ECOTAPWARE

Task 4: Base Case Assessment

EUROPEAN COMMISSION

Institute for Prospective Technological Studies

Table of contents

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 a tap the study team purchased and dismantled.

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 also 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 a sensitivity analysis whereby the base case description could be perturbed to study the effects of changing any one or more 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; strip down of products we purchased and dismantled or from stakeholders.

- 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

This chapter contains 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.

A number of components and commonly used materials have been identified in relation to taps and showerheads. These are summarised below:

Commonly used materials for taps and showerheads:

- Brass
- Chrome Plate
- Plastic
- Stainless Steel
- Rubber

These are used to make the various components of the products, which include:

Taps:

- Tap body, including valve
- Plating
- Nuts and Bolts
- Washers e.g. horseshoe washer
- O Rings
- Non-domestic taps may include additional aspects such as infra red sensors.

Showerheads:

- Outlet, accelerator, jet disc, tube, deep injection, water distributor cartridge, connector, cone
- Body, plastic cover for cone

Further details, where information is available, has been provided in the life cycle phase sections below in relation to the types of materials used. This includes reference to previous reports published as part of this study.

2.1 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[1].

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 possible varies between different member states.

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.

As noted in Section 1.1 no product specific information relating to material composition for taps has been secured. In order to address this, a tap was purchased and dismantled to inform an assessment of material weights. As brass mixer tap was chosen in light of the feedback outlined above by stakeholders.

For showerheads stakeholders indicated a range of plastic and metals can be used, although some indicated that the showerheads are increasingly made of plastic. Some bill of material data has been provided for a showerhead; however the extent to which it is representative of the wider market is unknown.

2.2 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. This is consistent with the packaging for the example tap purchased.

2.3 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.

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

- 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[2] indicates a split of water use between taps and showerheads as[3] shown in Table 1.

[2] 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

[3] 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

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*

We welcome stakeholder feedback on the following questions:

1. **Is the 76%:24% split between taps and showerheads representative across the EU? If you disagree please provide additional information.**

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[4].

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

[4] This assumption has been made in the absence of data to provide an alternative split.

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[5]:

Table 2: Hot and cold water consumption from taps

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

[5] 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

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[6]. 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**

We welcome stakeholder feedback on the following questions:

1. **Is the 70:30 ratio for the hot and cold water mix appropriate for the EU? If you disagree please provide additional information.**

Step 3: Calculation of Energy Consumption

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.

- 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[7].
    - Boiler efficiency is assumed as 70%[8]

- 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

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[6] http://www.energy.wa.gov.au/cproot/2311/2/choose_hot_water.pdf
[7] http://www.hse.gov.uk/pubns/indg376.pdf
[8] From Table 11 of Critchley, R. and Phipps, D (2007) Water and Energy Efficient Showers: Project Report http://www.unitedutilities.com/Documents/UULJMUwaterenergyefficientshowerFinalreport23rdMay2007.pdf

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[9].
    - Boiler efficiency is assumed as 70%[10]
- 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.

Table 4 EcoReport Inputs for Use Phase Electricity for Showerheads

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

In addition to the water and energy use outlined above, taps and showerheads will 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.

We welcome stakeholder feedback on the following questions:

1. **Please provide information in relation to the maintenance and repair frequencies for taps and showerheads**
2. **Is there a difference between domestic and non-domestic sectors in relation to maintenance and repair?**
3. **Are you able to provide any cost information in relation to maintenance and repair, e.g. cost of spare parts, labour charges for typical jobs.**

2.4 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.

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

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

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, no product specific information relating to material composition has been secured. In order to address this, a tap was purchased and dismantled to inform an assessment of material weights.

The tap purchased was a Plumb Sure Topaz chrome basin mixer[11] as shown in Figure 1.

Figure 1 - Plumb Sure Topaz tap and fittings purchased from UK retail store

[11] http://www.diy.com/diy/jsp/bq/nav.jsp?isSearch=true&isYmal=true&fh_search=0000003633700

In addition to the taps and fittings shown in Figure 1, the taps also came with documentation, including the following:

- Assembly instructions, which outlined the tools required
- A note that the tap must be installed in compliance with relevant legislation, in this case the UK Water Bylaw Regulations
- Details of the minimum working pressure (0.2 bar)
- A customer services contact number

Using the information from this example tap two base case scenarios have been developed for a brass taps and a stainless steel tap.

3.2 Product Specific Inputs - Taps

3.2.1 Bill of Materials

The composition of the brass tap, shown in Table 5 for the base case uses actual weights of the various components of the purchased product detailed above. The exception to this is the chrome plating which cannot be weighed. An assumption was made that chrome plate is 1% of the tap weight.

Table 5 Bill of Materials - Brass Tap

Material	Weight (g)	Components	Material code in EcoReport
Brass	882	Tap body	31-CuZn38 cast
Chrome Plating	9	Plating	40-Cu/Ni/Cr plating
Stainless Steel	59	Horseshoe washer, nut and bolt	25-Stainless 18/8 coil
Plastic	7	O ring and horseshoe washer	16-Flex PUR

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 differing construction types, a base case for stainless steel also has been assessed.

For the stainless steel tap base case, the weights have been based on those for the purchased tap detailed above, with stainless steel substituting brass for the tap body with stainless steel. The EcoReport inputs are summarised in Table 6 below.

Table 6 Bill of Materials – Stainless Steel Tap

Material	Weight (g)	Components	Material code in EcoReport
Stainless Steel	950	Tap body, Horseshoe washer, nut and bolt	25-Stainless 18/8 coil
Plastic	7	O ring and horseshoe washer	16-Flex PUR

We welcome your feedback on the following questions:

1. Is the bill of materials data representative for typical products within the EU? If you disagree please provide additional information.
2. The bill of material information presented above relates to examples of domestic sector taps. In your experience is this representative of non-domestic sector taps? If not please provide further information.
3. Are there any other materials for key components which are not included in the above base cases?
4. Is the assumption for chrome plating outlined above appropriate? If not please provide further information.

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 7.

Table 7 Packaging dimensions and volume for taps

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

We welcome your feedback on the following question:

1. Is this an appropriate packaging volume to use for both domestic and non-domestic sector taps? If not please provide alternative information.

3.2.3 Use Phase

The inputs for the use phase are shown in Table 8. 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 8 Use Phase Water and Energy Inputs for taps

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

The inputs for water and energy are based on the assumptions outlined in Section 2.3.

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

3.3 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 2 to Figure 16). 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 use phase parameters i.e. water and energy use with regards non-domestic use are highlighted for specific environmental indicators as necessary.

3.3.1 Other Resources and Waste

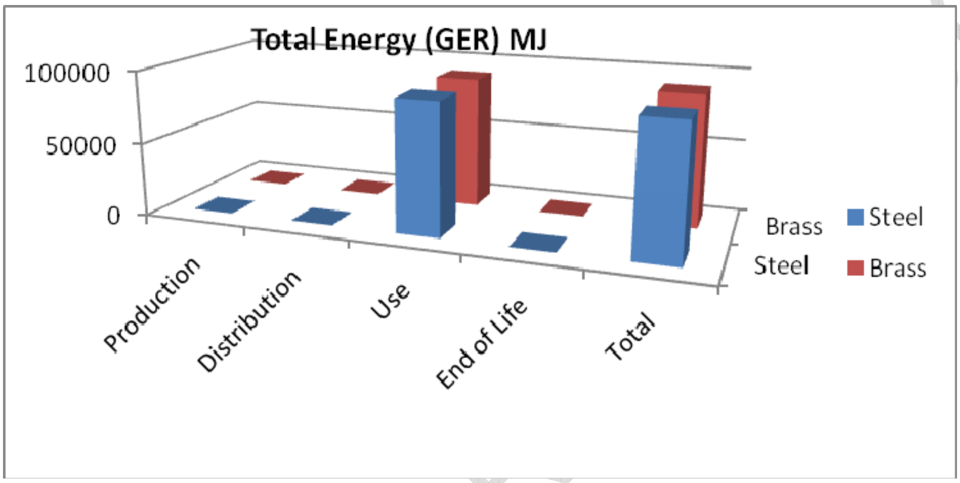

Figure 2 - Total Energy for Domestic Taps

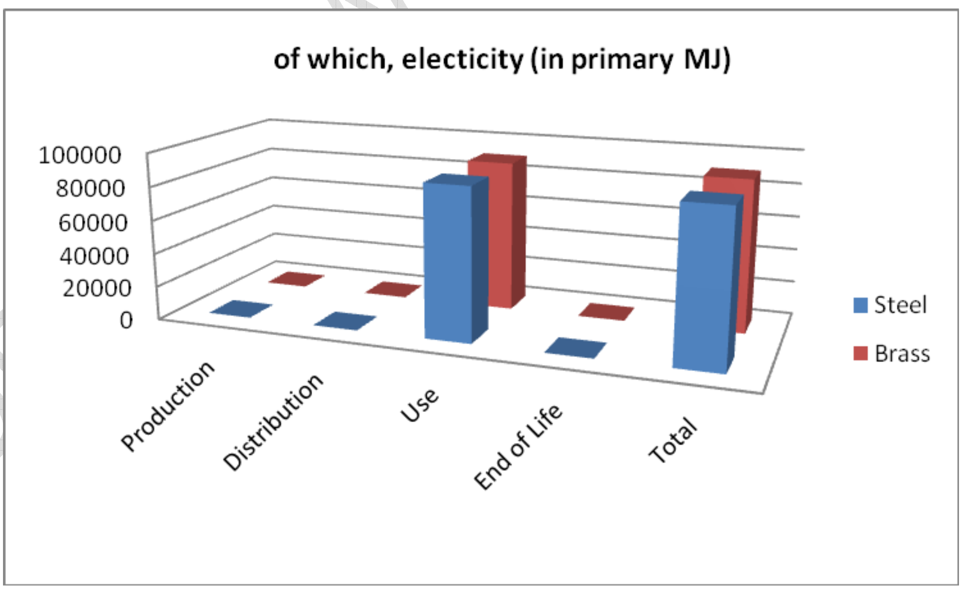

Figure 3 - Electricity for Domestic Taps

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[12].

