling. Based on the EcoReport inputs the amount of cooling water used is greater than the direct water use through the product itself (water (process)), highlighting the importance of the impact from energy use associated with taps.

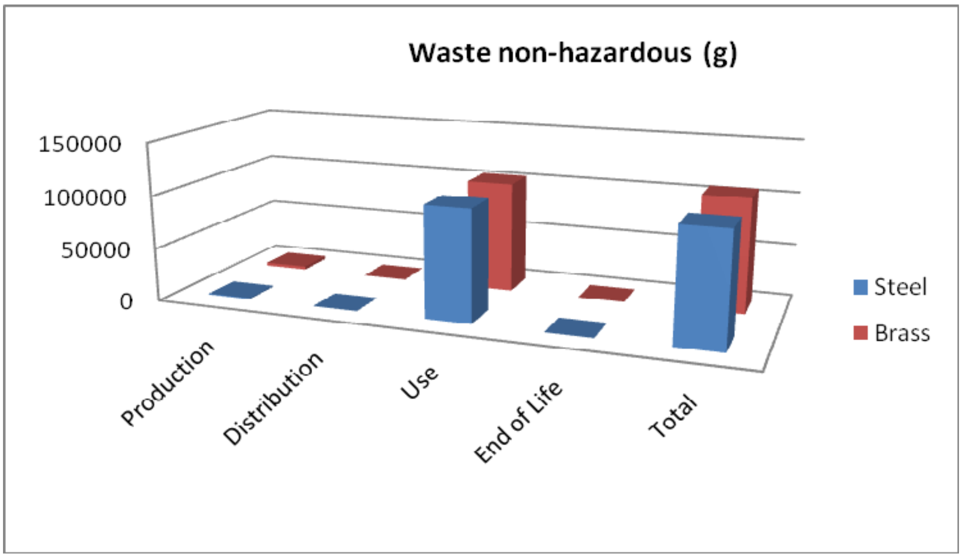

Figure 13 – Non Hazardous Waste for Taps

Again, the use phase dominates the non-hazardous waste production as a result of the energy use for heating of water, generating in excess of 100 kg of waste in both the brass and stainless steel tap base cases.

The results from the EcoReport tool, use phase aside, show that non-hazardous waste is generated mainly in the production phase. Scrutiny of the EcoReport outputs shows that the waste generated in the production phase is dominated by the processes for material extraction and production for both base cases. EcoReport does not identify specific waste types; however this may include waste from ore extraction processes or foundry waste related to the production of metals such as brass and steel. The end of life impacts relate to the disposal of the product.

Table 9 shows the relative impacts for non-hazardous waste for brass and stainless steel in the production phase:

Table 9 Non Hazardous waste in the production phase from brass and stainless steel

Material	EcoReport Code	1kg of material	Brass Base Case	Stainless Steel Base Case
Brass	31-CuZn38 cast	3049 g	2562 g	N/A
Stainless Steel	25-Stainless 18/8 coil	1047 g	N/A	720 g

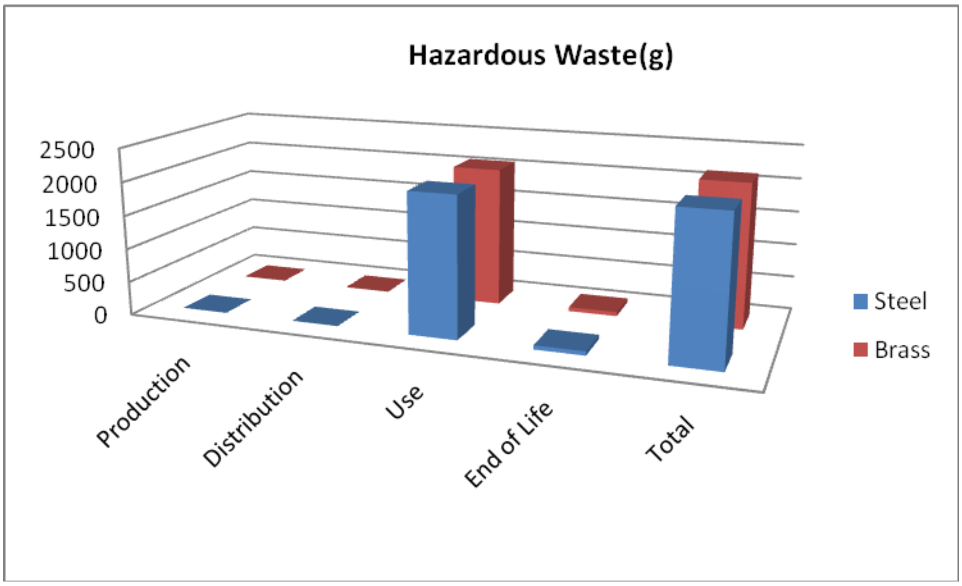

Figure 14 – Hazardous Waste for Taps

As with non-hazardous waste, hazardous waste generation is mainly associated with the use phase energy consumption, generating over 2 kg.

After the use phase, the end of life phase generates the most hazardous waste with 62g produced for both the brass and stainless steel base cases. The hazardous waste generation in the end of life phase calculated by EcoReport is associated with the 'Incineration of plastics/PWB not reused/recycled' and reflects the amount of plastic in the two base cases. This is based on the assumptions in the EcoReport model, and may not be wholly true for this product group, as the EcoReport tool was originally designed to be used with energy using products, many of which would contain Printed Wiring Boards (PWBs). As the base case taps do not include PWBs EcoReport may be forming an overestimate based on the assumptions used by the tool.

3.3.2 Emissions to Air

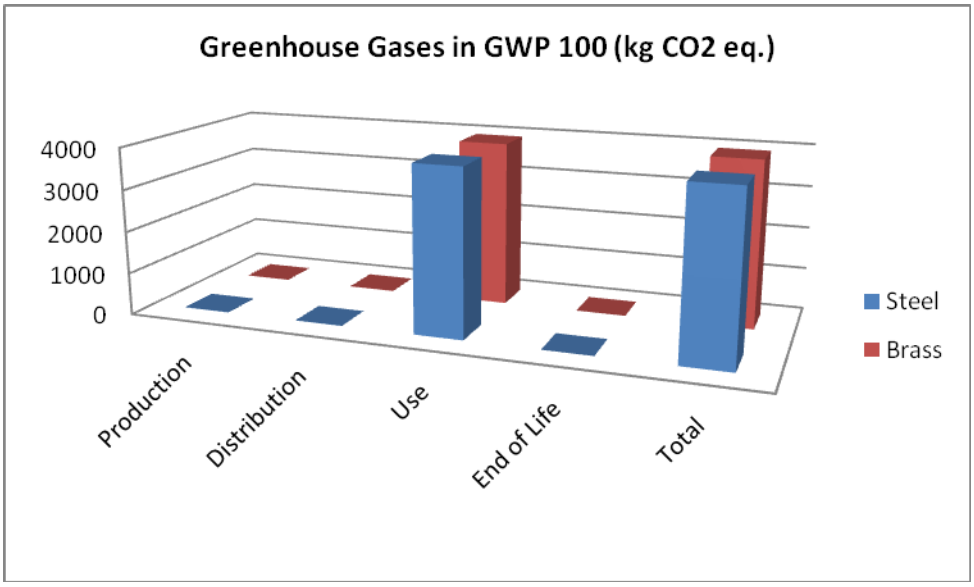

Figure 15 – Greenhouse Gases for Taps

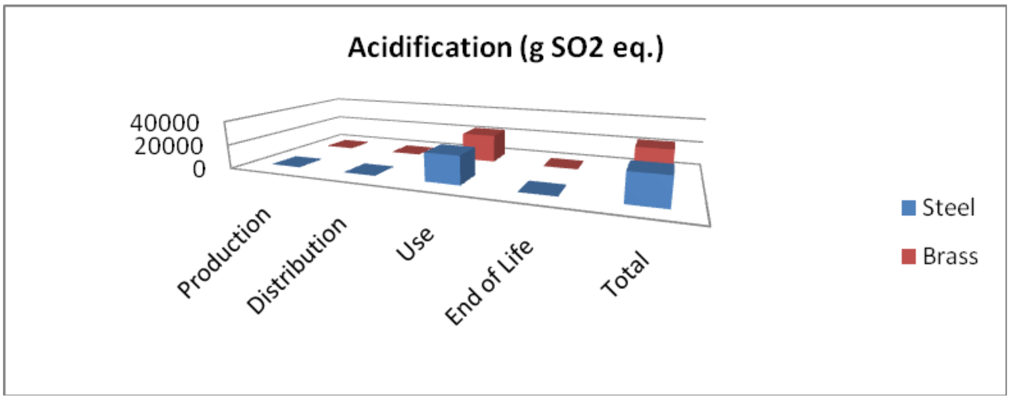

Figure 16 – Acidification for Taps

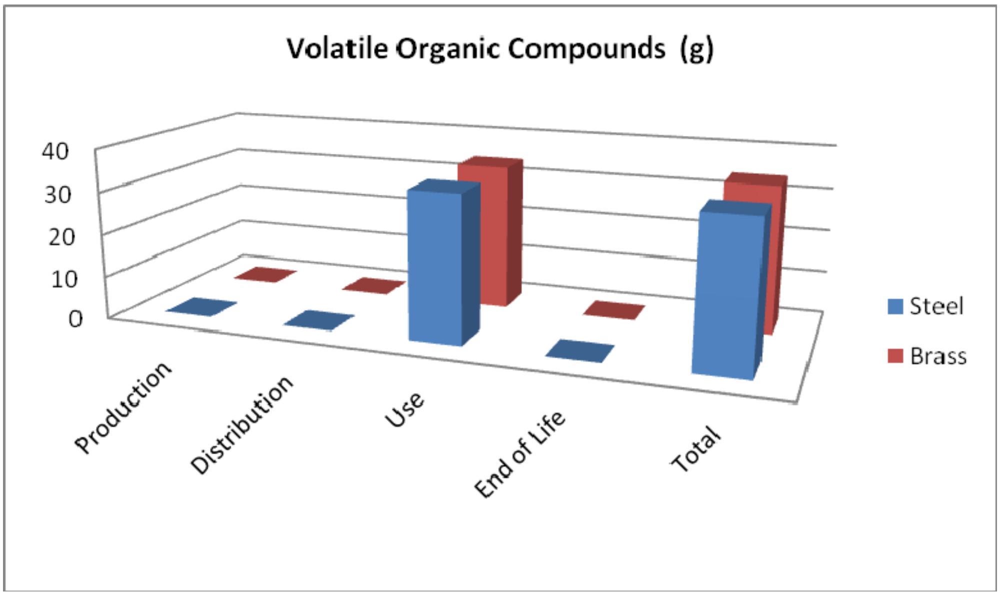

Figure 17 – Volatile Organic Compounds for Taps

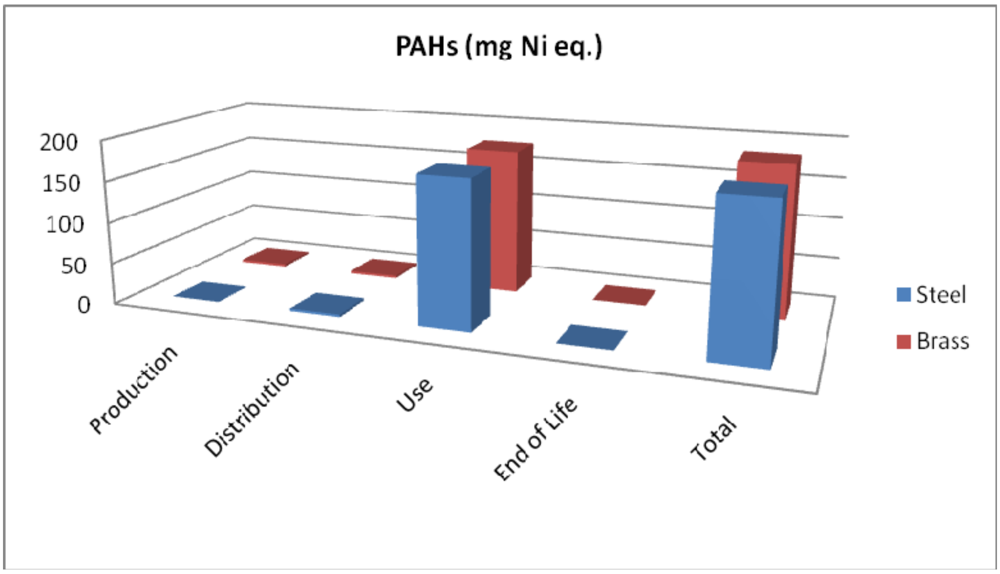

Figure 18 – PAHs for Taps

The impacts from the global warming potential, acidification, VOCs and PAHs are related to the use of energy and are therefore dominated by use phase energy consumption for the heating of water.

Significantly lower levels of emissions will occur in the extraction and production phases, for example in relation to the processing of metals e.g. melting, casting, smelting activities.

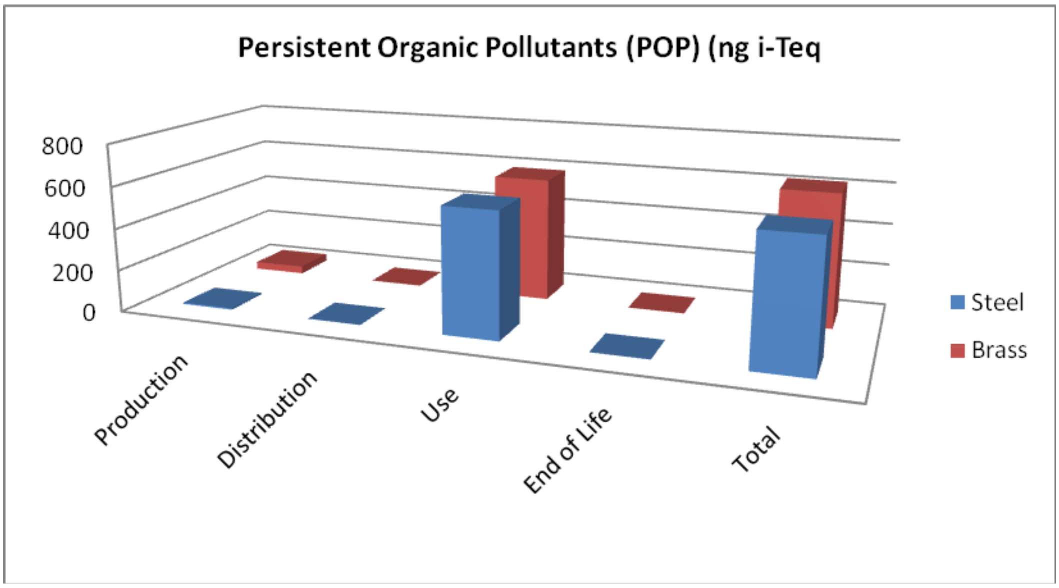

Figure 19 – Persistent Organic Pollutants for Taps

Again POP emissions are mainly associated with the use phase energy consumption for heating water. However there are some differences in POP emissions at the production phase associated with the use of different materials for the steel and brass taps as shown in Table 10. The increased POP levels in the production phase of brass taps appears to be related mostly to the brass element of the tap, with some input from the chrome plating when analysing the output from the EcoReport tool.

These differences will be the result of the different factors used in EcoReport associated with the various materials, reflecting the differences in emissions from processes such as sinter plants, smelting and casting during their production.

POP emissions as generally expressed as the total concentration equivalent (Teq) of tetrachlorodibenzodioxin (TCCD) EcoReport uses ng I-TEQ (2, 3, 7, 8 TCCD equivalent).