In comparison to the use phase energy consumption, production and distribution energy consumption is minor. 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 and metal manufacturing of the stainless steel for the steel tap.

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.

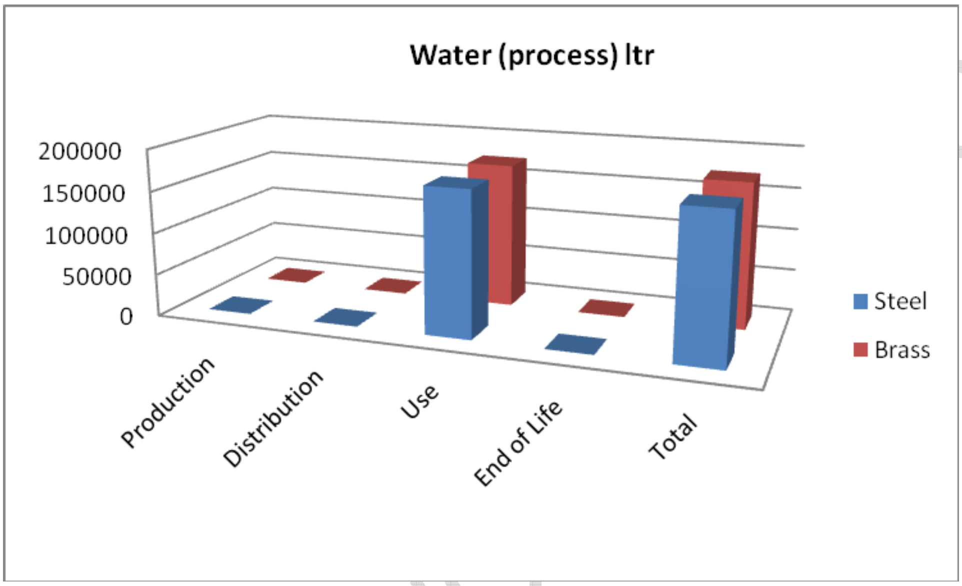

Figure 4 - Water (Process) for Taps

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[13]. 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 9 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.

[12] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm
[13]MEEuP Methodology Report – VHK, November 2005
http://www.pre.nl/EUP/Download/default.htm

Table 9 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	1.68 litres	N/A
Stainless Steel	25-Stainless 18/8 coil	75.87 litres	4.47 litres	71.95 litres

These values need to be kept in context so whilst the production water use for the stainless steel base case tap is 72 litres, the in use water consumption is in excess of 170,000 litres – a factor of two thousand times more.

Figure 4 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.

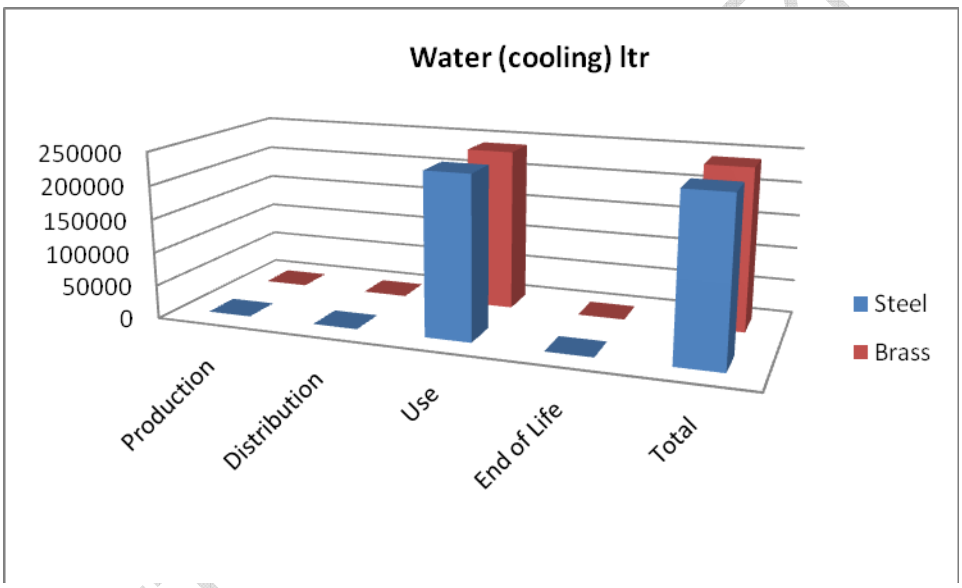

Figure 5 – Water (Cooling) for Taps

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.

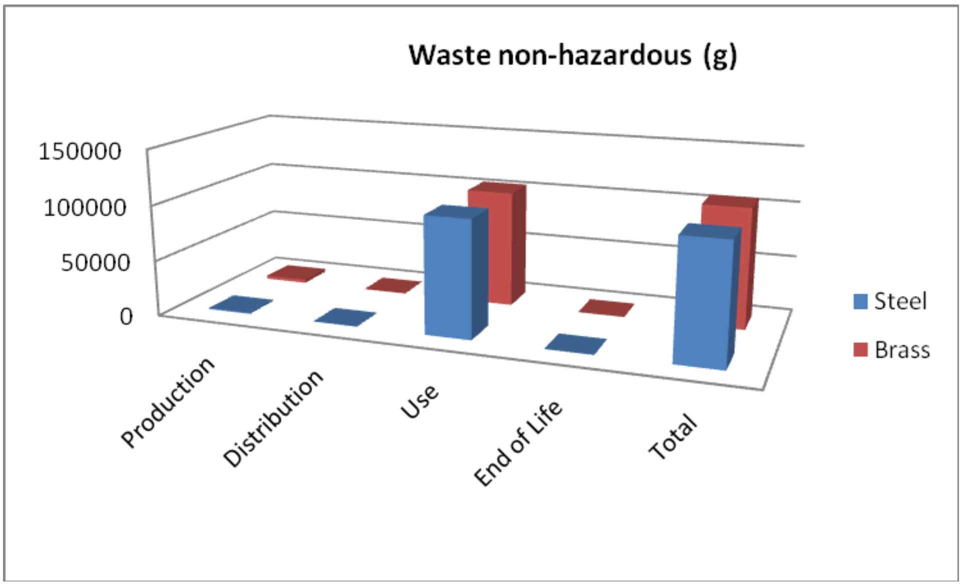

Figure 6 – Non Hazardous Waste for Taps

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.

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

Table 10 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	2683 g	N/A
Stainless Steel	25-Stainless 18/8 coil	1047 g	59 g	950 g

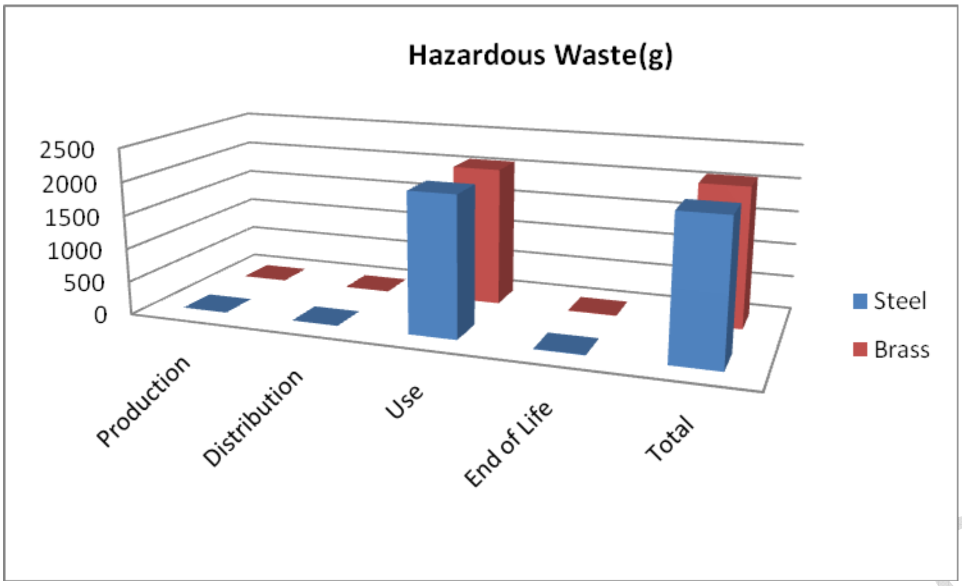

Figure 7 – Hazardous Waste for Taps

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 just over 6g. The hazardous waste generation in the end of life phase calculated by EcoReport is associated with the 'Incineration of plastics/PWB not reused/recycled'. This 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

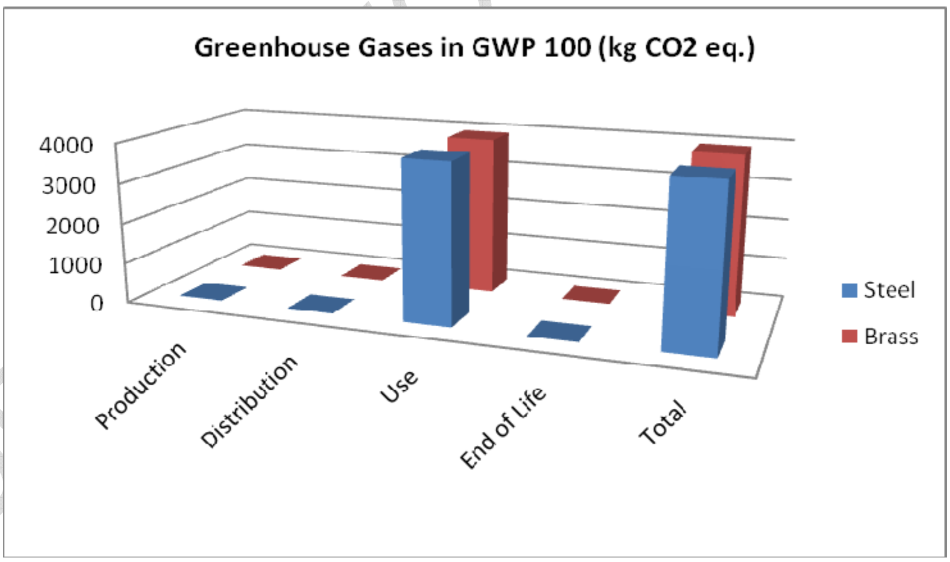

Figure 8 – Greenhouse Gases for Taps

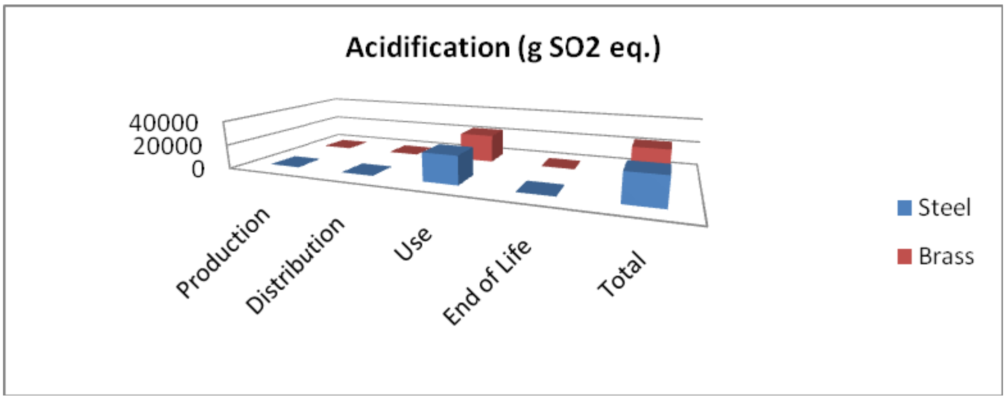

Figure 9 – Acidification for Taps

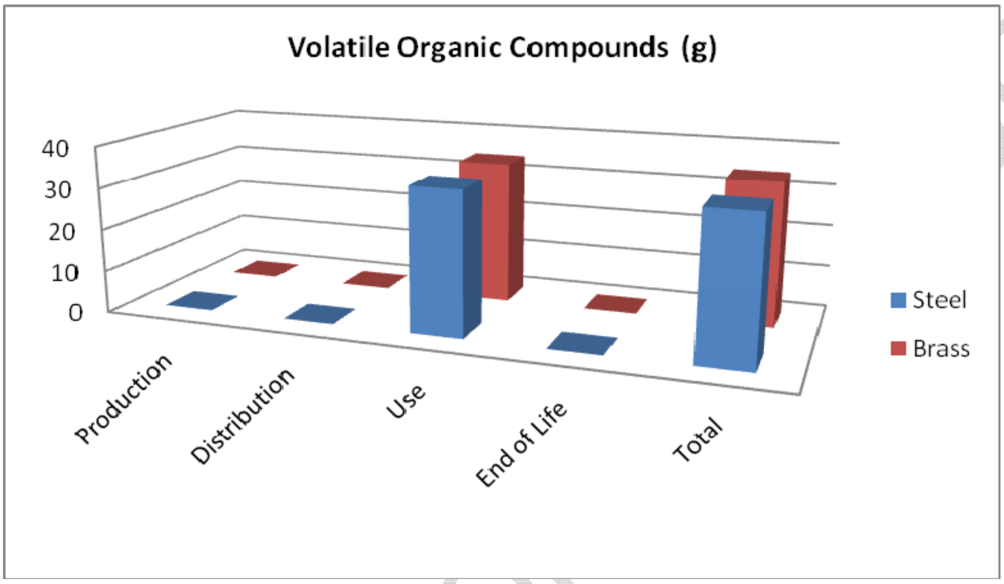

Figure 10 – Volatile Organic Compounds for Taps

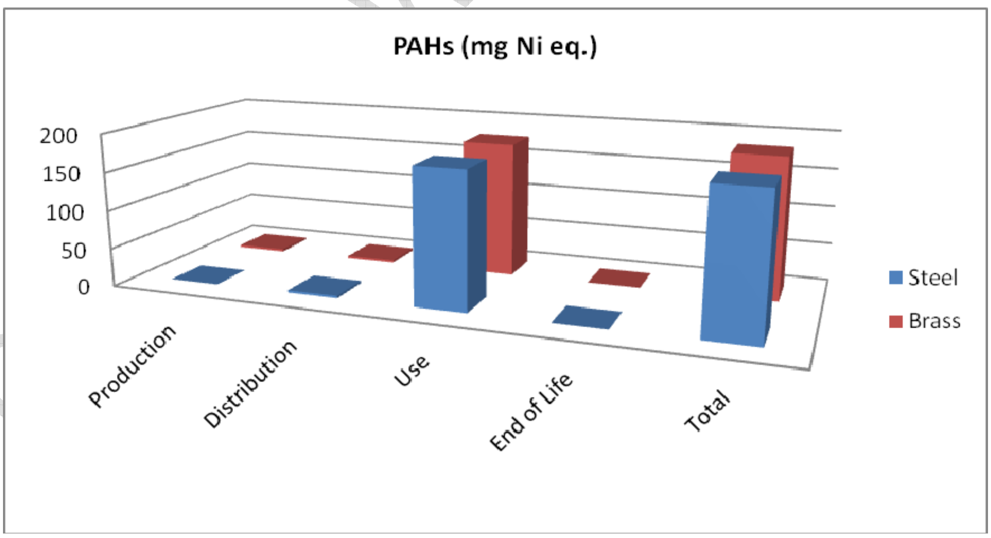

Figure 11 – PAHs for Taps

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.

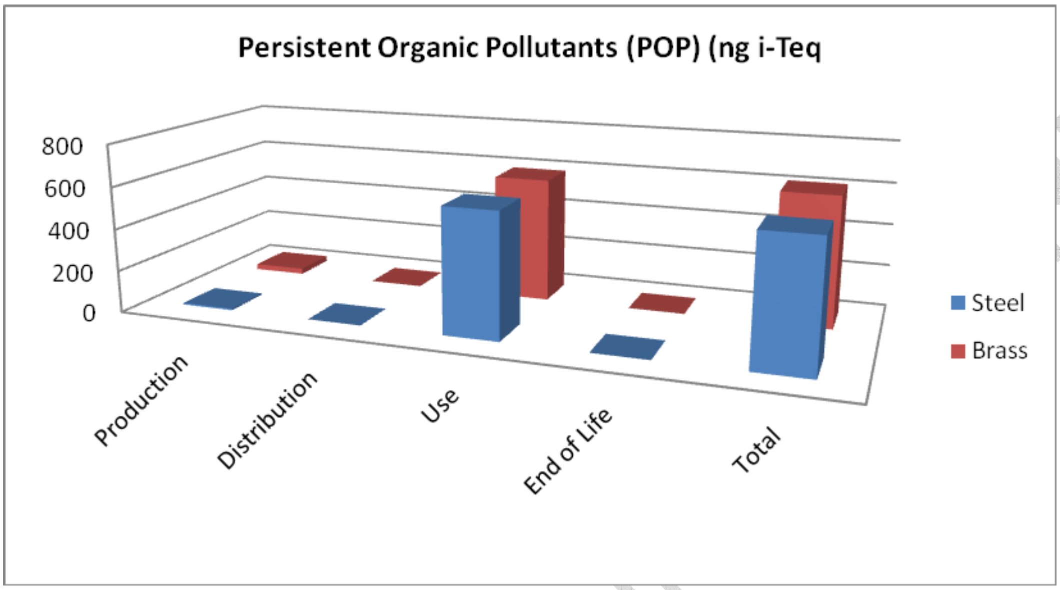

Figure 12 – Persistent Organic Pollutants for Taps

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 11. 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 11 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	22.49 ng i-Teq	N/A
Chrome Plate	40-Cu/Ni/Cr plating	396.51 ng i-Teq	3.57 ng i-Teq	N/A
Stainless Steel	25-Stainless 18/8 coil	7.7 ng i-Teq	0.45 ng i-Teq	7.32 ng i-Teq

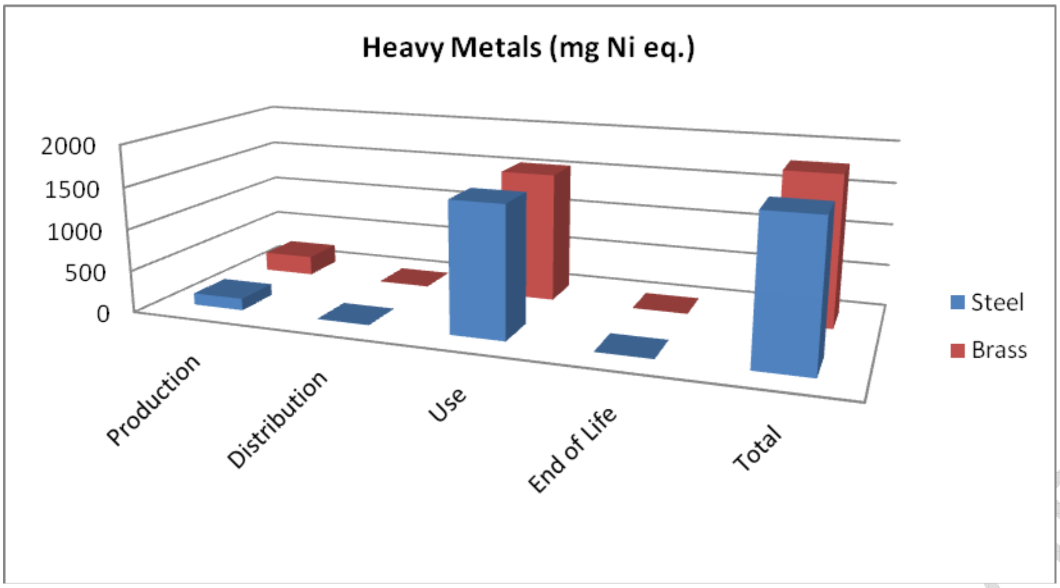

Figure 13 – Heavy Metal Emissions to Air for Taps

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 to the materials extraction and production of the stainless steel (125-Stainless 18/8 coil). For the brass tap, the heavy metal emissions are largely a result of the extraction and production of the chrome plating (75%) and brass (21%).