Table 10 POP emissions in the production phase for different materials

Material	EcoReport Code	1kg of material	Brass Base Case	Stainless Steel Base Case
Brass	31-CuZn38 cast	25.49 ng i-Teq	21.47 ng i-Teq	N/A
Chrome Plate	40-Cu/Ni/Cr plating	396.51 ng i-Teq	0.79 ng i-Teq	0.79 ng i-Teq
Stainless Steel	25-Stainless 18/8 coil	7.7 ng i-Teq	N/A	5.54 ng i-Teq
Ceramic	24-Ferrite	39.00 ng i-Teq	0.82 ng i-Teq	0.82 ng i-Teq

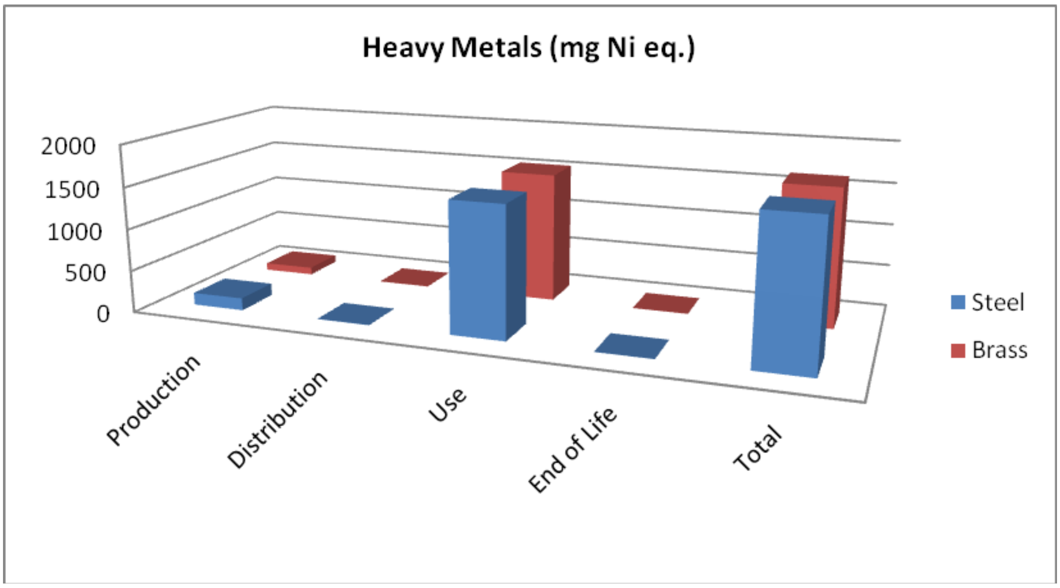

Figure 20 – Heavy Metal Emissions to Air for Taps

As with previous environmental indicators, energy consumption associated with water heating in the use phase dominates heavy metal emissions to air, approximately 1500 mg Ni eq. The heavy metal emissions in the production phase for stainless steel taps relate mainly to the materials extraction and production of the stainless steel (73%) and chrome plating (26%). For the brass tap, the heavy metal emissions are largely a result of the extraction and production of the chrome plating (55%) and brass (44%).

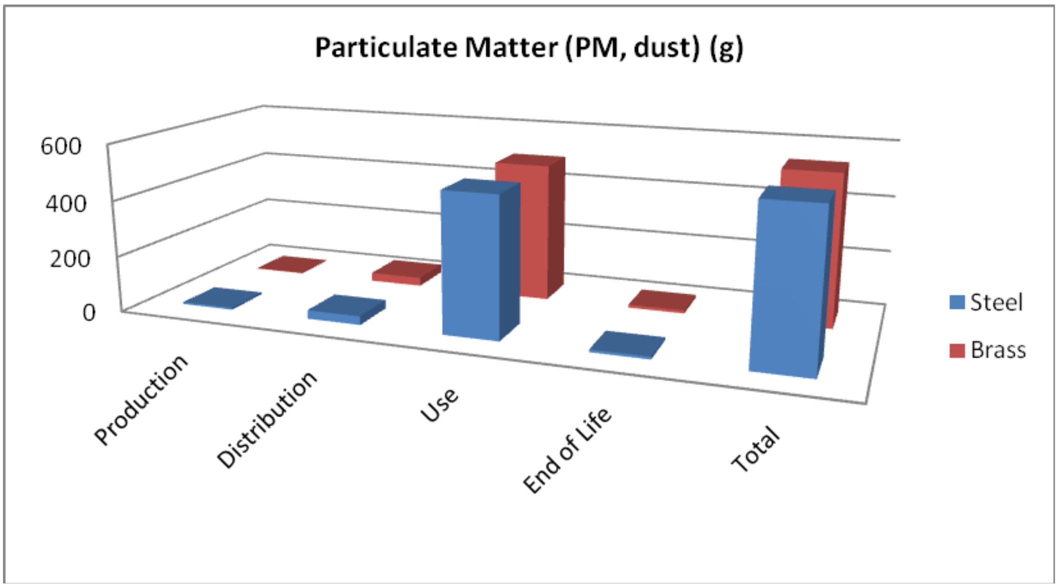

Figure 21 – Particulate Matter for Taps

The particulate matter impacts for both base cases are mainly due to energy consumption in the use phase associated with water heating. Other particulate matter impacts highlighted by the EcoReport results relate to the distribution phase, and in particular the assumptions made in EcoReport with regards the transportation of the product, The higher production impacts of steel taps compared to brass taps relate to particulate matter associated with the extraction and production of the stainless steel (25-Stainless 18/8 coil).

3.3.3 Emissions to Water

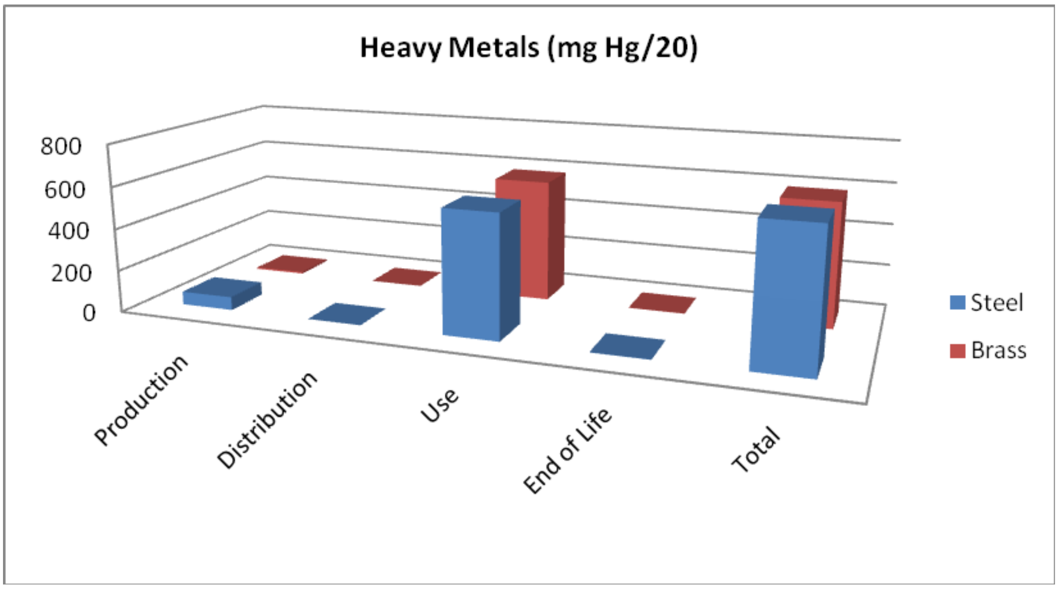

Figure 22 – Heavy Metal Emissions to Water for Taps

Heavy metal emissions to water are mainly the result of energy consumption in the use phase. However, in the production phase they are mainly associated with the stainless steel included in the products. Heavy Metals are expressed as Hg/20 equivalent (mercury divided by 20) as outlined in the EcoReport Methodology.

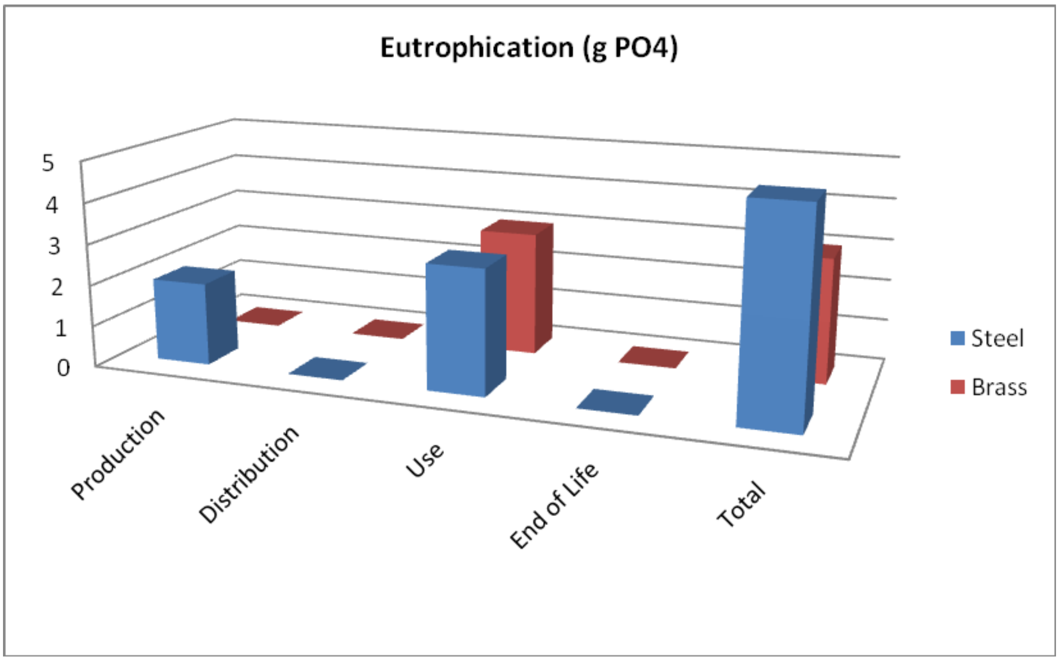

Figure 23 – Eutrophication for Taps

The use phase related to energy use for heating water is the main eutrophication impact; however difference between use phase and production phase is less significant for eutrophication than other environmental indicators, although the absolute values are relatively low. The impacts from production mainly relate to chrome plating for the brass base case and the production of stainless steel for the steel base case impacts are also noticeable

3.3.4 Observations

It is clear from the above analysis that the use phase is key; as there is no impact category where the in-use phase does not dominate. Table 11 clearly demonstrates this for domestic brass taps, with the use phase accounting for a very high percentage across all the impact categories. The same trends are also shown in the data for the domestic stainless steel base case and non-domestic sector base cases, which is summarised in Appendix 1.

Table 11 Percentage breakdown of impacts across life cycle phases for the different impact categories for a brass domestic sector tap

Parameter	Units	Production	Distribution	Use	End of Life	Total
		% of total	% of total	% of total	% of total	% of total
Total Energy (GER)	MJ	0.06%	0.07%	99.86%	0.01%	100.00%
of which, electricity (in primary MJ)	MJ	0.01%	0.00%	99.99%	0.00%	100.00%
Water (process)	ltr	0.00%	0.00%	100.00%	0.00%	100.00%
Water (cooling)	ltr	0.01%	0.00%	99.99%	0.00%	100.00%
Waste, non-haz./ landfill	g	2.79%	0.05%	97.09%	0.07%	100.00%
Waste, hazardous/ incinerated	g	0.05%	0.05%	96.96%	2.90%	100.00%
Emissions (Air)						
Greenhouse Gases in GWP100	kg CO2 eq.	0.08%	0.13%	99.80%	0.00%	100.00%
Ozone Depletion, emissions	mg R-11 eq.					neg
Acidification, emissions	g SO2 eq.	0.16%	0.06%	99.78%	0.00%	100.00%
Volatile Organic Compounds (VOC)	g	0.00%	0.00%	100.00%	0.00%	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	5.74%	0.00%	94.26%	0.00%	100.00%
Heavy Metals	mg Ni eq.	5.37%	0.18%	94.33%	0.12%	100.00%
PAHs	mg Ni eq.	1.63%	1.63%	96.20%	0.00%	100.00%
Particulate Matter (PM, dust)	g	0.37%	5.75%	91.84%	2.04%	100.00%
Emissions (Water)						
Heavy Metals	mg Hg/20	1.36%	0.00%	98.64%	0.17%	100.00%
Eutrophication	g PO4	0.00%	0.00%	100.00%	0.00%	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq					neg

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

3.4 Showerheads – Setting up the base case

As for taps, CEIR has provided the material composition for two example showerheads, one mainly plastic, and the other metal. This information has been used to undertake the base case assessment using the EcoReport tool.

These two examples are considered typical products currently available on the market, although it should be noted that some products will use other materials depending on their design or application. Diagrams of the two products are shown in Figure 24 and Figure 25.

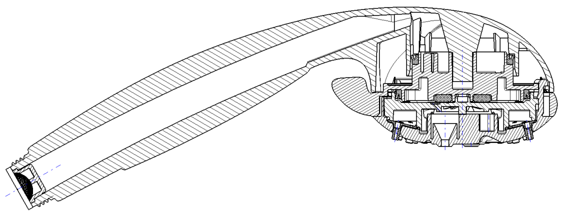

Figure 24: Diagram of the plastic showerhead

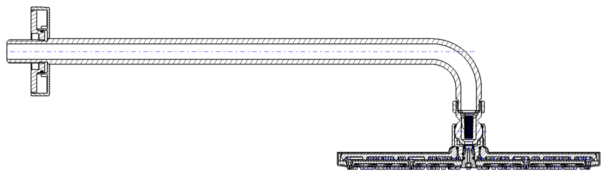

Figure 25: Diagram of the metal showerhead

3.5 Product Specific Inputs - Showerheads

The technical analysis in Section 2 outlines the methodology for calculating some of these inputs, in particular the water and energy inputs for the use phase. It also provides a brief overview of the data availability and rationale for other inputs, for example bill of materials for the production phase. This section summarises the product specific inputs for showerheads that are required for the EcoReport tool.

3.5.1 Bill of Materials

The composition of the showerhead shown in Table 12 for the base case uses information provided by CEIR. These bills of material are used to represent both domestic and non-domestic showerheads.

Table 12 Bill of Materials – Showerheads

Product Type	Material	Weight (g)	Material code in EcoReport
Plastic Showerhead	Nickel chrome plating	2	40 Cu/Ni/Cr Plating
	Plastic	177	10 ABS
Metal Showerhead	Brass	1902	31 CuZn38 Cast
	Nickel chrome plating	2	40 Cu/Ni/Cr Plating
	Plastic	393	10 ABS

3.5.2 Volume of packaged product

Limited information has been provided in relation to the volume of the packaged product. Therefore the packaging dimensions/volume for showerheads is based on the same dimensions as the tap base case, as shown in Table 13.

Table 13 Packaging dimensions and volume for showerheads

Dimensions (cm)	Volume (m3)
38.5(l)x18(w)x13(h)	0.009009

3.5.3 Use Phase

The inputs for the use phase are shown in Table 14. The inputs differ for domestic and non domestic showerheads.

Table 14 Use Phase Water and Energy Inputs for showerheads

Parameter	Domestic Showerhead	Non Domestic Showerhead
Lifetime (years)	10	7
Electricity consumption (kWh/showerhead/year)	846	834
Water consumption (m3/showerhead/year)	13.140	12.953

The inputs for water and energy are based on the assumptions outlined in Section 2.3.3.

The product life time based on information gathered during the research for Task 2 and 3 - Economic and Market Analysis and User Behaviour.

3.6 Showerheads - Environmental Impact Assessment

A summary of the data generated by the EcoReport Tool is provided in Appendix 2. The graphs below (Figure 26 to Figure 40) illustrate the results for the example showerheads outlined above for the different impact categories, together with commentary as appropriate. The results presented are in relation to the domestic sector base case for showerheads. The same material composition for the non-domestic base case has been used; therefore the main difference in the results for domestic and non domestic showerheads is in relation to water use and energy used for the heating of water. Unlike the base case for taps, the differences in the domestic and non-domestic water use and energy use for showerheads has been calculated as minimal, with domestic use slightly higher than the non-domestic use.

The analysis for showerheads shows that all impact categories are dominated by the use phase and this is mainly related to the energy use associated with the heating of water, with the exception of process water, which is attributable to the direct consumption of water.

3.6.1 Resources and Waste

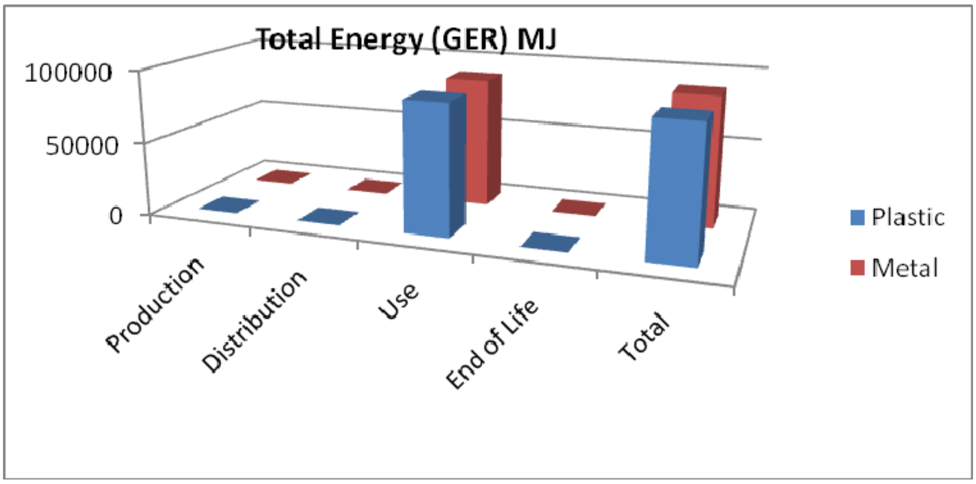

Figure 26 – Total Energy for showerheads

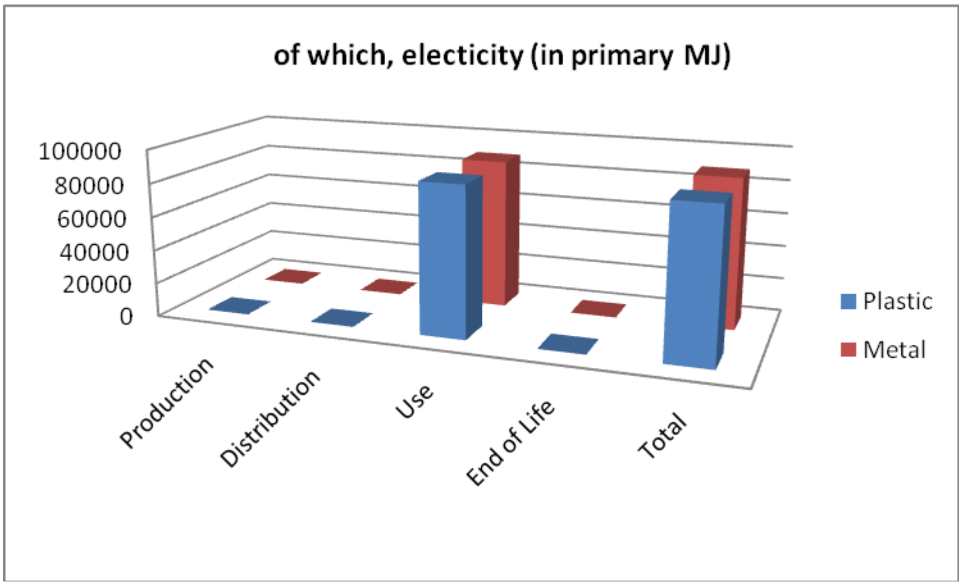

Figure 27 – Electricity for showerheads

The total energy use is dominated by the energy used for the heating of hot water in the use phase. As highlighted in the analysis for taps, the use phase impacts include not only the direct energy used to heat the water, but also non-product related energy use associated with aspects such as the fuel mix and electricity distribution losses, which are pre-defined by EcoReport.

The energy use associated with the production and distribution phases is minor in comparison to the use phase. Total energy in distribution phase impacts are defined by the model in relation to packaging size and set parameters. The electricity element of the total energy in the production phase relates mainly to the materials extraction and production of the material used for the plating and the manufacturing of the plastic.

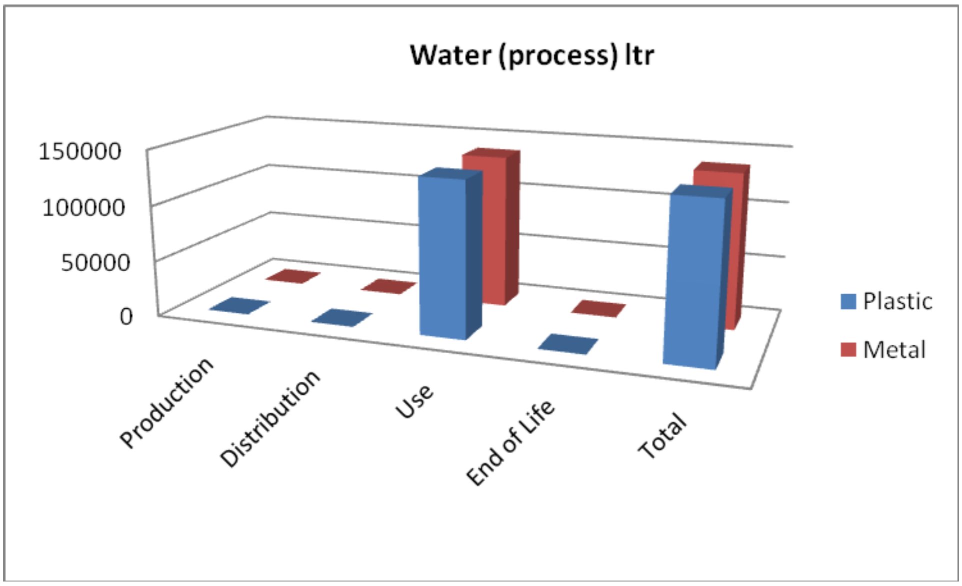

Figure 28 – Water (process) for showerheads

The high amount of water in the use phase reflects the water consumption by the end user. As with taps this will be influenced by flow rate and the behaviour of the end user. Behaviour may be influenced by a number of factors for example the region the product is being used, cultural aspects, domestic or non-domestic use. Figure 28 relates to the domestic use calculated in Section 2.3.3; however the non-domestic base case shows the same trend and dominance of water in the use phase when changing the water use and lifetime to reflect non-domestic use. Water consumption in the other life cycle phases is insignificant when compared to the use phase consumption.

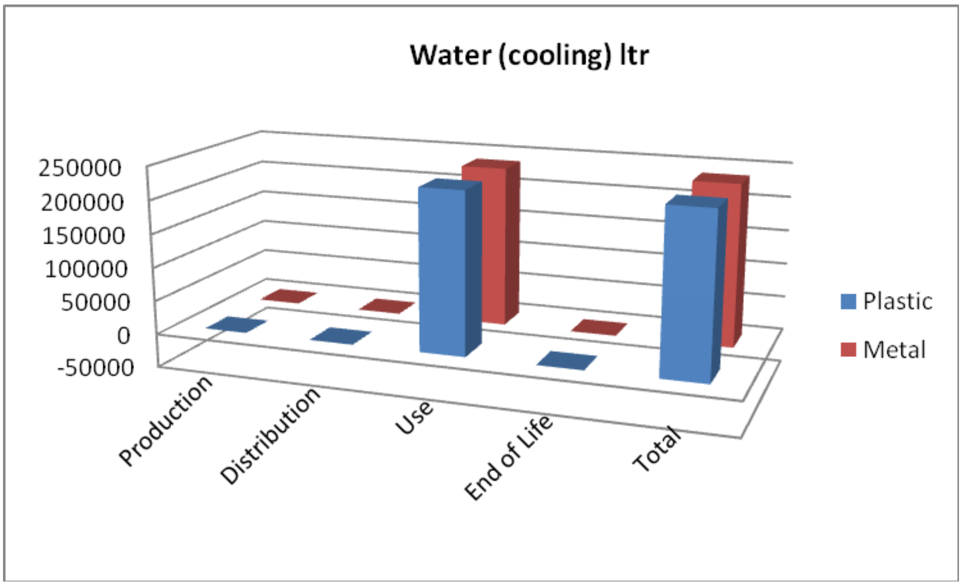

Figure 29 – Water (cooling) for showerheads

The amount of cooling water used throughout the life cycle is focused in the use phase and is again associated with the energy consumption used for the heating of water. Based on the EcoReport inputs, the amount of cooling water used is greater than the direct water use through the product itself, highlighting the importance of the impact from energy use associated with showerheads. The y-axis shows a minus due to the recycling and re-use benefits in the end of life phase calculated by EcoReport that are associated with plastics. EcoReport calculates a debit and credit figure associated with the disposal and recycling of plastics to provide a net result. Where the recycling credits are greater than the disposal impact this results in an overall minus figure. For the metal showerhead base case a very small net benefit in relation to cooling water (approximately 1 litre) has been calculated by EcoReport as a result of the amount of plastic used in the product and subsequently assumed to be recycled, however this is very insignificant.

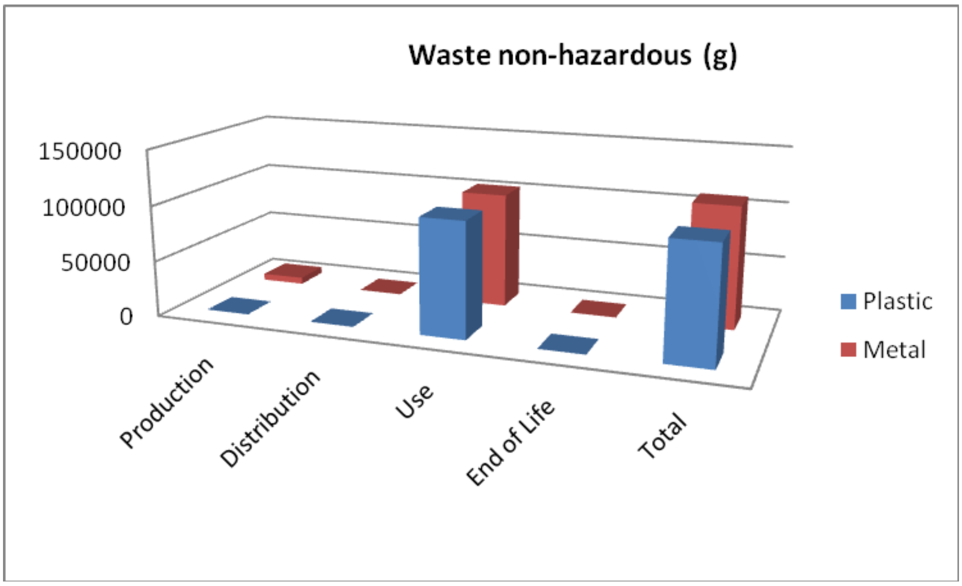

Figure 30 – Non-hazardous Waste for showerheads

Again, the use phase dominates the non-hazardous waste production as a result of the energy use for heating water used through showerhead, generating in excess of 100 kg of waste in both the metal and plastic showerheads.

The results from the EcoReport tool show that non-hazardous waste is also generated in the production phase, although at much lower levels compared to the use phase. Approximately 5.9 kg of waste is generated at the production phase for the metal showerhead. Scrutiny of the EcoReport outputs shows this is largely related to the materials extraction and production of brass (31-CuZn38 cast), with much smaller proportions relating to the plastics and plating used. The amount of waste generated in the production phase for the plastic showerhead is much lower, approximately 0.080 kg.

The main end of life impacts for both showerhead base cases relate to the disposal of the product in landfill.

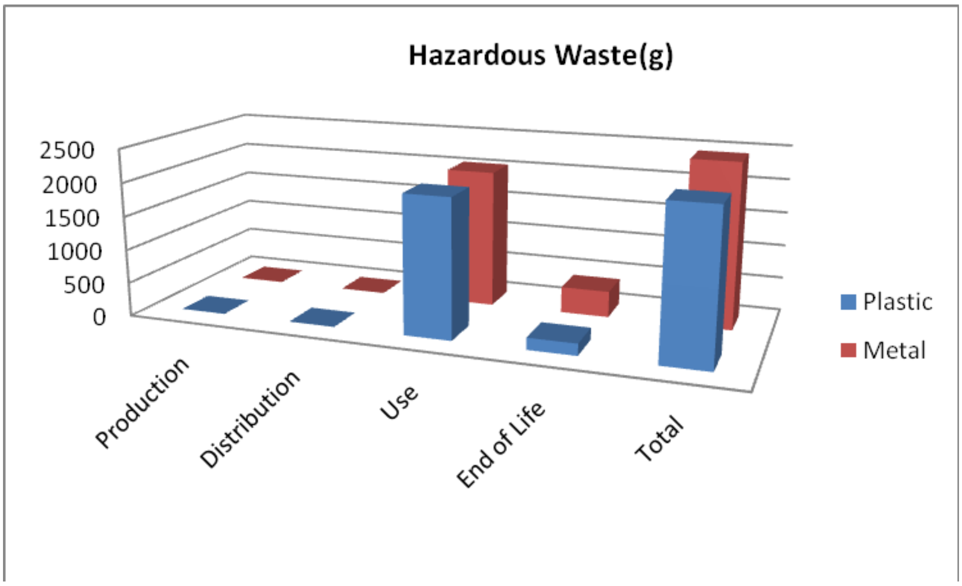

Figure 31 – Hazardous waste for showerheads

As with non-hazardous waste, hazardous waste generation is mainly associated with the use phase energy consumption, generating over 2,000g. The hazardous waste generation in the end of life phase approximately 175g and 390g for the plastic and metal showerheads respectively. This is associated with the 'Incineration of plastics/PWB not reused/recycled' and reflects the amount of plastic in the respective base cases. This is based on the assumptions in the EcoReport model, and may not necessarily be the case for this product group, however as outlined in Section 2.3.4, the extent of end of life recycling is not known for showerheads.