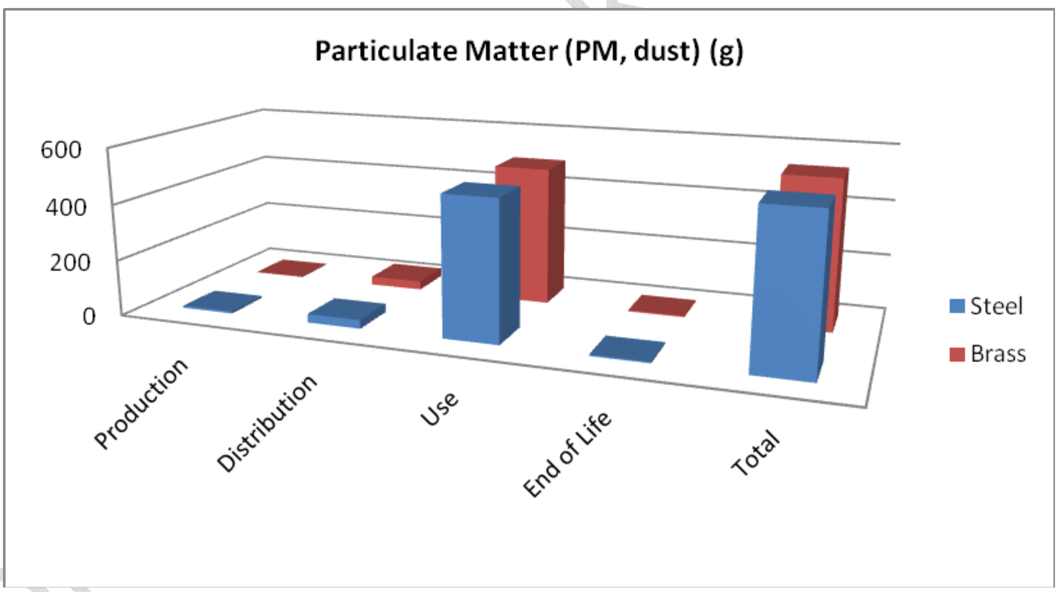

Figure 14 – Particulate Matter for Taps

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

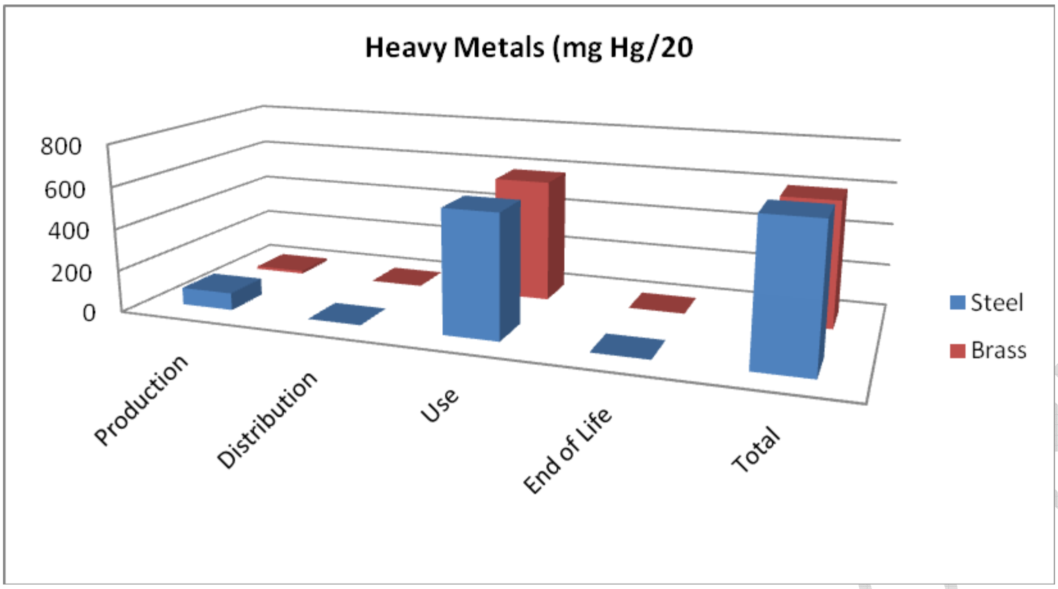

Figure 15 – Heavy Metal Emissions to Water for Taps

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.

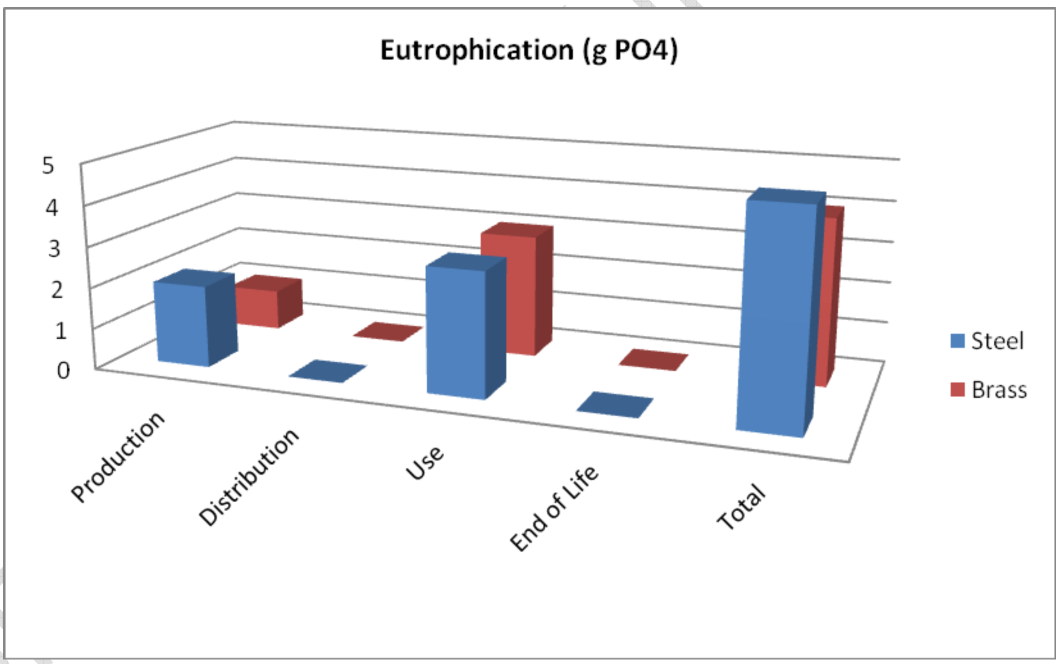

Figure 16 – Eutrophication for Taps

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 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 12 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 stainless steel base case and non-domestic sector, which is summarised in Appendix 1.

Table 12 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
Total Energy (GER)	MJ	0.07%	0.07%	99.85%	0.00%	100.00%
of which, electricity (in primary MJ)	MJ	0.03%	0.00%	99.97%	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	2.73%	0.05%	97.16%	0.05%	100.00%
Waste, hazardous/ incinerated	g	0.05%	0.05%	99.57%	0.34%	100.00%
Emissions (Air)						
Greenhouse Gases in GWP100	kg CO2 eq	0.08%	0.13%	99.77%	0.00%	100.00%
Ozone Depletion, emissions	mg R-11 eq	neg	neg	neg	neg	neg
Acidification, emissions	g SO2 eq	0.22%	0.06%	99.72%	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	4.37%	0.00%	95.63%	0.00%	100.00%
Heavy Metals	mg Ni eq	13.05%	0.17%	86.67%	0.06%	100.00%
PAHs	mg Ni eq	1.63%	1.63%	96.20%	0.00%	100.00%
Particulate Matter (PM, dust)	g	0.38%	5.82%	92.87%	0.94%	100.00%
Emissions (Water)						
Heavy Metals	mg Hg/20	2.35%	0.00%	97.65%	0.00%	100.00%
Eutrophication	g PO4	25.00%	0.00%	75.00%	0.00%	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%.

3.4 Showerheads – Setting up the base case

For showerheads, a bill of materials was supplied by a stakeholder. Additional data have not been provided or identified through the research to date. Therefore the information provided in the questionnaire response has been used as an example of a showerhead to undertake an initial base case assessment using the EcoReport tool.

It is acknowledged that this may not necessarily be representative of the market in general, as the range of materials e.g. plastics and metals and designs of showerheads available on the market vary considerably.

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 13 for the base case uses information provided by stakeholders in response to the first questionnaire. This bill of material is used to represent both domestic and non-domestic showerheads.

Table 13 Bill of Materials – Showerheads

Material	Weight (g)	Components	Material code in EcoReport
Brass	89	Outlet, accelerator, jet disc, tube, deep injection, water distributor cartridge, connector, cone	31-CuZn38 cast (Note the manufacturer indicated different grades of brass not included in the EcoReport tool – most appropriate available material type has been used)
Plastic	76	Body, plastic cover for cone	10-ABS

We welcome your feedback on the following questions:

1. Is the bill of materials data representative for typical products within the EU? If you disagree please provide additional information.
2. The bill of material information presented above relates to examples of domestic sector showerheads. In your experience is this is representative of non-domestic sector showerheads? If not please provide further information.
3. Are there any other materials for key components which are not included in the above base cases?

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 14.

Table 14 Packaging dimensions and volume for showerheads

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

We welcome your feedback on the following question:

1. Is this an appropriate packaging volume to use for both domestic and non-domestic sector showerheads? If not please provide alternative information.

3.5.3 Use Phase

The inputs for the use phase are shown in Table 15. The inputs differ for domestic and non domestic showerheads.

Table 15 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.

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 17 to Figure 31) illustrate the results for the example showerhead outlined above for the different impact categories, together with commentary as appropriate. The graphs are for the domestic use base case, where applicable reference is made to the non-domestic base case also.