3.6.2 Emissions (Air)

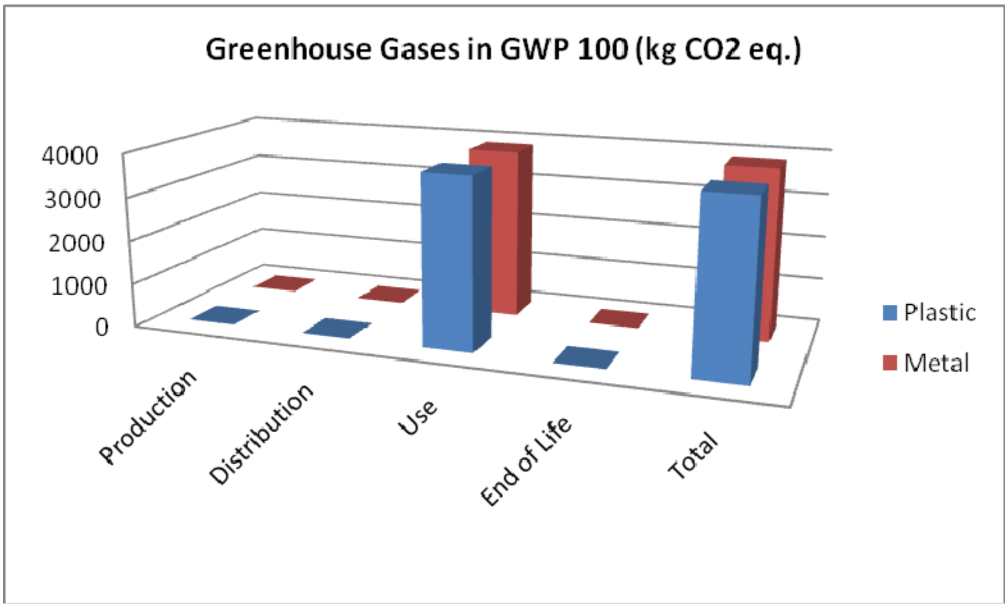

Figure 32 – Greenhouse Gases for Showerheads

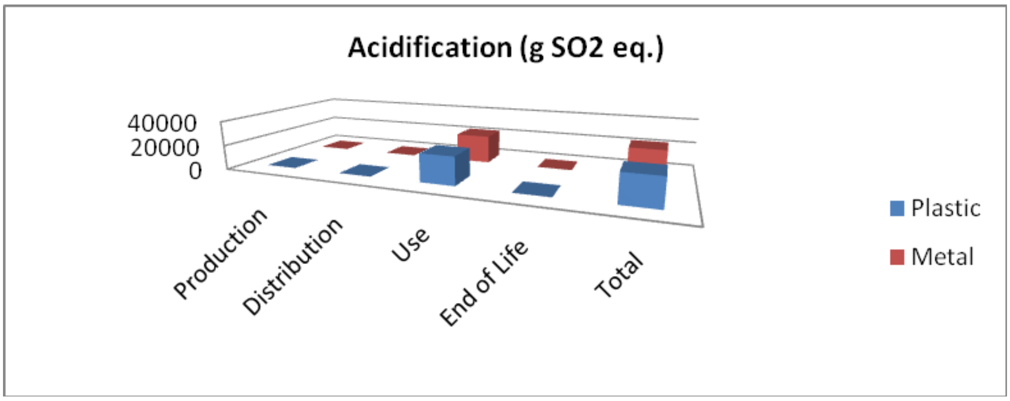

Figure 33 – Acidification for Showerheads

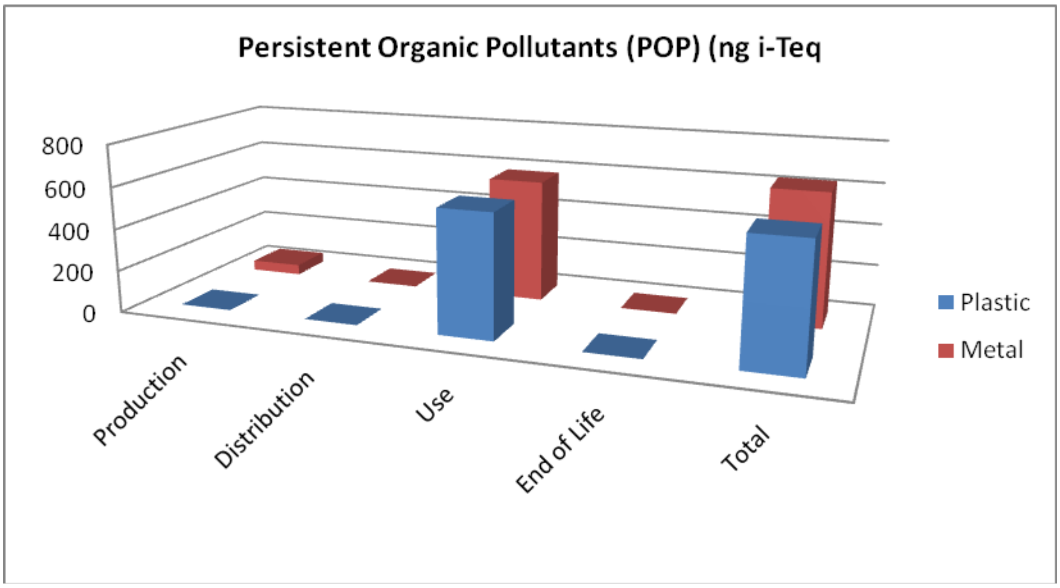

Figure 34 – Persistent Organic Pollutants for Showerheads

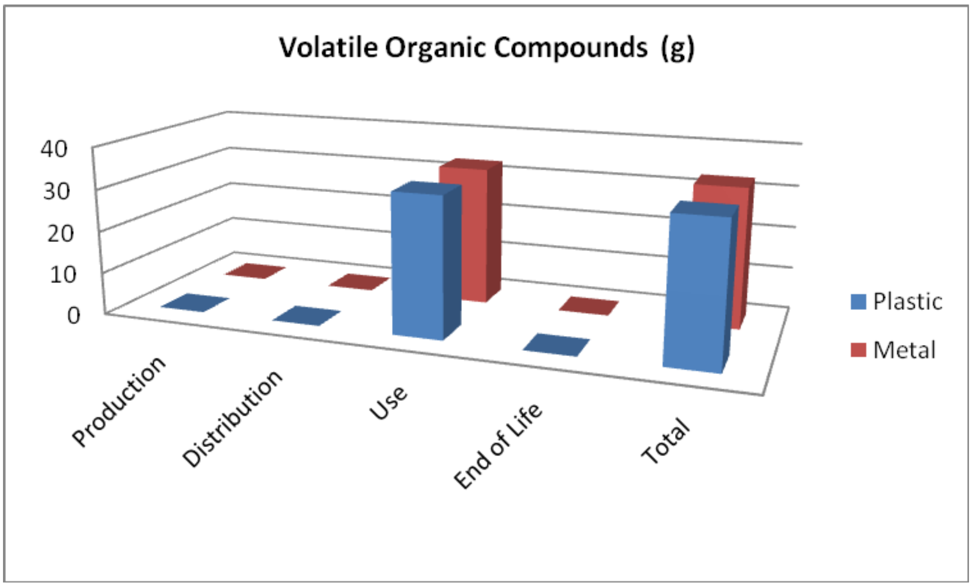

Figure 35 – Volatile Organic Compound for Showerheads

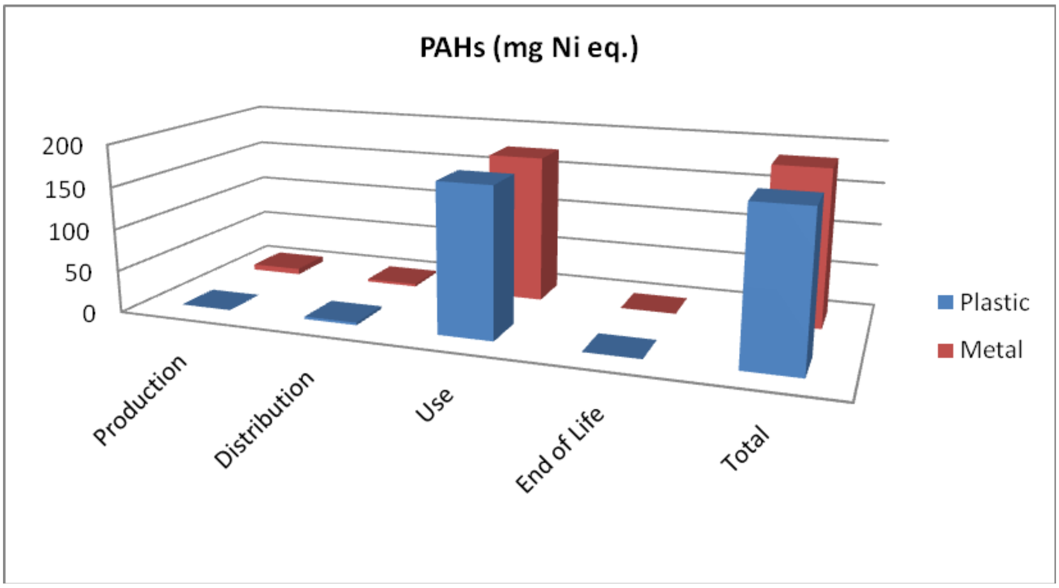

Figure 36 – PAHs for Showerheads

The global warming potential, acidification, POPs, PAH and VOC impacts dominate the use phase and are related to the energy consumption for the heating of water.

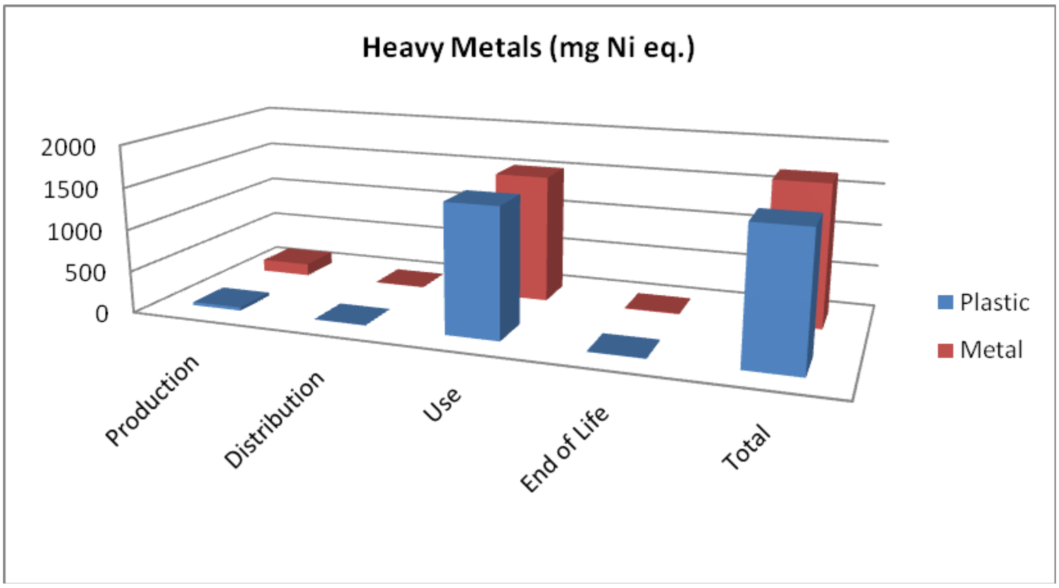

Figure 37 – Heavy metal emissions to air for showerheads

As with previous environmental indicators, energy consumption associated with water heating in the use phase dominates heavy metal emissions to air, approximately, 1500 mg Ni eq. The impact of heavy metal emissions to air in the production, distribution and end of life phases are minimal in comparison. The production phase emissions are associated with the extraction and production of brass and are therefore higher in the metal showerhead when compared to the plastic showerhead. Those in the end of life phase are associated with the incineration of plastics not re-used/recycled.

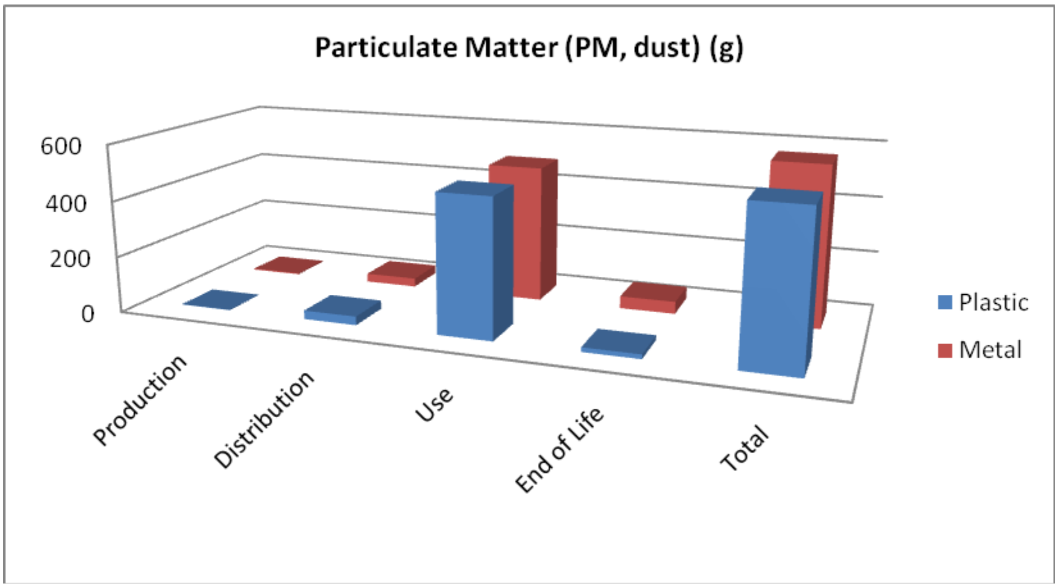

Figure 38 – Particulate matter emissions for showerheads

The particulate matter impacts of showerheads are mainly due to energy consumption in the use phase associated with water heating. Other particulate matter impacts highlighted by the EcoReport results relate to the distribution phase, and in particular the assumptions made in EcoReport with regards the transportation of the product. The particulate matter impacts in the end of life phase are associated with the incineration of plastics not re-used/recycled, with the values relating directly to the amount of plastic used in the two base cases.

3.6.3 Emissions (Water)

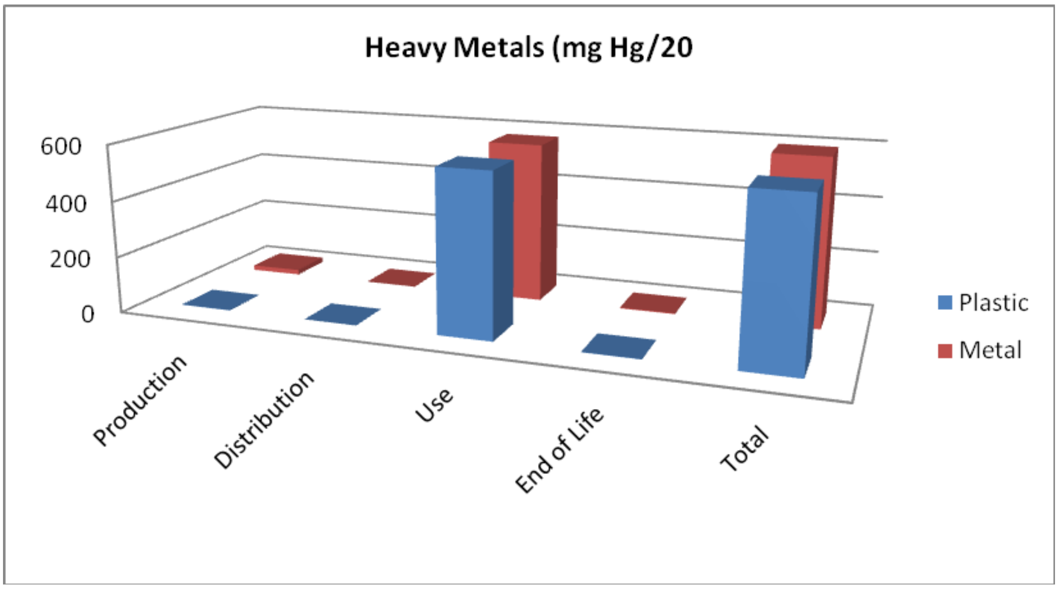

Figure 39 – Heavy metal emissions to water for showerheads

Heavy metal emissions to water are mainly the result of energy consumption in the use phase. Minor amounts are generated in the production phase and end of life phases; however this is minimal and insignificant when compared to the use phase.

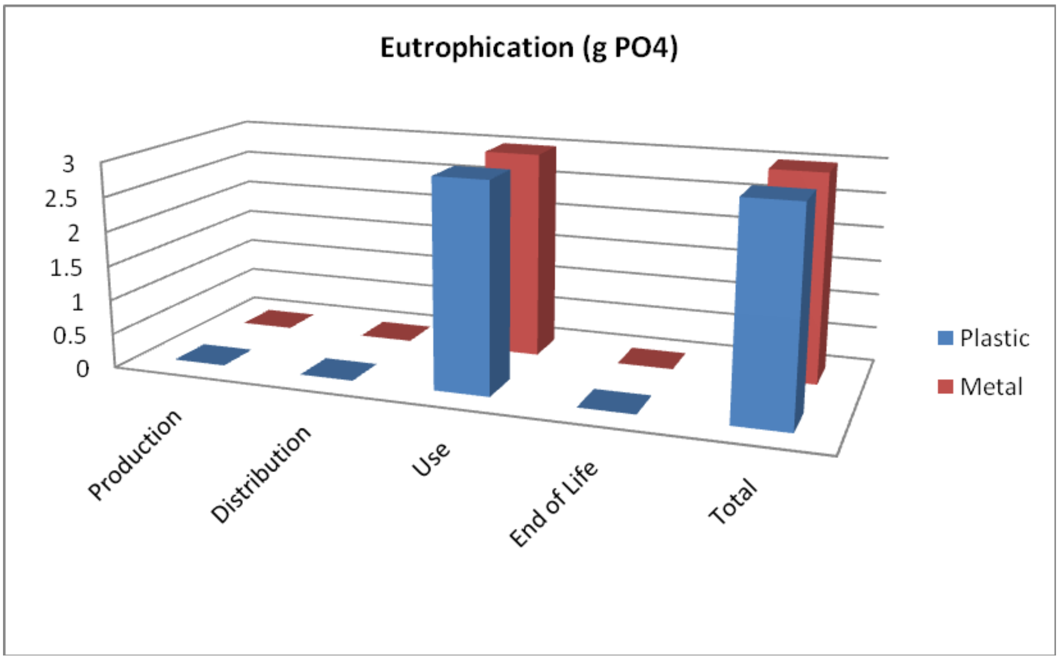

Figure 40 – Eutrophication for Showerheads

The use phase for showerheads dominates the eutrophication environmental indicator and is related to the energy use for the heating of water in this life cycle phase.

3.6.4 Observations

It is clear from the above analysis that the use phase is key; as there is no impact category where the in-use phase does not dominate. Table 15 clearly demonstrates this for a domestic showerhead, with the use phase accounting for a very high percentage across all the impact categories. The same trends are also shown in the data for the metal domestic showerheads and the plastic and metal non-domestic sector showerheads, which is summarised in Appendix 2.

Table 15 Percentage breakdown of impacts across life cycle phases for the different impact categories for a plastic domestic sector showerhead

Parameter	Units	Production	Distribution	Use	End of Life	Total
Total Energy (GER)	MJ	0.03%	0.07%	99.89%	0.00%	100.00%
of which, electricity (in primary MJ)	MJ	0.01%	0.00%	99.99%	0.00%	100.00%
Water (process)	ltr	0.00%	0.00%	100.00%	0.00%	100.00%
Water (cooling)	ltr	0.01%	0.00%	99.99%	0.00%	100.00%
Waste, non-haz./ landfill	g	0.08%	0.06%	99.86%	0.01%	100.00%
Waste, hazardous/ incinerated	g	0.09%	0.04%	92.00%	7.87%	100.00%
Emissions (Air)						
Greenhouse Gases in GWP100	kg CO2 eq.	0.03%	0.13%	99.85%	0.00%	100.00%
Ozone Depletion, emissions	mg R-11 eq.					neg
Acidification, emissions	g SO2 eq.	0.03%	0.06%	99.90%	0.00%	100.00%
Volatile Organic Compounds (VOC)	g	0.00%	0.00%	97.06%	0.00%	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	0.17%	0.00%	99.83%	0.00%	100.00%
Heavy Metals	mg Ni eq.	2.49%	0.19%	97.13%	0.19%	100.00%
PAHs	mg Ni eq.	0.00%	1.69%	98.31%	0.00%	100.00%
Particulate Matter (PM, dust)	g	0.19%	5.77%	91.06%	2.98%	100.00%
Emissions (Water)						
Heavy Metals	mg Hg/20	0.17%	0.00%	99.65%	0.17%	100.00%
Eutrophication	g PO4	0.00%	0.00%	100.00%	0.00%	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq					neg

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

4 Scenario Variations - Analysis

It is clear from the environmental impact analysis of the base cases for both taps and showerheads that energy and water consumption in the use phase dominate across the different environmental indicators.

There are a number of parameters that can be varied in relation to taps and showerheads to understand how they influence the environmental impacts of the product.

However given the scale of the impacts generated by the water consumption and associated energy use for heating water, analysis of these parameters has been undertaken to understand how the impacts of these parameters change if the EcoReport Inputs for these change.

Focusing on domestic use, an average EU figure was used for the analysis outlined above. The data this average figure is based on information provided for individual Member States, allowing a minimum and maximum to be identified.

The EU average water from taps and showers was 75 litres per person per day. The minimum identified is, Lithuania[19], 31 litres per person per day, the maximum identified is for Italy, 138 litres per person per day.

Using this information and the same assumptions outlined previously in Section 2.3.3 a comparison can be made with the EU average with regards the EcoReport inputs. This is summarised in Table 16.

Table 16 Different EcoReport Inputs for water and energy in the use phase

Parameter	EU Minimum (31 litres per person per day)	EU Average (75litres per person per day)	EU Maximum (138 litres per person per day)
DOMESTIC TAPS			
Electricity consumption (kWh per tap per year)	222	536	986
Water consumption (m^3/tap/year)	4.30	10.40	19.14
DOMESTIC SHOWERHEADS			
Electricity consumption (kWh/showerhead/year)	350	846	1557
Water consumption (m^3/tap/year)	5.43	13.14	24.18

Further analysis of the detailed EcoReport outputs indicates that even using the minimum water use figure, water and associated energy use for water heating still dominate all environmental indicators by a significant margin, reflecting the analysis already undertaken using the average figure. Obviously for the maximum figure the impacts are even greater.

[19] Note Latvia was not chosen due to the very low figure and therefore concerns over data robustness

Essential changes in water use and subsequent energy use of water heating will be influenced by user behaviour.

The impacts of energy use might be affected by the assumptions used, for example boiler efficiency or the hot/cold water use or mixing ratios for taps and showerheads respectively. However it is likely that energy use would still be the most significant factor, together with the use phase water consumption. To consider this point further, an alternative scenario with improved boiler energy efficiency has been developed below.

The original calculation for the energy used to heat water is based on the methodology outlined in Section 2.3.3. This made an assumption that the efficiency of the boiler used to heat the water is 70%. Other policy instruments are in development to improve the future efficiency of boilers as part of the Ecodesign Directive, Lot 1 specifically deals with boilers, whereas Lot 2 deals with water heaters. At the time of writing the Implementing Measures for both Lots 1 and 2 have not been finalised, however using the latest drafts the effect of improved efficiency for water heating can be analysed.

Lot 1 focuses on boilers, and includes energy efficiency requirements for different boiler types in relation to space heating. It does however also include water heating energy efficiency requirements for combination boilers. The boiler efficiencies proposed in the latest draft of the Boilers Regulation (March 2011) for 5 years after the Ecodesign Regulation comes into force range from 32% to 86% depending on the load profile[20]. Lot 2 focuses specifically on water heaters; the latest available draft of this Ecodesign Regulation (June 2010) does not indicate water heating energy efficiencies above 64%.

The energy efficiency of boilers and water heaters is clearly a complex area, depending on the type of appliance and load profiles. The analysis reported here uses the water heating energy efficiency for a combination boiler for the 4XL load profile (86%). This provides an indication of the change in energy use as a result of using a higher energy efficiency value, assuming the other parameters outlined in Section 2.3.3 remain unchanged. The results are presented in Table 17.

Table 17 Energy inputs for EcoReport for different water heating energy efficiencies

Product Type	Domestic or Non Domestic	Energy use at 70% efficiency – kWh per tap / showerhead per year	Energy Use at 86% efficiency kWh per tap / showerhead per year	Percentage Reduction
Taps	Domestic	536	437	18.4 % reduction in energy use for each of the four base cases
	Non Domestic	2668	2175	
Showerheads	Domestic	846	690	
	Non Domestic	834	680	

Using the lower energy figures above as an input to the EcoReport tool, the environmental impacts will still be dominated by the energy consumption for heating water in the use phase, together with use phase water consumption. This is illustrated by the example of domestic brass tap base case, where the impacts of the change in energy efficiency for heating water are negligible. The data presented in Appendix 3, which compares the percentage breakdown of impacts across the life cycle phases for the two different energy efficiency scenarios clearly indicates that the use phase still dominates, with over 90% of the impacts in the use life cycle phase for the different environmental indicators. A similar trend is observed for the other base cases.

[20] The load profiles reflect certain sequences of water draw offs – nine load profiles are included in the draft boilers regulation

As highlighted above, the results indicate that water and the energy used for water heating dominate the life cycle impacts. In order to understand the importance of the energy use further analysis has been undertaken using EcoReport to compare the EcoReport results with and without in use energy consumption included. The full results are presented are presented fully in Appendix 4 for the domestic taps and showerheads base cases.

The results of this analysis show that the magnitude of the impacts across the different environmental indicators is significantly reduced when energy is excluded, over 95% in most cases. This can be seen by comparing the total impacts for the two scenarios, summarised in Table 18 for a domestic brass tap as an example.

Table 18 Comparison of EcoReport results for a domestic brass tap with energy for heating water included and excluded

Parameter	Units	TOTAL (with energy)	TOTAL (without energy)	Reduction in value	% Reduction
Total Energy (GER)	MJ	90,175	127	90,048	99.86
of which, electricity (in primary MJ)	MJ	90,057	9	90,048	99.99
Water (process)	ltr	172,438	166,434	6,004	3.48
Water (cooling)	ltr	240,143	15	240,128	99.99
Waste, non-haz./ landfill	g	107,563	3,157	104,406	97.06
Waste, hazardous/ incinerated	g	2,140	65	2,075	96.96
Emissions (Air)					
Greenhouse Gases in GWP100	kg CO2 eq.	3,938	8	3,930	99.80
Ozone Depletion, emissions	mg R-11 eq.	neg	neg	N/A	N/A
Acidification, emissions	g SO2 eq.	23,240	53	23,187	99.77
Volatile Organic Compounds (VOC)	g	34	0	34	100.00
Persistent Organic Pollutants (POP)	ng i-Teq	627	36	591	94.26
Heavy Metals	mg Ni eq.	1,639	94	1,545	94.26
PAHs	mg Ni eq.	184	6	178	96.74
Particulate Matter (PM, dust)	g	539	43	496	92.02
Emissions (Water)					
Heavy Metals	mg Hg/20	589	9	580	98.47
Eutrophication	g PO4	3	0	3	100.00
Persistent Organic Pollutants (POP)	ng i-Teq	neg	neg	N/A	N/A

This again demonstrates the importance of energy for heating water during the in use life cycle phase of the tap or showerhead. The full details of the analysis in Appendix 4 also highlight the importance of other use phase impacts. With energy for heating water included as part of the analysis, the use phase accounts for over 90% of the impacts across the different life cycle phases. With energy for heating water excluded from the analysis the profile of the impacts across the different life cycle phase's changes. Production and distribution now account for a higher proportion of the impacts previously dominated by the use phase, with the exception of water and hazardous waste, which are dominated by the use and end of life phases respectively. However as outlined above, the magnitude of these impacts are significantly reduced when energy is excluded.

The base cases for non-domestic taps and showerheads will show the same trends as outlined above if energy is excluded, as the material composition for these base cases is the same as the domestic base cases, therefore for this reason comparison tables have not been included in Appendix 4 for the non-domestic base cases.

Aside from the user behaviour aspects, there are other parameters that will potentially influence the life cycle impacts of taps and showerheads, for example lifetime and product weight.

EcoReport presents the impacts per tap or showerhead; therefore when considering the impact of changing life span of the product it is important to understand this. If we consider the life cycle service of a tap delivering water over a 16 year life time, this service could be provided by a single tap with a 16 year life time, or two taps each with an eight year life time – the second tap being used to replace the first after the initial eight year operation period.

In both scenarios the amount of water consumed during the in-use phase will be the same. However, differences occur during other life cycle phases associated with the manufacture, distribution and end of life treatment of an additional tap in the second scenario. The same would also be true for showerheads.

Another parameter that influences the life cycle impacts is product weight i.e. the quantity and type of material used. Information gathered as part of the Economic and Market Analysis indicated that tap weight can vary between different products. A change in weight will affect production phase impacts in particular, as more or less materials will need to be used to manufacture the tap or showerhead. However, given the significance across all impact categories of water consumption and the associated energy consumption for water heating in the use phase, any changes to the weight of the products, in relation to the average weights identified in the Economic and Market Analysis will have little impact.

5 Life Cycle Cost Assessment

5.1 Introduction to Life Cycle Costs

There is often the perception that 'green' products cost more than their 'non green' equivalent. Sometimes, but not necessarily always, the purchasing price of a 'green' product may be more than its 'non green' alternative. However if all the costs are analysed over the life time of the product, the 'green' product may well prove to be cheaper over time[21].

From a Green Public Procurement (GPP) perspective and for Purchasing Authorities' to understand which products will be most cost effective for them to purchase this life cycle cost (LCC) approach needs to be applied.

The European Commission's GPP website[22] highlights that life cycle costing should consider the following and factor them in at the awarding stage:

- Purchase and all associated costs (delivery, installation, commissioning etc.)
- Operating costs, including energy, spares, and maintenance
- End of life costs, such as decommissioning and removal

Using this life cycle approach can bring a number of benefits[22]:

- All costs associated with a good or service become visible, especially operating costs such as maintenance or energy consumption;
- It allows an analysis of business function interrelationships. Low purchasing costs may lead to high service costs in the future;
- Expenditure in various stages of the life cycle are highlighted, enabling public authorities draw up budgetary predication

A life cycle cost approach is important for Green Public Procurement as it may help to procure products with a better environmental performance, whilst saving the purchasing authority money.

The approach to develop Ecolabel and GPP criteria requires a number of steps to be taken. This involves the development of a number of analyses outlining the background and evidence required to develop ecolabel criteria and GPP specifications. More detailed information regarding these steps is available from the European Commission's website[23].

Importantly for the development of GPP specifications there needs to be an 'evaluation of the costs to public procurers and demonstration of ways for calculating the costs on a life-cycle cost basis'[23].

There are a number of tools that can be used to assess life cycle costs including EcoReport, which has been used throughout this project to assess the life cycle impacts of taps and showerheads and is the tool used for the Commissions product policy activities. The remainder of this section demonstrates the calculation of life cycle costs for taps and showerheads, using EcoReport and the base cases as examples.

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[21] http://ec.europa.eu/environment/gpp/pdf/toolkit/module1_factsheet_lcc.pdf
[22] http://ec.europa.eu/environment/gpp/gpp_and_life_costing_en.htm
[23] http://ec.europa.eu/environment/gpp/gpp_criteria_procedure.htm

Further detailed information on how EcoReport calculates life cycle costs can be found in Section 7.3.4 of the EcoReport Methodology Report[24].

5.2 Green Public Procurement of Taps and Showerheads

Taps and showerheads are procured by a range of public sector bodies and installed in public washrooms, leisure centres, hospitals, social housing, schools, colleges, public offices and other public buildings. There is a large range of taps and showerheads available on the market for public sector bodies to choose from, which vary in terms of design, price and performance.

It should be noted that public procurement may include taps in both the non-domestic e.g. for public washroom and the domestic e.g. social housing sectors. The base case assessment highlighted that while the tap and its intended use may be similar in these different sectors, the use patterns of taps and showerheads do differ between the domestic and non domestic sectors. Therefore the results of the LCC analysis have been included for both the domestic and non-domestic base cases.

The sections below outline the inputs used for calculating life cycle costs on a per product basis for taps and showerheads and summarises the results from EcoReport.

5.3 Life Cycle Costs for Taps

The base case assessment task (Section 3 of this report) identified two example base cases for taps, a brass tap and a stainless steel tap, for which life cycle calculations considered domestic and non-domestic sectors.

Information concerning purchase price, installation, maintenance and water and energy prices has been collated and used as inputs for the assessment of life cycle costs. The differentiation between taps made with brass and those with stainless steel has not been made as our initial calculations indicated that rather than purchase price it is the cost of water and energy over the products lifetime that are most important and offer the potential for savings. This is demonstrated in the results below.

The EcoReport inputs for taps are summarised in Table 19. These are based on information gathered as part of Task 2 Market and Economic Analysis and are detailed in full in Section 2.4 of the report for that task (see project website[25]). The information is based on data collected from product catalogues and stakeholder feedback, in particular from the first questionnaire.

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[24] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm
[25] http://susproc.jrc.ec.europa.eu/ecotapware/stakeholders.html

Table 19: Life cycle cost inputs for taps

Input parameter	Input value - Domestic	Input value – non domestic	Notes - Domestic	Notes - Non Domestic
Product Life (Years)	16	10	Based on stakeholder feedback	Based on stakeholder feedback
Product price (Euros)	192 (Bathroom Taps)	240	Average of the median prices for a 3 hole mixer, monobloc mixer and pillar taps three taps	Average of the median prices for the four different types of taps identified
Installation (Euros)	65	150	Median of range provided by stakeholder feedback	Based on stakeholder feedback
Maintenance and repair (Euros)	60 (Bathroom Taps)	75	Median of range provided by stakeholder feedback	Based on stakeholder feedback
Electricity Rate (Euro/kWh)	0.1223	0.0918	Based on 2010 electricity price data. A differentiation is made for electricity prices between household consumers and industrial consumers, which have been used for domestic and non domestic sectors respectively.	
Water Rate (Euro/m^3)	3.7	3.7	This value is consistent with that used in the EuP Study for Washing machines. The same value has been used for domestic and non domestic sectors	
Discount Rate % (interest minus inflation)	1.73	1.73	EU27 2010 Inflation Rate (2.1%) and Interest Rate (3.83) have been used to calculate the discount rate of 1.73%	

The EcoReport life cycle cost calculation for taps is presented in Table 20 and indicates higher life cycle costs for a non-domestic tap, which is due to the costs associated with higher water consumption and electricity use for heating water. This point is illustrated further by

Table 21, which shows the results of the life cycle cost calculation in terms of percentage cost for the different LCC parameters, highlighting the significant cost contributions from electricity and water.