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

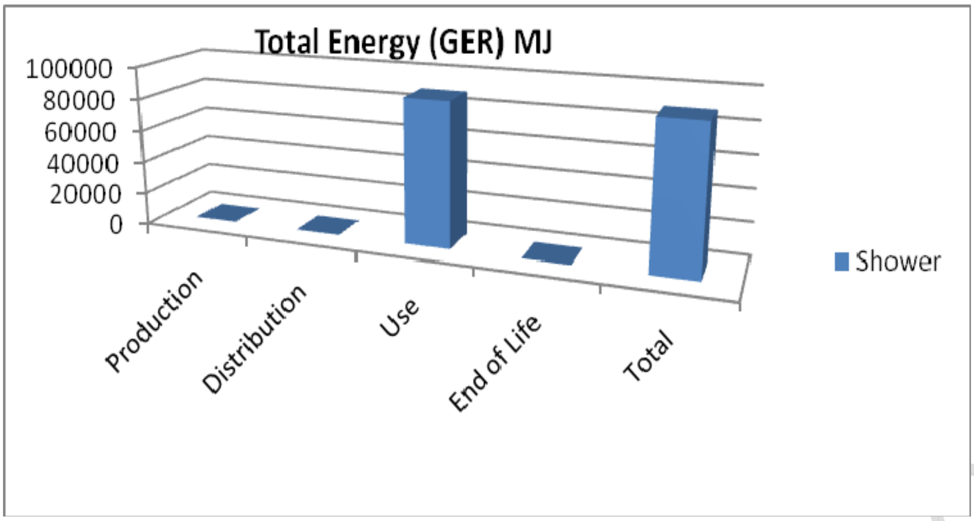

Figure 17 – Total Energy for showerheads

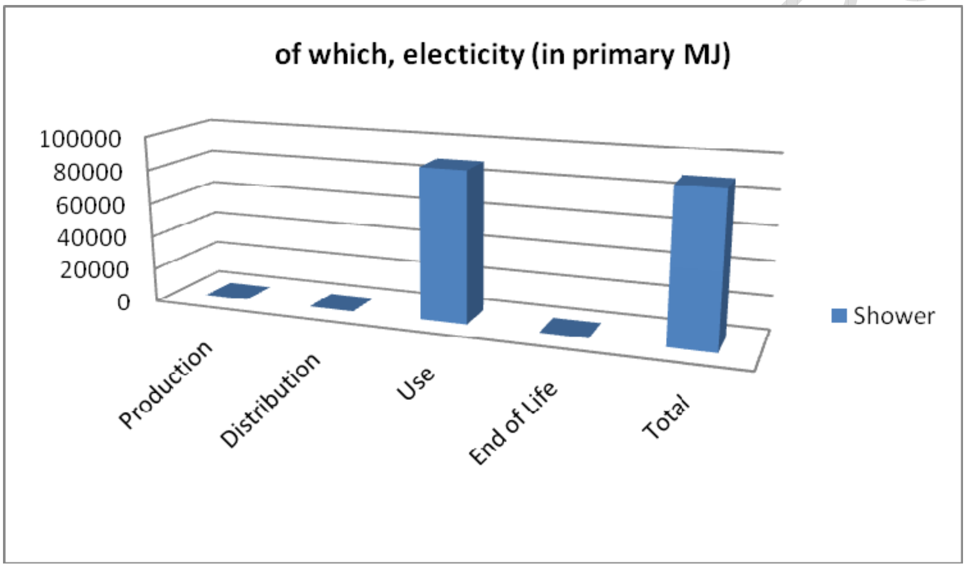

Figure 18 – Electricity for showerheads

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 redefined 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 to the materials extraction and production and manufacturing of the plastic (10-ABS).

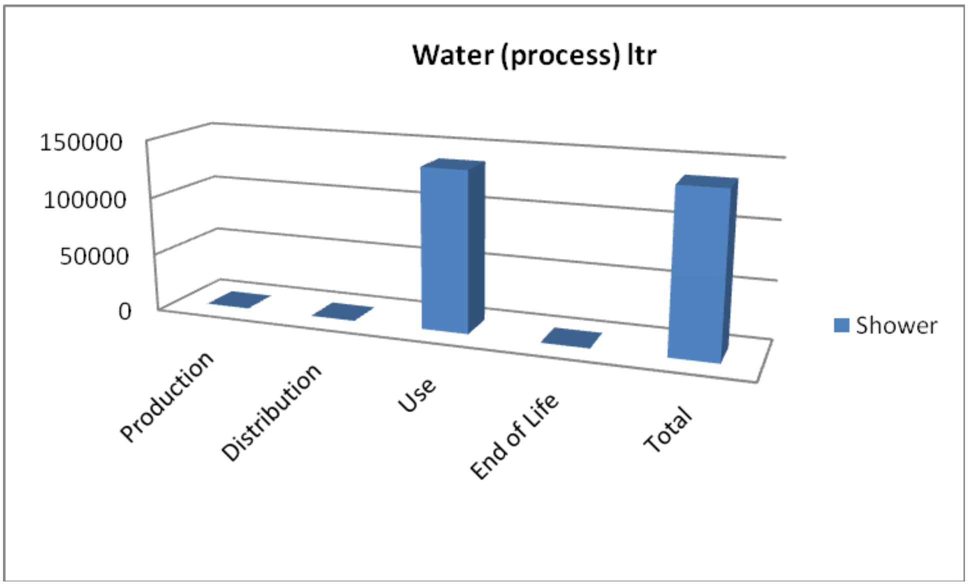

Figure 19 – Water (process) for showerheads

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 been used, cultural aspects, domestic or non-domestic use. Figure 19 relates to the domestic use calculated in Section 2.3; however the non-domestic use 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.

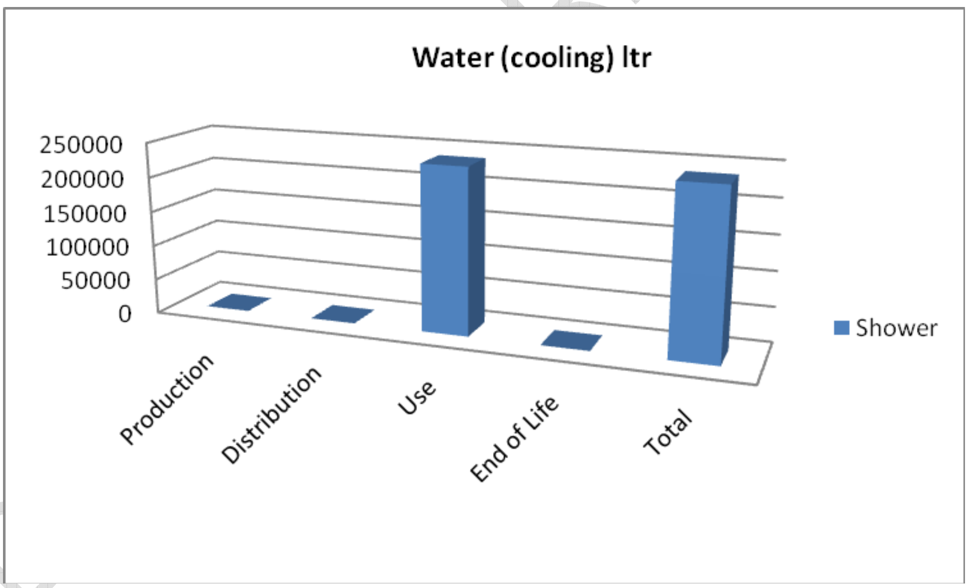

Figure 20 – Water (cooling) for showerheads

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.

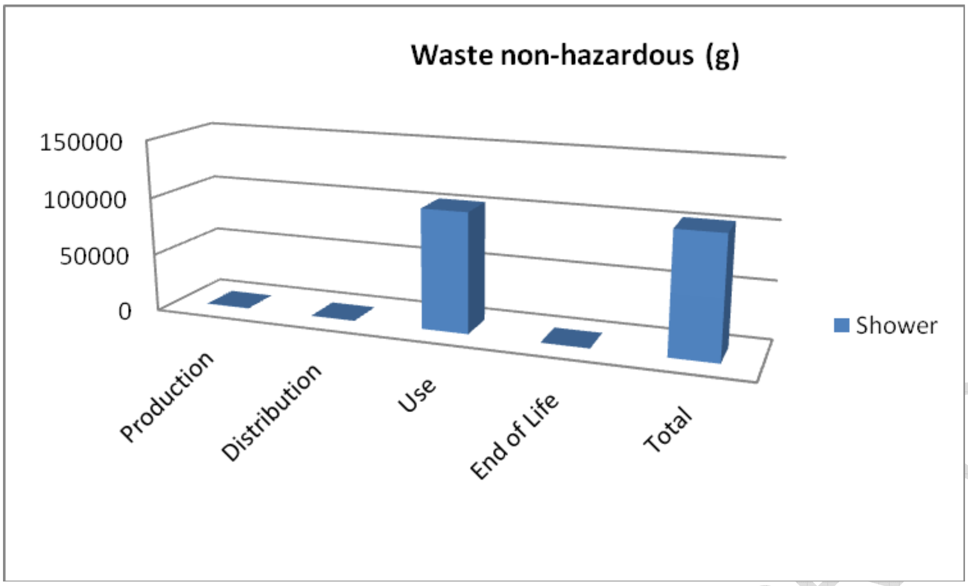

Figure 21 – Non-hazardous Waste for showerheads

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

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 280g. Scrutiny of the EcoReport outputs shows this is largely related to the materials extraction and production of brass (31-CuZn38 cast), with a smaller proportion generated by the manufacturing of the plastic. The end of life impacts relate to the disposal of the product in landfill.

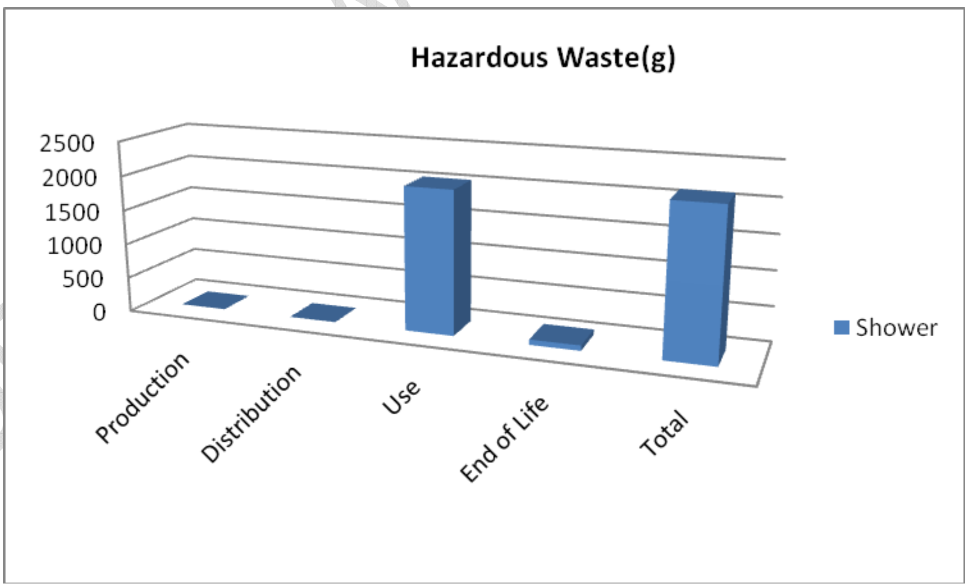

Figure 22 – Hazardous waste for showerheads

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 75g, is associated with the 'Incineration of plastics/PWB not reused/recycled'. 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 2.4, the extent of end of life recycling is not known for showerheads.