Table 20: Base Case Life Cycle Costs Per Product

	Domestic Taps	**Non Domestic Taps**
LCC Parameter	**Cost (Euros)**	**Cost (Euros)**
Product price	192	240
Installation	65	150
Electricity	909	2231
Water	534	1746
Repair & maintenance	52	68
TOTAL	**1752**	**4435**

Table 21: Taps - Percentage of total cost for different life cycle cost parameters

	Domestic Tap	**Non Domestic Tap**
LCC Parameter	**Percentage of Total**	**Percentage of Total**
Product price	10.96	5.41
Installation	3.71	3.38
Electricity	51.88	50.30
Water	30.48	39.37
Repair & maintenance	2.97	1.53
TOTAL	**100**	**100**

As indicated above the purchase price is a relatively small proportion of the overall life cycle costs. Even if the purchase price of a domestic tap doubles the percentage of total life cycle costs would only be 19.75% and LCCs would still be dominated by electricity (46.75%) and water (27.47%). A similar situation exists for a non-domestic tap, increasing the purchase price to 480 Euros will raise its percentage of total life cycle cost to 9.77% however electricity (45.39%) and water (35.52%) will still dominate.

Using the life cycle costs shown in Table 20 as a baseline, and a scenario of reducing water consumption by 30%, Table 22 shows how the life cycle assessment tool can be used to demonstrate potential savings over the lifetime of the tap.

Table 22: Potential LCC savings following a 30% reduction in water consumption

	Domestic Taps			**Non-Domestic Taps**		
	Baseline	**30% Reduction**	**Savings**	**Baseline**	**30% Reduction**	**Savings**
LCC Parameter	**Cost (Euros)**	**Cost (Euros)**	**Euros**	**Cost (Euros)**	**Cost (Euros)**	**Euros**
Product price	192	192	0	240	240	0
Installation	65	65	0	150	150	0
Electricity	909	636	273	2231	1562	669
Water	534	374	160	1746	1222	524
Repair & maintenance	52	52	0	68	68	0
TOTAL	**1752**	**1319**	**433**	**4435**	**3243**	**1193**

5.4 Life Cycle Costs for Showerheads

As for taps, the base case assessment task (Section 3 of this report) identified two example base cases for showerheads, a metal showerhead and a plastic showerhead for which life cycle calculations considered domestic and non-domestic uses.

Information concerning purchase price, installation, maintenance and water and energy prices has been collated and used as inputs for the assessment of life cycle costs. The differentiation between showerheads made with metal and those with plastic has not been made as our initial calculations indicated that rather than purchase price it is the cost of water and energy over the products lifetime that are most important and offer the potential for savings. This is demonstrated in the results below.

The EcoReport inputs for showerheads are summarised in Table 23. These are based on information gathered as part of Task 2 Market and Economic Analysis and are detailed in full in Section 2.4 of the report for that task, (see project website[26]). The information is based on data collected from product catalogues and stakeholder feedback, in particular from the first questionnaire.

Table 23: Showerheads – Life Cycle Cost Inputs

Input parameter	**Input value - Domestic**	**Input value – non domestic**	**Notes - Domestic**	**Notes - Non Domestic**
Product Life	10 years	7 years	Based on stakeholder feedback	Based on stakeholder feedback
Product price:	42 Euro's	83 Euro's	Median of the price range identified	Median of the price range identified
Installation	40 Euro's	60 Euro's	Median of range	Based on

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

			provided by SH feedback	stakeholder feedback
Maintenance and repair –	60 Euro's	60 Euro's	Median of range provided by stakeholder feedback	No value provided for showerheads – same figure as domestic used
Electricity Rate Euro/kWh	0.1223	0.0918	Based on 2010 electricity price data. A differentiation is made for electricity process between household consumers and industrial consumers, which have been used for domestic and non domestic sectors respectively.	
Water Rate Euro/m3	3.7	3.7	This value is consistent with that used in the EuP Study for Washing machines. The same value has been used for domestic and non domestic sectors	
Discount Rate % (interest minus inflation)	1.73	1.73	EU27 2010 Inflation Rate (2.1%) and Interest Rate (3.83%) have been used to calculate the discount rate of 1.73%	

The EcoReport life cycle cost calculation for showerheads is presented in Table 24 and indicates higher life cycle costs for a domestic showerhead, which is again due to the costs associated with higher water consumption and electricity use for heating water. This point is illustrated further by Table 25 which shows the results of the life cycle cost calculation in terms of percentage cost for the different LCC parameters, highlighting the significant cost contributions from electricity and water.

Table 24: Showerheads - Base Case Life Cycle Costs per product

	Domestic Showerhead	**Non Domestic Showerhead**
LCC Parameter	**Cost (Euros)**	**Cost (Euros)**
Product price	42	83
Installation	40	60
Electricity	943	501
Water	443	313
Repair & maintenance	55	56
TOTAL	**1522**	**1013**

Table 25: Showerheads - Percentage of total cost for different LCC parameters

	Domestic Showerhead	Non Domestic Showerhead
LCC Parameter	**Percentage of Total**	**Percentage of Total**
Product price	2.76	8.19
Installation	2.63	5.92
Electricity	61.96	49.46
Water	29.11	30.90
Repair & maintenance	3.61	5.53
TOTAL	**100***	**100**

*Individual values do not total 100% exactly due to rounding

As indicated above the purchase price is a relatively small proportion of the overall life cycle costs. Even if the purchase price of a domestic showerhead doubles the percentage of total life cycle costs would only be 5.37% and LCCs would still be dominated by electricity (60.29%) and water (28.32%). A similar situation exists for a non-domestic tap, increasing the purchase price to 166 Euros will raise its percentage of total life cycle cost to 15.15% however electricity (45.71%) and water (28.56%) will still dominate.

Using the life cycle costs shown in Table 24 as a baseline, and a scenario of reducing water consumption by 30%, Table 26 shows how the life cycle assessment tool can be used to demonstrate potential savings over the lifetime of the showerhead.

Table 26: Potential LCC savings following a 30% reduction in water consumption

	Domestic Showerheads			Non-Domestic Showerheads		
	Baseline	**30% Reduction**	**Savings**	**Baseline**	**30% Reduction**	**Savings**
LCC Parameter	**Cost (Euros)**	**Cost (Euros)**	**Euros**	**Cost (Euros)**	**Cost (Euros)**	**Euros**
Product price	42	42	0	83	83	0
Installation	40	40	0	60	60	0
Electricity	943	660	283	501	351	150
Water	443	310	133	313	219	94
Repair & maintenance	55	55	0	56	56	0
TOTAL	**1522**	**1106**	**416**	**1013**	**769**	**244**

5.5 Life Cycle Cost Assessment Observations

The life cycle cost assessment using the base cases as an example has demonstrated that it is important not to consider purchase price in isolation, but the life cycle cost including water and energy use over the product's life.

The calculations above shows the costs of water and electricity dominate the LCCs for taps and showerheads, based on the use profile established for the base cases. The benefit of the LCC approach and using a tool such as EcoReport is that it allows public bodies to explore the costs benefits of different taps and showerheads not just by their purchase price but also their operational cost.

The assessment shows that just by changing water consumption, and keeping all other things equal savings ranging from 244 to 1193 Euros can be achieved per product for the base case examples over their lifetime. Even if purchase prices were to double across all examples, the savings in each case would still exceed the increase in purchase price.

By reducing water consumption the greatest financial savings can be made through lower water charges and reduced energy use for the heating of water. This indicates that purchasing strategies should therefore be developed to specify lower flow rate products in order to minimise life cycle costs.

It is clear that given the large variation in designs, functionality, prices and use patterns, the inputs for the LCC assessment will need to be considered by purchasing authorities on a case by case basis.

The use pattern for taps and showerheads within public buildings will vary, for example a shower in an office environment compared to a shower in a leisure centre. The expected use will need to be considered carefully by the purchasing authority in order to calculate LCCs accurately.

The installation, repair and maintenance costs used in the above analysis are based on feedback from the first questionnaire for this project. Again, depending on the type of installation, or level of repair and maintenance e.g. cleaning required these costs will vary case by case. Although, repair and maintenance costs are likely to be relatively low in the overall life cycle costs as the indication from stakeholders and research undertaken as part of the technical analysis is that the level of repair required is generally minimal.

Likewise installation costs will also vary and may depend on whether it is part of larger refurbishment work or the replacement of individual taps or showerheads. Indeed, an additional source identified during the research suggests lower installation costs for taps of approximately 27 Euros[27].

In summary, the EcoReport tool provides a method for purchasing authorities to compare different performing products on a life cycle cost basis. The inputs will vary depending on the specific circumstances, and it is recommended that further discussions are held with the GPP Advisory Group as part of the GPP specification development process who may be able to identify typical scenarios for public procurement for which life cycle costs could be calculated. Some Member States may already have research or guidance in relation to procurement of water efficiency products[28].

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[27] Based on installation cost of £22 per unit – Appendix D, table 12 in report published by Entec, May 2009 'Office of Government Commerce – CESP Review of Sustainable Operations targets and Sustainable Procurement Measures Final Recommendations'
Available from: http://www.ogc.gov.uk/documents/Entec_SOGE_final_report.pdf

[28] In December 2010, WRAP in the UK published 'Procurement requirements for water efficiency'
Available from:
http://www.wrap.org.uk/downloads/2011_01_19_WRAP_water_eff_model_proc_reqs_v6_FINAL.fad042fd.10378.pdf

5.6 Observations from EcoReport Assessment

The base case assessment for the example products has highlighted a number of points for consideration when developing ecolabel proposals, namely:

- Water Consumption and related Energy Consumption / User Behaviour
- Material Composition
- Waste and product life time

Each of these points is discussed in more detail below.

Water Consumption / User Behaviour

In use water consumption is important for both types of taps and showerheads and as such supports the focus of other water product labelling schemes given to this parameter. In addition the energy consumption associated with hot water use is also a key factor, influencing a wide range of environmental impacts.

Water consumption is clearly the significant impact in the use phase together with associated energy consumption and is clearly linked to user behaviour as well as product design. Ecolabel criteria could be devised addressing both points by setting a high standard for the flow rate and providing user instructions for product use – the latter being a commonly used approach adopted by the ecolabel for most products.

Market data in relation to the availability of products with certain flow rates is not readily available however, an indication has been shown previously in the Task 2 and 3 report by assessing the BMA's water efficient labelling scheme.

Reducing water use through ecolabel criteria will reduce environmental impacts further by reducing those associated with heating water.

Criteria for other water saving features could also be considered for ecolabel criteria, for example aerated showerheads or stop click technology[29], however these are generally niche markets features and may be better suited as optional criteria, or as part of future criteria revisions. Additional features such as these may result in more complex products, using more and/or a wider range of materials.

As in use water consumption will be influenced greatly by user behaviour, appropriate ecolabel criteria should include user information to ensure the product is used efficiently. Additional behavioural aspects to consider include provision of adequate assembly and installation instructions to ensure the product is correct for the type of system it is attached to e.g. high or low pressure and installed correctly. Instructions may also include clear temperature control adjustment information to ensure water losses when adjusting water temperature are minimised.

Material Composition

In December 2010 WaterWise in the UK published 'Water Efficiency Retrofitting in Schools' Available from: http://www.waterwise.org.uk/images/site/Documents/WES/evidence%20base%20for%20large%20scale%20water%20efficiency%20-%20water%20efficiency%20in%20schools%20report%20-%20december%202010.pdf

[29] This feature allows the tap to be turned on by the user until they feel a resistance. The point of resistance limits the flow of the tap to, for example, 50%, of its maximum flow potential. Lifting the handle further, beyond the point of resistance will allow the tap to deliver its maximum flow.

It is clear from the EcoReport analysis that the materials used in the construction of taps and showerheads can have quite different characteristics across the lifecycle i.e. they perform better or less well in different impact categories, and this will also be influenced by the amount of a material used. In headline terms, the extent of these differences for the two tap types (brass and stainless steel) is, compared to the in use water consumption and associated energy consumption, small and certainly there are no order of magnitude differences to note.

Stainless steel and brass perform differently with brass being better in some impact categories and stainless steel performing better in others. Given that brass taps dominate the market, and stakeholders indicating that stainless steel taps currently represent only a small proportion of the market, it is not appropriate to restrict the use of particular metals through the ecolabel criteria. To do so would seriously affect the ecolabel's potential market penetration.

For showerheads, the EcoReport results indicate that the plastic base case showerhead has lower impacts across the different environmental indicators in the production phase compared to the metal base case showerhead. However this will vary from model to model, depending on the particular material composition. As with taps, the extent of these differences for the two showerhead types (plastic and metal) is, compared to the in use water consumption and associated energy consumption, small.

Given that chrome plating is used in small quantities, the impacts on a product basis are limited and lower in terms of their impact when compared to the other materials used within taps. There are some exceptions, for example Eutrophication emissions to water for brass taps are higher from the chrome plating compared to other materials, even though through small quantities are used. Also the output from the EcoReport tool indicates that chrome plating is particularly an issue in relation to heavy metal emissions to air. It should however be remembered that these production phase impacts are small when compared to the use phase impacts, for the environmental indicators, related to water and the associated energy use.

For showerheads, the relative importance of chrome plating depends on the other materials in the product. For the plastic base case showerhead chrome plating is relatively more important than other materials for non hazardous waste, heavy metal emissions to air and eutrophication in particular. For the metal base case showerhead the impacts from chrome plating on a product basis are limited and lower than those of other materials due to the small quantities used. It should however again be remembered that these production phase impacts are insignificant when compare to the use phase impacts, for the environmental indicators, related to water and the associated energy use.

Feedback from a trade association indicates that brass/chrome finished taps will continue to dominate the market in the future and therefore considering the impact of chrome plating as part of the ecolabel criteria could be considered appropriate. Additional information regarding the different methods of chrome plating is included in Appendix 5.

Waste and Lifetime

Another aspect identified by the base case assessment relates to the generation of waste. In the production and end of life phases this is in relation to the product itself. In the production phase in particular this is associated with the brass and stainless steel. Maximising recovery and recycling of materials at the end of life phase should also be considered. This could be affected through ease of dismantling criteria and user instructions, both of which are included in many other ecolabels.

The in use phase waste production is mainly as a result of the energy consumption for water heating. Therefore an ecolabel that targets in use water consumption, and hence energy consumption, will have the added benefit of reducing in use waste.

Criteria relating to the ease of dismantling will also aid repair, extending the lifetime of the product. This will reduce production, distribution and end of life phase impacts. Maximising the life span of products could also be supported through guarantees and the provision of spare parts criteria adopted for many other product ecolabels.

It will be important to balance the extension of lifetime with advances in technology. A point is likely to be reached where it is preferable to replace a product with a newer more efficient model, rather than repair an older less efficient one. This issue has been raised in previous ecolabel discussions and will depend on the product group in question and how significant any future development may be on product performance.

5.7 Additional Considerations

Other points have been highlighted when discussing the project with stakeholders, which should be considered as part of ecolabel criteria development:

- It is important that the tap or showerhead is used with a compatible mixing valve / shower type to ensure safety standards are maintained.
- It is important that the type of system e.g. high/low pressure is considered when selecting a product, to ensure it is suitable for use with the system for which it will be used with.
- Water consumption and associated energy consumption in the use phase are key, therefore although only related to the product itself i.e. the tap or showerhead, consideration of aspects that influence this energy use should be considered, for example checking boiler efficiency, in order to reduce overall impacts associated with the use of the tap or showerhead.

The aspects highlighted in Sections 5.6, 5.6 and 5.7 should be dealt with as part of the criteria development process and any proposals discussed further with key industry stakeholders as early as possible to identify barriers, for example forthcoming legislation/standards or technical points which may influence the criteria development.

Appendices

Appendix 1: EcoReport Results for Taps

Appendix 2: EcoReport Results for Showerheads

Appendix 3: Comparison of EcoReport results for different water heating energy efficiency scenarios

Appendix 4: Comparison of EcoReport results for domestic taps and showerheads with the inclusion and exclusion of energy for the heating of water

Appendix 5 – Additional information regarding chrome plating processes

Appendix 1 – EcoReport Results for Taps

Domestic Brass Taps

Parameter	Units	Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	56	0.06%	64	0.07%	90,050	99.86%	5	0.01%	90,175	100.00%
of which, electricity (in primary MJ)	MJ	8	0.01%	0	0.00%	90,048	99.99%	0	0.00%	90,057	100.00%
Water (process)	ltr	2	0.00%	0	0.00%	172,435	100.00%	0	0.00%	172,438	100.00%
Water (cooling)	ltr	15	0.01%	0	0.00%	240,128	99.99%	0	0.00%	240,143	100.00%
Waste, non-haz./ landfill	g	2,999	2.79%	57	0.05%	104,437	97.09%	70	0.07%	107,563	100.00%
Waste, hazardous/ incinerated	g	1	0.05%	1	0.05%	2,075	96.96%	62	2.90%	2,140	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq.	3	0.08%	5	0.13%	3,930	99.80%	0	0.00%	3,938	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	37	0.16%	14	0.06%	23,188	99.78%	1	0.00%	23,240	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	34	100.00%	0	0.00%	34	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	36	5.74%	0	0.00%	591	94.26%	0	0.00%	627	100.00%
Heavy Metals	mg Ni eq.	88	5.37%	3	0.18%	1,546	94.33%	2	0.12%	1,639	100.00%
PAHs	mg Ni eq.	3	1.63%	3	1.63%	177	96.20%	0	0.00%	184	100.00%
Particulate Matter (PM, dust)	g	2	0.37%	31	5.75%	495	91.84%	11	2.04%	539	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	8	1.36%	0	0.00%	581	98.64%	1	0.17%	589	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	3	100.00%	0	0.00%	3	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg	

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

Domestic Steel Taps

Parameter	Units	Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	71	0.08%	64	0.07%	90,050	99.85%	1	0.00%	90,186	100.00%
of which, electricity (in primary MJ)	MJ	21	0.02%	0	0.00%	90,048	99.98%	0	0.00%	90,069	100.00%
Water (process)	ltr	56	0.03%	0	0.00%	172,436	99.97%	0	0.00%	172,492	100.00%
Water (cooling)	ltr	24	0.01%	0	0.00%	240,128	99.99%	0	0.00%	240,152	100.00%
Waste, non-haz./ landfill	g	863	0.82%	57	0.05%	104,416	99.08%	49	0.05%	105,386	100.00%
Waste, hazardous/ incinerated	g	1	0.05%	1	0.05%	2,075	97.01%	62	2.90%	2,139	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq.	6	0.15%	5	0.13%	3,930	99.72%	0	0.00%	3,941	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	48	0.21%	14	0.06%	23,188	99.73%	0	0.00%	23,251	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	34	100.00%	0	0.00%	34	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	7	1.17%	0	0.00%	590	98.66%	0	0.00%	598	100.00%
Heavy Metals	mg Ni eq.	146	8.60%	3	0.18%	1,546	91.10%	2	0.12%	1,697	100.00%
PAHs	mg Ni eq.	0	0.00%	3	1.66%	177	97.79%	0	0.00%	181	100.00%
Particulate Matter (PM, dust)	g	7	1.29%	31	5.72%	495	91.33%	9	1.66%	542	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	63	9.77%	0	0.00%	581	90.08%	1	0.16%	645	100.00%
Eutrophication	g PO4	2	40.00%	0	0.00%	3	60.00%	0	0.00%	5	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg	

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

Non-Domestic Brass Taps

Parameter	Units	Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	56	0.02%	64	0.02%	280,145	99.96%	5	0.00%	280,270	100.00%
of which, electricity (in primary MJ)	MJ	9	0.00%	0	0.00%	280,140	100.00%	0	0.00%	280,149	100.00%
Water (process)	ltr	2	0.00%	0	0.00%	536,506	100.00%	0	0.00%	536,508	100.00%
Water (cooling)	ltr	15	0.00%	0	0.00%	747,040	100.00%	0	0.00%	747,055	100.00%
Waste, non-haz./ landfill	g	2,999	0.91%	57	0.02%	324,841	99.05%	70	0.02%	327,967	100.00%
Waste, hazardous/ incinerated	g	1	0.02%	1	0.02%	6,455	99.00%	62	0.95%	6,520	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq.	3	0.02%	5	0.04%	12,225	99.93%	0	0.00%	12,234	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	37	0.05%	14	0.02%	72,138	99.93%	1	0.00%	72,189	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	106	100.00%	0	0.00%	106	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	36	1.92%	0	0.00%	1,837	98.08%	0	0.00%	1,873	100.00%
Heavy Metals	mg Ni eq.	88	1.80%	3	0.06%	4,807	98.10%	2	0.04%	4,900	100.00%
PAHs	mg Ni eq.	3	0.54%	3	0.54%	552	98.92%	0	0.00%	558	100.00%
Particulate Matter (PM, dust)	g	2	0.13%	31	1.96%	1,541	97.29%	11	0.69%	1,584	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	8	0.44%	0	0.00%	1806	99.50%	1	0.06%	1815	100.00%
Eutrophication	g PO4	1	11.11%	0	0.00%	9	100.00%	0	0.00%	9	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg	

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

Non-Domestic Steel Taps

Parameter	Units	Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	71	0.03%	64	0.02%	280,145	99.95%	1	0.00%	280,281	100.00%
of which, electricity (in primary MJ)	MJ	21	0.01%	0	0.00%	280,140	99.99%	0	0.00%	280,161	100.00%
Water (process)	ltr	56	0.01%	0	0.00%	536,507	99.99%	0	0.00%	536,563	100.00%
Water (cooling)	ltr	24	0.00%	0	0.00%	747,040	100.00%	0	0.00%	747,064	100.00%
Waste, non-haz./ landfill	g	863	0.26%	57	0.02%	324,480	99.60%	49	0.02%	325,790	100.00%
Waste, hazardous/ incinerated	g	1	0.02%	1	0.02%	6,455	99.00%	62	0.95%	6,520	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq.	6	0.05%	5	0.04%	12,225	99.90%	0	0.00%	12,237	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	48	0.07%	14	0.02%	72,138	99.91%	0	0.00%	72,201	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	106	100.00%	0	0.00%	106	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	7	0.38%	0	0.00%	1,836	99.57%	0	0.00%	1,844	100.00%
Heavy Metals	mg Ni eq.	146	2.94%	3	0.06%	4,808	96.96%	2	0.04%	4,959	100.00%
PAHs	mg Ni eq.	0	0.00%	3	0.54%	552	99.46%	0	0.00%	555	100.00%
Particulate Matter (PM, dust)	g	7	0.44%	31	1.95%	1,541	97.04%	9	0.57%	1,588	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	63	3.37%	0	0.00%	1807	96.63%	1	0.05%	1870	100.00%
Eutrophication	g PO4	2	18.18%	0	0.00%	9	81.82%	0	0.00%	11	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg	

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

Appendix 2 - EcoReport Results for Showerheads

Domestic Showerheads – Plastic

Parameter	Units	Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	30	0.03%	64	0.07%	88,831	99.89%	4	0.00%	88,928	100.00%
of which, electricity (in primary MJ)	MJ	11	0.01%	0	0.00%	88,830	99.99%	0	0.00%	88,841	100.00%
Water (process)	ltr	2	0.00%	0	0.00%	137,322	100.00%	0	0.00%	137,324	100.00%
Water (cooling)	ltr	35	0.01%	0	0.00%	236,880	99.99%	0	0.00%	236,915	100.00%
Waste, non-haz./ landfill	g	79	0.08%	57	0.06%	102,995	99.86%	11	0.01%	103,142	100.00%
Waste, hazardous/ incinerated	g	2	0.09%	1	0.04%	2,047	92.00%	175	7.87%	2225	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq.	1	0.03%	5	0.13%	3,877	99.85%	0	0.00%	3,883	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	8	0.03%	14	0.06%	22,874	99.90%	1	0.00%	22,898	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	33	97.06%	0	0.00%	34	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	1	0.17%	0	0.00%	582	99.83%	0	0.00%	583	100.00%
Heavy Metals	mg Ni eq.	39	2.49%	3	0.19%	1,524	97.13%	3	0.19%	1,569	100.00%
PAHs	mg Ni eq.	0	0.00%	3	1.69%	175	98.31%	0	0.00%	178	100.00%
Particulate Matter (PM, dust)	g	1	0.19%	31	5.77%	489	91.06%	16	2.98%	537	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	1	0.17%	0	0.00%	573	99.65%	1	0.17%	575	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	3	100.00%	0	0.00%	3	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg	

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

Domestic Showerheads – Metal

Parameter	Units	Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	136	0.15%	64	0.07%	88,832	99.76%	15	0.02%	89,047	100.00%
of which, electricity (in primary MJ)	MJ	20	0.02%	0	0.00%	88,830	99.98%	0	0.00%	88,850	100.00%
Water (process)	ltr	4	0.00%	0	0.00%	137,322	100.00%	0	0.00%	137,326	100.00%
Water (cooling)	ltr	74	0.03%	0	0.00%	236,881	99.97%	-1	0.00%	236,954	100.00%
Waste, non-haz./ landfill	g	5927	5.43%	57	0.05%	103,054	94.39%	140	0.13%	109,179	100.00%
Waste, hazardous/ incinerated	g	5	0.20%	1	0.04%	2,047	83.82%	389	15.93%	2442	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq.	6	0.15%	5	0.13%	3,877	99.69%	1	0.03%	3,889	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	82	0.36%	14	0.06%	22,875	99.57%	3	0.01%	22,974	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	33	97.06%	0	0.00%	34	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	49	7.74%	0	0.00%	583	92.10%	1	0.16%	633	100.00%
Heavy Metals	mg Ni eq.	147	8.72%	3	0.18%	1,525	90.50%	9	0.53%	1,685	100.00%
PAHs	mg Ni eq.	7	3.78%	3	1.62%	175	94.59%	0	0.00%	185	100.00%
Particulate Matter (PM, dust)	g	4	0.70%	31	5.46%	489	86.09%	44	7.75%	568	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	18	3.03%	0	0.00%	573	96.46%	3	0.51%	594	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	3	100.00%	0	0.00%	3	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg	

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

Non-Domestic Showerheads – Plastic

Parameter	Units	Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	30	0.05%	64	0.10%	61,300	99.84%	4	0.01%	61,397	100.00%
of which, electricity (in primary MJ)	MJ	11	0.02%	0	0.00%	61,299	99.98%	0	0.00%	61,310	100.00%
Water (process)	ltr	2	0.00%	0	0.00%	94,758	100.00%	0	0.00%	94,760	100.00%
Water (cooling)	ltr	35	0.02%	0	0.00%	163,464	99.98%	0	0.00%	163,499	100.00%
Waste, non-haz./ landfill	g	79	0.11%	57	0.08%	71,074	99.79%	11	0.02%	71,221	100.00%
Waste, hazardous/ incinerated	g	2	0.13%	1	0.06%	1,413	88.81%	179	11.25%	1,591	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq.	1	0.04%	5	0.19%	2,675	99.74%	0	0.00%	2,682	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	8	0.05%	14	0.09%	15,785	99.85%	1	0.01%	15,808	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	23	100.00%	0	0.00%	23	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	1	0.25%	0	0.00%	402	99.75%	0	0.00%	403	100.00%
Heavy Metals	mg Ni eq.	39	3.56%	3	0.27%	1,052	95.90%	3	0.27%	1,097	100.00%
PAHs	mg Ni eq.	0	0.00%	3	2.42%	121	97.58%	0	0.00%	124	100.00%
Particulate Matter (PM, dust)	g	1	0.26%	31	8.05%	337	87.53%	16	4.16%	385	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	1	0.25%	0	0.00%	395	99.50%	1	0.25%	397	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	2	100.00%	0	0.00%	2	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg	

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

Non-Domestic Showerheads - Metal

Parameter	Units	Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	136	0.22%	64	0.10%	61,301	99.65%	15	0.02%	61,516	100.00%
of which, electricity (in primary MJ)	MJ	20	0.03%	0	0.00%	61,299	99.97%	0	0.00%	61,319	100.00%
Water (process)	ltr	4	0.00%	0	0.00%	94,758	100.00%	0	0.00%	94,762	100.00%
Water (cooling)	ltr	74	0.05%	0	0.00%	163,465	99.96%	-1	0.00%	163,538	100.00%
Waste, non-haz./ landfill	g	5927	7.67%	57	0.07%	71,133	92.07%	140	0.18%	77,258	100.00%
Waste, hazardous/ incinerated	g	5	0.28%	1	0.06%	1,413	78.15%	389	21.52%	1,808	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq.	6	0.22%	5	0.19%	2,675	99.52%	1	0.04%	2,688	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	82	0.52%	14	0.09%	15,786	99.38%	3	0.02%	15,885	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	23	100.00%	0	0.00%	23	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	49	10.82%	0	0.00%	402	88.74%	1	0.22%	453	100.00%
Heavy Metals	mg Ni eq.	147	12.12%	3	0.25%	1,053	86.81%	9	0.74%	1,213	100.00%
PAHs	mg Ni eq.	7	5.34%	3	2.29%	121	92.37%	0	0.00%	131	100.00%
Particulate Matter (PM, dust)	g	4	0.96%	31	7.43%	337	80.82%	44	10.55%	417	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	18	4.33%	0	0.00%	395	94.95%	3	0.72%	416	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	2	100.00%	0	0.00%	2	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg	

NB Values have been rounded to whole numbers, and percentages to two decimal places. Therefore the values in each life cycle phase may not appear to add up to the total value, and small percentages may appear as 0.00%.

Appendix 3 – Comparison of EcoReport results for different water heating energy efficiency scenarios

The table below presents the results for a domestic brass tap with two different water heating energy efficiency scenarios.

		70% water heating energy efficiency										86% water heating energy efficiency									
Parameter	**Units**	**Production**		**Distribution**		**Use**		**End of Life**		**TOTAL**		**Production**		**Distribution**		**Use**		**End of Life**		**TOTAL**	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	56	0.06%	64	0.07%	90,050	99.86%	5	0.01%	90,175	100.00%	56	0.08%	64	0.09%	73,418	99.83%	5	0.01%	73,543	100.00%
of which, electricity (in primary MJ)	MJ	8	0.01%	0	0.00%	90,048	99.99%	0	0.00%	90,057	100.00%	9	0.01%	0	0.00%	73,416	99.99%	0	0.00%	73,425	100.00%
Water (process)	ltr	2	0.00%	0	0.00%	172,435	100.00%	0	0.00%	172,438	100.00%	2	0.00%	0	0.00%	171,326	100.00%	0	0.00%	171,329	100.00%
Water (cooling)	ltr	15	0.01%	0	0.00%	240,128	99.99%	0	0.00%	240,143	100.00%	15	0.01%	0	0.00%	195,776	99.99%	0	0.00%	195,791	100.00%
Waste, non-haz./ landfill	g	2,999	2.79%	57	0.05%	104,437	97.09%	70	0.07%	107,563	100.00%	2,999	3.40%	57	0.06%	85,153	96.46%	70	0.08%	88,279	100.00%
Waste, hazardous/ incinerated	g	1	0.05%	1	0.05%	2,075	96.96%	62	2.90%	2,140	100.00%	1	0.06%	1	0.06%	1,692	96.36%	62	3.53%	1,756	100.00%
Emissions (Air)																					
Greenhouse Gases in GWP100	kg CO2 eq.	3	0.08%	5	0.13%	3,930	99.80%	0	0.00%	3,938	100.00%	3	0.09%	5	0.16%	3,204	99.75%	0	0.00%	3,212	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	37	0.16%	14	0.06%	23,188	99.78%	1	0.00%	23,240	100.00%	37	0.20%	14	0.07%	18,905	99.73%	1	0.01%	18,957	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	34	100.00%	0	0.00%	34	100.00%	0	0.00%	0	0.00%	28	100.00%	0	0.00%	28	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	36	5.74%	0	0.00%	591	94.26%	0	0.00%	627	100.00%	36	6.95%	0	0.00%	482	93.05%	0	0.00%	518	100.00%
Heavy Metals	mg Ni eq.	88	5.37%	3	0.18%	1,546	94.33%	2	0.12%	1,639	100.00%	88	6.50%	3	0.22%	1,260	93.06%	2	0.15%	1,354	100.00%
PAHs	mg Ni eq.	3	1.63%	3	1.63%	177	96.20%	0	0.00%	184	100.00%	3	1.99%	3	1.99%	145	96.03%	0	0.00%	151	100.00%
Particulate Matter (PM, dust)	g	2	0.37%	31	5.75%	495	91.84%	11	2.04%	539	100.00%	2	0.45%	31	6.94%	404	90.38%	11	2.46%	447	100.00%
Emissions (Water)																					
Heavy Metals	mg Hg/20	8	1.36%	0	0.00%	581	98.64%	1	0.17%	589	100.00%	8	1.66%	0	0.00%	473	98.13%	1	0.21%	482	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	3	100.00%	0	0.00%	3	100.00%	0	0.00%	0	0.00%	2	100.00%	0	0.00%	2	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	

Appendix 4 – Comparison of EcoReport results for domestic taps and showerheads with the inclusion and exclusion of energy for the heating of water.