3.6.2 Emissions (Air)

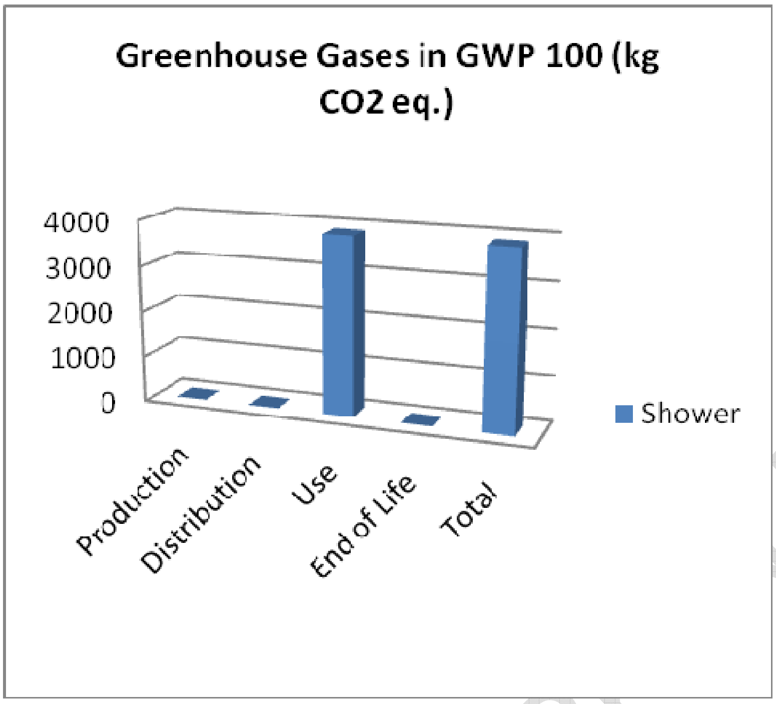

Figure 23 – Greenhouse Gases for Showerheads

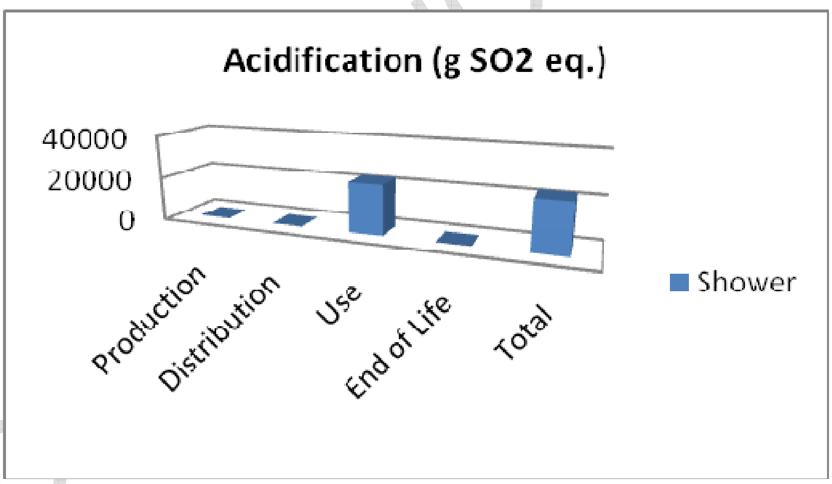

Figure 24 – Acidification for Showerheads

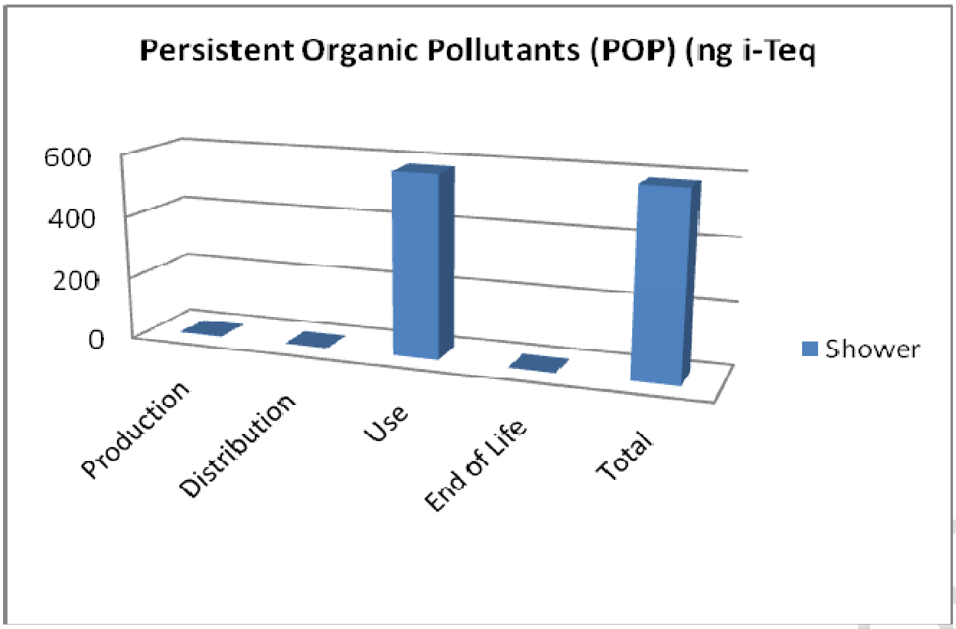

Figure 25 – Persistent Organic Pollutants for Showerheads

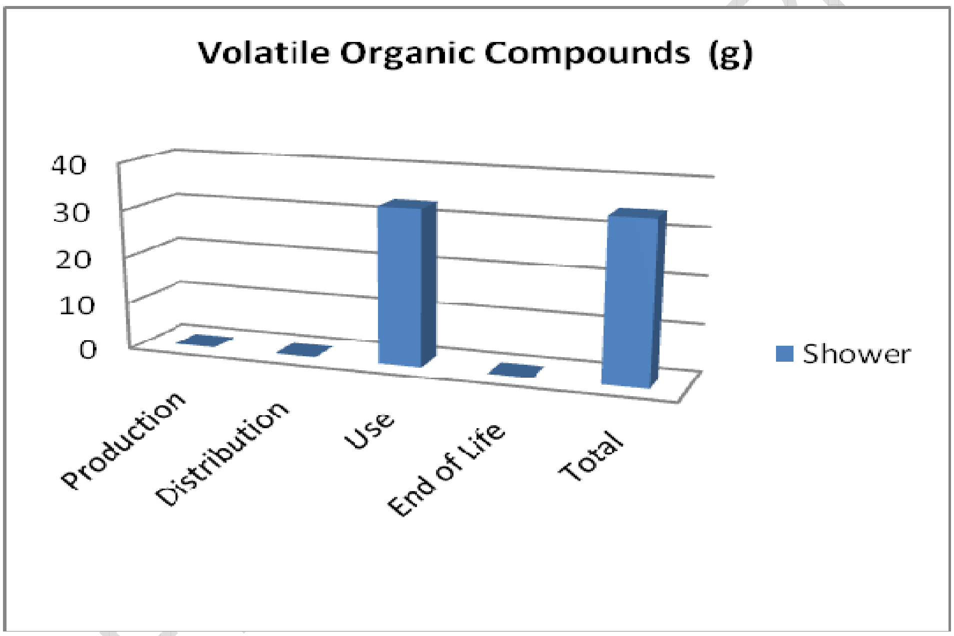

Figure 26 – Volatile Organic Compound for Showerheads

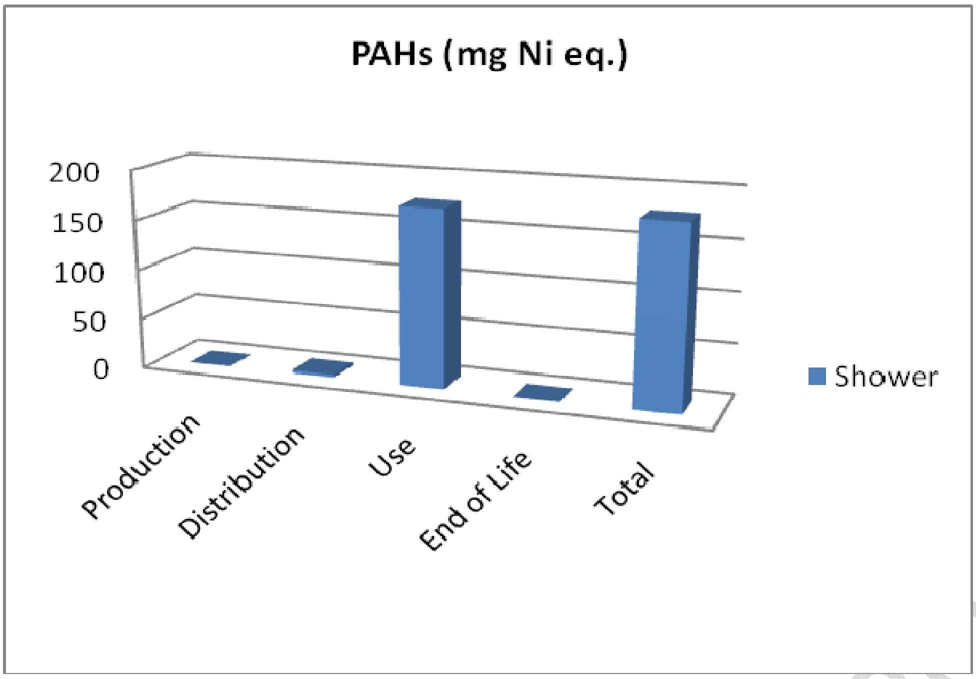

Figure 27 – PAHs for Showerheads

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.