The tables below show a comparison of the EcoReport results for the domestic taps and showerhead base cases with energy for heating water included and excluded.

Domestic Brass Tap:

		With Energy										Without Energy									
Parameter	Units	Production		Distribution		Use		End of Life		TOTAL		Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	56	0.06%	64	0.07%	90,050	99.86%	5	0.01%	90,175	100.00%	56	44.09%	64	50.39%	2	1.57%	5	3.94%	127	100.00%
of which, electricity (in primary MJ)	MJ	8	0.01%	0	0.00%	90,048	99.99%	0	0.00%	90,057	100.00%	9	100.00%	0	0.00%	0	0.00%	0	0.00%	9	100.00%
Water (process)	ltr	2	0.00%	0	0.00%	172,435	100.00%	0	0.00%	172,438	100.00%	2	0.00%	0	0.00%	166,432	100.00%	0	0.00%	166,434	100.00%
Water (cooling)	ltr	15	0.01%	0	0.00%	240,128	99.99%	0	0.00%	240,143	100.00%	15	100.00%	0	0.00%	0	0.00%	0	0.00%	15	100.00%
Waste, non-haz./ landfill	g	2,999	2.79%	57	0.05%	104,437	97.09%	70	0.07%	107,563	100.00%	2,999	95.00%	57	1.81%	32	1.01%	70	2.22%	3,157	100.00%
Waste, hazardous/ incinerated	g	1	0.05%	1	0.05%	2,075	96.96%	62	2.90%	2,140	100.00%	1	1.54%	1	1.54%	0	0.00%	62	95.38%	65	100.00%
Emissions (Air)																					
Greenhouse Gases in GWP100	kg CO2 eq.	3	0.08%	5	0.13%	3,930	99.80%	0	0.00%	3,938	100.00%	3	37.50%	5	62.50%	0	0.00%	0	0.00%	8	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	37	0.16%	14	0.06%	23,188	99.78%	1	0.00%	23,240	100.00%	37	69.81%	14	26.42%	1	1.89%	1	1.89%	53	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	34	100.00%	0	0.00%	34	100.00%	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Persistent Organic Pollutants (POP)	ng i-Teq	36	5.74%	0	0.00%	591	94.26%	0	0.00%	627	100.00%	36	100.00%	0	0.00%	0	0.00%	0	0.00%	36	100.00%
Heavy Metals	mg Ni eq.	88	5.37%	3	0.18%	1,546	94.33%	2	0.12%	1,639	100.00%	88	93.62%	3	3.19%	1	1.06%	2	2.13%	94	100.00%
PAHs	mg Ni eq.	3	1.63%	3	1.63%	177	96.20%	0	0.00%	184	100.00%	3	50.00%	3	50.00%	0	0.00%	0	0.00%	6	100.00%
Particulate Matter (PM, dust)	g	2	0.37%	31	5.75%	495	91.84%	11	2.04%	539	100.00%	2	4.65%	31	72.09%	0	0.00%	11	25.58%	43	100.00%
Emissions (Water)																					
Heavy Metals	mg Hg/20	8	1.36%	0	0.00%	581	98.64%	1	0.17%	589	100.00%	8	88.89%	0	0.00%	0	0.00%	1	11.11%	9	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	3	100.00%	0	0.00%	3	100.00%	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	

Domestic Stainless Steel Tap:

		With Energy										Without Energy									
Parameter	Units	Production		Distribution		Use		End of Life		TOTAL		Production		Distribution		Use		End of Life		TOTAL	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	71	0.08%	64	0.07%	90,050	99.85%	1	0.00%	90,186	100.00%	71	51.45%	64	46.38%	2	1.45%	1	0.72%	138	100.00%
of which, electricity (in primary MJ)	MJ	21	0.02%	0	0.00%	90,048	99.98%	0	0.00%	90,069	100.00%	21	100.00%	0	0.00%	0	0.00%	0	0.00%	21	100.00%
Water (process)	ltr	56	0.03%	0	0.00%	172,436	99.97%	0	0.00%	172,492	100.00%	56	0.03%	0	0.00%	166,433	99.97%	0	0.00%	166,489	100.00%
Water (cooling)	ltr	24	0.01%	0	0.00%	240,128	99.99%	0	0.00%	240,152	100.00%	24	100.00%	0	0.00%	0	0.00%	0	0.00%	24	100.00%
Waste, non-haz./ landfill	g	863	0.82%	57	0.05%	104,416	99.08%	49	0.05%	105,386	100.00%	863	88.06%	57	5.82%	10	1.02%	49	5.00%	980	100.00%
Waste, hazardous/ incinerated	g	1	0.05%	1	0.05%	2,075	97.01%	62	2.90%	2,139	100.00%	1	1.56%	1	1.56%	0	0.00%	62	96.88%	64	100.00%
Emissions (Air)																					
Greenhouse Gases in GWP100	kg CO2 eq.	6	0.15%	5	0.13%	3,930	99.72%	0	0.00%	3,941	100.00%	6	54.55%	5	45.45%	0	0.00%	0	0.00%	11	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	48	0.21%	14	0.06%	23,188	99.73%	0	0.00%	23,251	100.00%	48	75.00%	14	21.88%	1	1.56%	0	0.00%	64	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	34	100.00%	0	0.00%	34	100.00%	0	N/A	0	N/A	0	N/A	0	N/A	0	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	7	1.17%	0	0.00%	590	98.66%	0	0.00%	598	100.00%	7	100.00%	0	0.00%	0	0.00%	0	0.00%	7	100.00%
Heavy Metals	mg Ni eq.	146	8.60%	3	0.18%	1,546	91.10%	2	0.12%	1,697	100.00%	146	95.42%	3	1.96%	1	0.65%	2	1.31%	153	100.00%
PAHs	mg Ni eq.	0	0.00%	3	1.66%	177	97.79%	0	0.00%	181	100.00%	0	0.00%	3	100.00%	0	0.00%	0	0.00%	3	100.00%
Particulate Matter (PM, dust)	g	7	1.29%	31	5.72%	495	91.33%	9	1.66%	542	100.00%	7	14.89%	31	65.96%	0	0.00%	9	19.15%	47	100.00%
Emissions (Water)																					
Heavy Metals	mg Hg/20	63	9.77%	0	0.00%	581	90.08%	1	0.16%	645	100.00%	63	96.92%	0	0.00%	1	1.54%	1	1.54%	65	100.00%
Eutrophication	g PO4	2	40.00%	0	0.00%	3	60.00%	0	0.00%	5	100.00%	2	100.00%	0	0.00%	0	0.00%	0	0.00%	2	100.00%
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	

Domestic Plastic Showerhead:

		With Energy										Without Energy									
Parameter	**Units**	**Production**		**Distribution**		**Use**		**End of Life**		**TOTAL**		**Production**		**Distribution**		**Use**		**End of Life**		**TOTAL**	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	30	0.03%	64	0.07%	88,831	99.89%	4	0.00%	88,928	100.00%	30	30.61%	64	65.31%	1	1.02%	4	4.08%	98	100.00%
of which, electricity (in primary MJ)	MJ	11	0.01%	0	0.00%	88,830	99.99%	0	0.00%	88,841	100.00%	11	100.00%	0	0.00%	0	0.00%	0	0.00%	11	100.00%
Water (process)	ltr	2	0.00%	0	0.00%	137,322	100.00%	0	0.00%	137,324	100.00%	2	0.00%	0	0.00%	131,400	100.00%	0	0.00%	131,402	100.00%
Water (cooling)	ltr	35	0.01%	0	0.00%	236,880	99.99%	0	0.00%	236,915	100.00%	35	100.00%	0	0.00%	0	0.00%	0	0.00%	35	100.00%
Waste, non-haz./ landfill	g	79	0.08%	57	0.06%	102,995	99.86%	11	0.01%	103,142	100.00%	79	53.02%	57	38.26%	2	1.34%	11	7.38%	149	100.00%
Waste, hazardous/ incinerated	g	2	0.09%	1	0.04%	2,047	92.00%	175	7.87%	2225	100.00%	2	1.12%	1	0.56%	0	0.00%	175	98.31%	178	100.00%
Emissions (Air)																					
Greenhouse Gases in GWP100	kg CO2 eq.	1	0.03%	5	0.13%	3,877	99.85%	0	0.00%	3,883	100.00%	1	16.67%	5	83.33%	0	0.00%	0	0.00%	6	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	8	0.03%	14	0.06%	22,874	99.90%	1	0.00%	22,898	100.00%	8	32.00%	14	56.00%	0	0.00%	1	4.00%	25	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	33	97.06%	0	0.00%	34	100.00%	0	N/A	0	N/A	0	N/A	0	N/A	-	N/A
Persistent Organic Pollutants (POP)	ng i-Teq	1	0.17%	0	0.00%	582	99.83%	0	0.00%	583	100.00%	1	100.00%	0	0.00%	0	0.00%	0	0.00%	1	100.00%
Heavy Metals	mg Ni eq.	39	2.49%	3	0.19%	1,524	97.13%	3	0.19%	1,569	100.00%	39	86.67%	3	6.67%	0	0.00%	3	6.67%	45	100.00%
PAHs	mg Ni eq.	0	0.00%	3	1.69%	175	98.31%	0	0.00%	178	100.00%	0	0.00%	3	100.00%	0	0.00%	0	0.00%	3	100.00%
Particulate Matter (PM, dust)	g	1	0.19%	31	5.77%	489	91.06%	16	2.98%	537	100.00%	1	2.08%	31	64.58%	0	0.00%	16	33.33%	48	100.00%
Emissions (Water)																					
Heavy Metals	mg Hg/20	1	0.17%	0	0.00%	573	99.65%	1	0.17%	575	100.00%	1	50.00%	0	0.00%	0	0.00%	1	50.00%	2	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	3	100.00%	0	0.00%	3	100.00%	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	

Domestic Metal Showerhead:

		With Energy										Without Energy									
Parameter	**Units**	**Production**		**Distribution**		**Use**		**End of Life**		**TOTAL**		**Production**		**Distribution**		**Use**		**End of Life**		**TOTAL**	
		Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total	Value	% of total
Total Energy (GER)	MJ	136	0.15%	64	0.07%	88,832	99.76%	15	0.02%	89,047	100.00%	136	62.67%	64	29.49%	2	0.92%	15	6.91%	217	100.00%
of which, electricity (in primary MJ)	MJ	20	0.02%	0	0.00%	88,830	99.98%	0	0.00%	88,850	100.00%	20	100.00%	0	0.00%	0	0.00%	0	0.00%	20	100.00%
Water (process)	ltr	4	0.00%	0	0.00%	137,322	100.00%	0	0.00%	137,326	100.00%	4	0.00%	0	0.00%	131,400	100.00%	0	0.00%	131,404	100.00%
Water (cooling)	ltr	74	0.03%	0	0.00%	236,881	99.97%	-1	0.00%	236,954	100.00%	74	100.00%	0	0.00%	1	1.35%	-1	-1.35%	74	100.00%
Waste, non-haz./ landfill	g	5927	5.43%	57	0.05%	103,054	94.39%	140	0.13%	109,179	100.00%	5927	95.83%	57	0.92%	61	0.99%	140	2.26%	6,185	100.00%
Waste, hazardous/ incinerated	g	5	0.20%	1	0.04%	2,047	83.82%	389	15.93%	2442	100.00%	5	1.27%	1	0.25%	0	0.00%	389	98.48%	395	100.00%
Emissions (Air)																					
Greenhouse Gases in GWP100	kg CO2 eq.	6	0.15%	5	0.13%	3,877	99.69%	1	0.03%	3,889	100.00%	6	50.00%	5	41.67%	0	0.00%	1	8.33%	12	100.00%
Ozone Depletion, emissions	mg R-11 eq.	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq.	82	0.36%	14	0.06%	22,875	99.57%	3	0.01%	22,974	100.00%	82	82.00%	14	14.00%	1	1.00%	3	3.00%	100	100.00%
Volatile Organic Compounds (VOC)	g	0	0.00%	0	0.00%	33	97.06%	0	0.00%	34	100.00%	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Persistent Organic Pollutants (POP)	ng i-Teq	49	7.74%	0	0.00%	583	92.10%	1	0.16%	633	100.00%	49	96.08%	0	0.00%	1	1.96%	1	1.96%	51	100.00%
Heavy Metals	mg Ni eq.	147	8.72%	3	0.18%	1,525	90.50%	9	0.53%	1,685	100.00%	147	91.30%	3	1.86%	1	0.62%	9	5.59%	161	100.00%
PAHs	mg Ni eq.	7	3.78%	3	1.62%	175	94.59%	0	0.00%	185	100.00%	7	70.00%	3	30.00%	0	0.00%	0	0.00%	10	100.00%
Particulate Matter (PM, dust)	g	4	0.70%	31	5.46%	489	86.09%	44	7.75%	568	100.00%	4	5.00%	31	38.75%	0	0.00%	44	55.00%	80	100.00%
Emissions (Water)																					
Heavy Metals	mg Hg/20	18	3.03%	0	0.00%	573	96.46%	3	0.51%	594	100.00%	18	85.71%	0	0.00%	0	0.00%	3	14.29%	21	100.00%
Eutrophication	g PO4	0	0.00%	0	0.00%	3	100.00%	0	0.00%	3	100.00%	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Persistent Organic Pollutants (POP)	ng i-Teq	neg		neg		neg		neg		neg		neg		neg		neg		neg		neg	

Appendix 5 – Additional information regarding chrome plating processes

It is not clear from the EcoReport tool the nature of the chrome plating technology that it considers; however there appears to be two main processes for decorative chrome plating:

- Hexavalent chromium
- Trivalent chromium

Hexavalent chromium is a known human carcinogen[30]; 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.

Discussions with a trade association indicate that some tap and showerhead manufacturers have had to change their chrome plating processes where the WEEE Directive applies, for example 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[31]. 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[32].

In addition to the environmental benefits alternatives to hexavalent chromium present, practical issues such as cost will also need to be considered. The literature indicates that the chemical costs for trivalent chromium are more expensive than hexavalent chromium[33], 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 has been undertaken by the Toxic Use Reduction Institute in the USA[34]. Chapter 6 of this research is particularly relevant and provides a summary of the characteristics of hexavalent chromium and the alternative available, re-iterating some of the points highlighted by the references above.

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[30] http://www.newmoa.org/prevention/p2tech/TriChromeFinal.pdf
[31] http://www.newmoa.org/prevention/p2tech/TriChromeFinal.pdf
[32] Gardner A, (2006) Decorative Trivalent Chromium Plating, Metal Finishing, Vol 104, Issue 11, pp41-45
[33] http://www.newmoa.org/prevention/p2tech/TriChromeFinal.pdf
[34] http://www.turi.org/library/turi_publications/five_chemicals_study