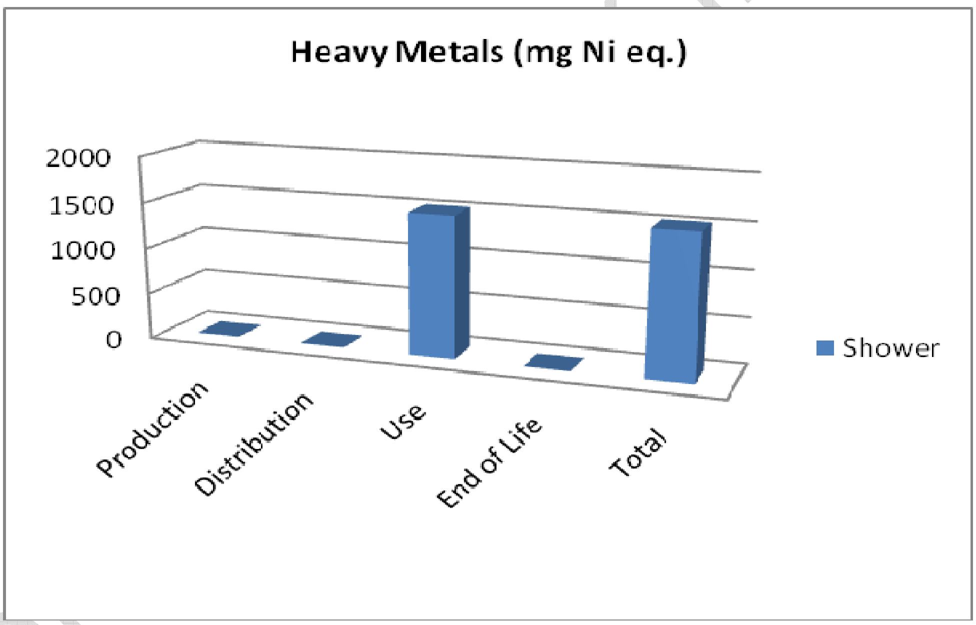

Figure 28 – Heavy metal emissions to air for showerheads

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. Those in the end of life phase are associated with the incineration of plastics not re-used/recycled.

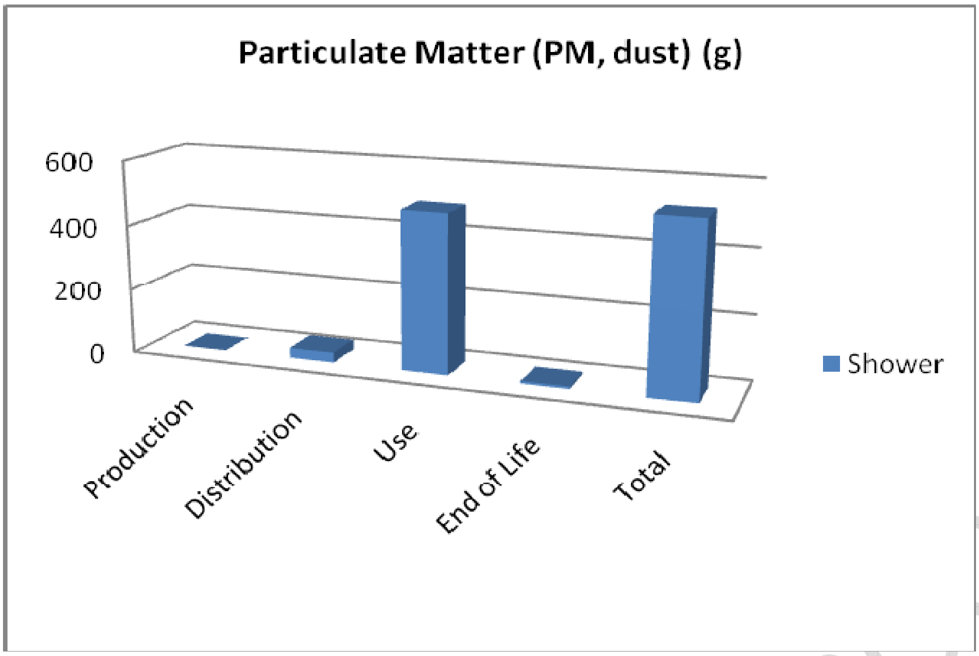

Figure 29 – Particulate matter emissions for showerheads

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.

3.6.3 Emissions (Water)

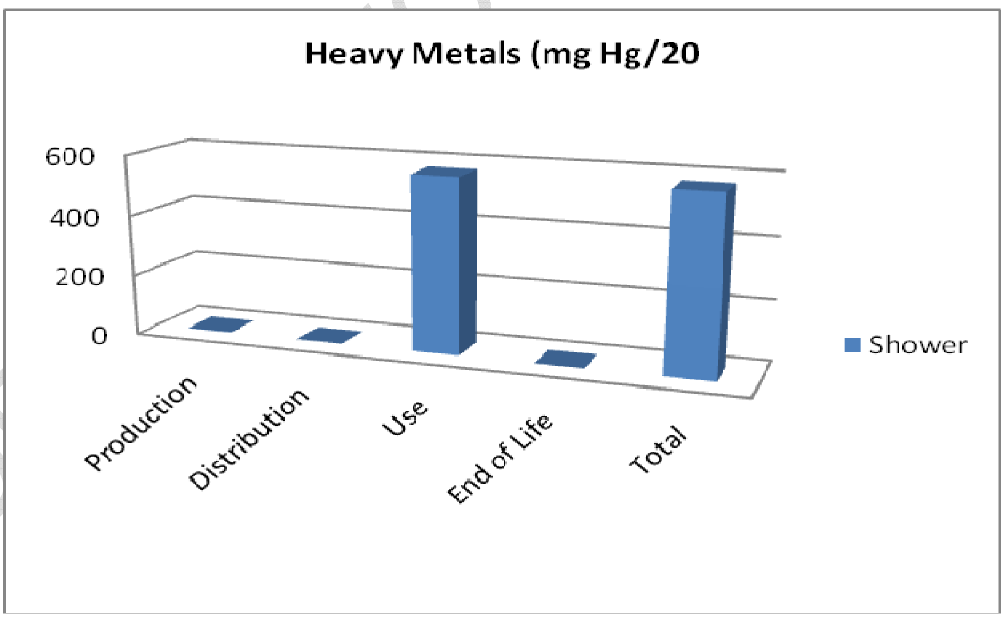

Figure 30 – Heavy metal emissions to water for showerheads

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.

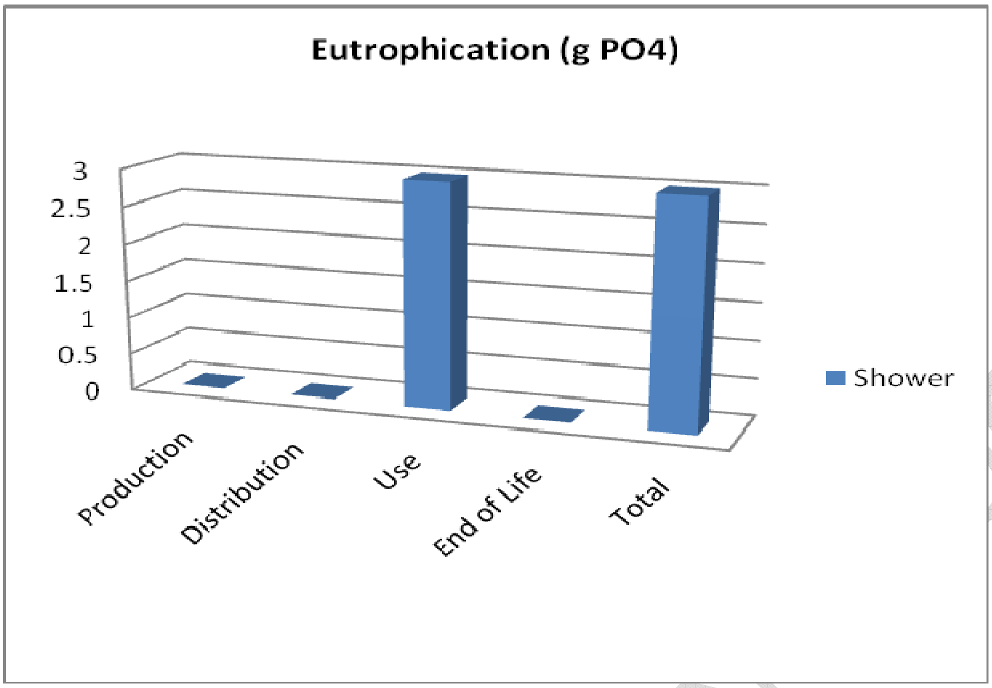

Figure 31 – Eutrophication for Showerheads

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 16 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 non-domestic sector showerheads, which is summarised in Appendix 2.

Table 16 Percentage breakdown of impacts across life cycle phases for the different impact categories for a domestic sector showerhead

Parameter	Units	Production	Distribution	Use	End of Life	TOTAL
Total Energy (GER)	MJ	0.02%	0.07%	99.91%	0.00%	100.00%
of which, electricity (in primary MJ)	MJ	0.00%	0.00%	100.00%	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	0.28%	0.06%	99.66%	0.01%	100.00%
Waste, hazardous/ incinerated	g	0.05%	0.05%	96.37%	3.53%	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	neg	neg	neg	neg
Acidification, emissions	g SO2 eq	0.02%	0.06%	99.91%	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	0.34%	0.00%	99.49%	0.00%	100.00%
Heavy Metals	mg Ni eq	0.33%	0.20%	99.35%	0.13%	100.00%
PAHs	mg Ni eq	0.00%	1.69%	98.31%	0.00%	100.00%
Particulate Matter (PM, dust)	g	0.00%	5.88%	92.79%	1.33%	100.00%
Emissions (Water)						
Heavy Metals	mg Hg/20	0.17%	0.00%	99.83%	0.00%	100.00%
Eutrophication	g PO4	0.00%	0.00%	100.00%	0.00%	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%.

4 Sensitivity 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 resources change if the EcoReport Inputs for these changes.

Focusing on domestic use, an average EU figure was used for the analysis outlined above. The data this average figure is based on provides information 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[14], 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 a comparison can be made with the EU average with regards the EcoReport inputs. This is summarised in Table 17.

Table 17 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)	4.3	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 under taken using the average figure. Obviously for the maximum figure the impacts are even greater.

[14] 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 would be further reduced by considering the assumptions used to calculate this input figure, 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.

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 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 and are clearly 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, focused on the product itself that will influence the life cycle impacts is the weight of the product i.e. the quantity 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 materials will need to be used to manufacture the tap or showerhead.

Given the significance across all impact categories of water and 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 not affect the overall dominance related to the water and energy consumption attributable to the in use phase.

5 Implications for ecolabel criteria development

5.1 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 many 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 energy used for the heating of water. Clearly this will depend on the proportion of reduced hot water use compared to cold water use.

Criteria for other water saving features could also be considered for ecolabel criteria, for example aerated showerheads or stop click technology[15], however these features are still generally niche markets 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 could include user information to ensure the product is used efficiently and ways of reducing water use further. Additional behavioural aspects to address may also

[15] 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.

include the provision of adequate assembly and installation instructions to ensure the product is correct for the type of system e.g. high/low pressure and installed correctly. Instruction may also include clear temperature control adjustment information to ensure water losses when adjusting water temperature are minimised.

Material Composition

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. 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.

Differences in material types for showerheads cannot be commented upon as only one showerhead base case has been considered.

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.

Chrome plating is important across a number of the impact categories, when compared to 1kg of other materials, however given that it is used in small quantities the impacts on a product basis are generally limited. One exception is in relation to heavy metal emissions to air, where emissions from chrome plating in the production phase are higher than those of other materials, even through small quantities are used. It should however be remembered that these production phase impacts are insignificant when compare to the use phase impacts relating to water and the associated energy use. Also the output from the EcoReport tool indicates that chrome plating is particularly an issue in relation to heavy metal emissions to air.

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.

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[16]; 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[17]. Other issues relating to trivalent chromium include colour differences and

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[16] http://www.newmoa.org/prevention/p2tech/TriChromeFinal.pdf
[17] http://www.newmoa.org/prevention/p2tech/TriChromeFinal.pdf

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[18].

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[19], however this would need to be balanced against production rates and waste disposal costs, for example sludge disposal. For example Snyder (1988) estimated that hexavalent waste treatment costs were almost ten times that of the trivalent process[20].

Additional research and a comparison of hexavalent chromium and trivalent chromium has been undertaken by the Toxic Use Reduction Institute in the USA[21]. 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.

Waste and Lifetime

Another key 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 use phase it is related mainly to the water consumption and associated energy consumption. 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 may be through ease of dismantling criteria, which have been included in ecolabel criteria for other product groups.

Criteria relating to the ease of dismantling will also aid repair, extending the lifetime of the product. This will serve to extend the life span of the product, which as discussed in Section 3.6.4 above, will reduce the impact in the production, distribution and end of life phases. Maximising the life span of products will also be supported through guarantees and the provision of spare parts.

It will be important to balance extension of lifetime with advances in technology. A point may be reached where it is preferable to replace a product with a newer more efficient model, rather than repair an older less efficiency model. 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.

5.2 Additional Considerations

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

- The ecolabel should consider metal coatings used in products that come into contact with drinking water. This issue has been raised by a number of stakeholders who are concerned how hygiene issues will be dealt with by any ecolabel criteria. There is concern amongst some stakeholders that an ecolabel would be seen as EC approval of a product with regards hygiene issues, when criteria may not necessarily address this issue. Work relating to this has been ongoing for a number of years through CEN/TC164 Water Supply. It will be important to involve this group in the criteria development process and discuss the point with industry to ensure the scope of the

[18] Gardner A, (2006) Decorative Trivalent Chromium Plating, Metal Finishing, Vol 104, Issue 11, pp41-45
[19] http://www.newmoa.org/prevention/p2tech/TriChromeFinal.pdf
[20] http://www.turi.org/library/turi_publications/five_chemicals_study/final_report/chapter_6_hexavalent_chromium#6.1
[21] http://www.turi.org/library/turi_publications/five_chemicals_study

ecolabel and its criteria are clearly communicated, do not conflict with other policies/standards and is understood.

- The use of consistent test standards – stakeholders have highlighted that harmonised standards do not exist and vary between different countries in particular France Germany and the UK. For example in the UK Building Regulations (Part G) state that new builds are required to have a maximum water use of 125 litres per person per day. Other countries may not have these requirements. This will need to be considered when setting criteria and their verification requirements, to ensure they do not become overly complex or burdensome for applicants.
- 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 o reduce overall impacts associated with the use of the tap or showerhead.

The aspects highlighted in Sections 5.1 and 5.2 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 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	66	0.07%	64	0.07%	90,050	99.85%	3	0.00%	90,183	100.00%
of which, electricity (in primary MJ)	MJ	26	0.03%	0	0.00%	90,048	99.97%	0	0.00%	90,074	100.00%
Water (process)	ltr	7	0.00%	0	0.00%	172,435	100.00%	0	0.00%	172,442	100.00%
Water (cooling)	ltr	19	0.01%	0	0.00%	240,128	99.99%	0	0.00%	240,147	100.00%
Waste, non-haz./ landfill	g	2,937	2.73%	57	0.05%	104,436	97.16%	59	0.05%	107,489	100.00%
Waste, hazardous/ incinerated	g	1	0.05%	1	0.05%	2,075	99.57%	7	0.34%	2,084	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq	3	0.08%	5	0.13%	3,930	99.77%	0	0.00%	3,939	100.00%
Ozone Depletion, emissions	mg R-11 eq	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq	50	0.22%	14	0.06%	23,188	99.72%	0	0.00%	23,253	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	27	4.37%	0	0.00%	591	95.63%	0	0.00%	618	100.00%
Heavy Metals	mg Ni eq	233	13.05%	3	0.17%	1,547	86.67%	1	0.06%	1,785	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	0.38%	31	5.82%	495	92.87%	5	0.94%	533	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	14	2.35%	0	0.00%	581	97.65%	0	0.00%	595	100.00%
Eutrophication	g PO4	1	25.00%	0	0.00%	3	75.00%	0	0.00%	4	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	74	0.08%	64	0.07%	90,050	99.85%	0	0.00%	90,188	100.00%
of which, electricity (in primary MJ)	MJ	18	0.02%	0	0.00%	90,048	99.98%	0	0.00%	90,066	100.00%
Water (process)	ltr	73	0.04%	0	0.00%	172,435	99.96%	0	0.00%	172,508	100.00%
Water (cooling)	ltr	14	0.01%	0	0.00%	240,128	99.99%	0	0.00%	240,142	100.00%
Waste, non-haz./ landfill	g	1,000	0.95%	57	0.05%	104,417	98.94%	59	0.06%	105,533	100.00%
Waste, hazardous/ incinerated	g	0	0.00%	1	0.05%	2,075	99.62%	7	0.34%	2,083	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq	7	0.18%	5	0.13%	3,930	99.70%	0	0.00%	3,942	100.00%
Ozone Depletion, emissions	mg R-11 eq	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq	57	0.25%	14	0.06%	23,188	99.69%	0	0.00%	23,260	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	141	8.34%	3	0.18%	1,546	91.43%	1	0.06%	1,691	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	8	1.48%	31	5.75%	495	91.84%	5	0.93%	539	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	82	12.35%	0	0.00%	581	87.50%	0	0.00%	664	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	66	0.02%	64	0.02%	280,145	99.95%	3	0.00%	280,278	100.00%
of which, electricity (in primary MJ)	MJ	26	0.01%	0	0.00%	280,140	99.99%	0	0.00%	280,166	100.00%
Water (process)	ltr	7	0.00%	0	0.00%	536,506	100.00%	0	0.00%	536,513	100.00%
Water (cooling)	ltr	19	0.00%	0	0.00%	747,040	100.00%	0	0.00%	747,059	100.00%
Waste, non-haz./ landfill	g	2,937	0.90%	57	0.02%	324,841	99.07%	59	0.02%	327,893	100.00%
Waste, hazardous/ incinerated	g	1	0.02%	1	0.02%	6,455	99.85%	7	0.11%	6,465	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	50	0.07%	14	0.02%	72,138	99.91%	0	0.00%	72,203	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	27	1.45%	0	0.00%	1,836	98.50%	0	0.00%	1,864	100.00%
Heavy Metals	mg Ni eq	233	4.62%	3	0.06%	4,809	95.30%	1	0.02%	5,046	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	97.59%	5	0.32%	1,579	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	14	0.77%	0	0.00%	1806	99.18%	0	0.00%	1821	100.00%
Eutrophication	g PO4	1	10.00%	0	0.00%	9	90.00%	0	0.00%	10	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	74	0.03%	64	0.02%	280,145	99.95%	0	0.00%	280,283	100.00%
of which, electricity (in primary MJ)	MJ	18	0.01%	0	0.00%	280,140	99.99%	0	0.00%	280,158	100.00%
Water (process)	ltr	73	0.01%	0	0.00%	536,507	99.99%	0	0.00%	536,579	100.00%
Water (cooling)	ltr	14	0.00%	0	0.00%	747,040	100.00%	0	0.00%	747,054	100.00%
Waste, non-haz./ landfill	g	1,000	0.31%	57	0.02%	324,821	99.66%	59	0.02%	325,937	100.00%
Waste, hazardous/ incinerated	g	0	0.00%	1	0.02%	6,455	99.86%	7	0.11%	6,464	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq	7	0.06%	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	57	0.08%	14	0.02%	72,138	99.90%	0	0.00%	2,209	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	141	2.85%	3	0.06%	4,808	97.07%	1	0.02%	4,953	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	8	0.50%	31	1.96%	1,541	97.22%	5	0.32%	1,585	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	82	4.34%	0	0.00%	1,807	95.61%	0	0.00%	1,890	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

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	14	0.02%	64	0.07%	88,831	99.91%	2	0.00%	88,911	100.00%
of which, electricity (in primary MJ)	MJ	3	0.00%	0	0.00%	88,830	100.00%	0	0.00%	88,833	100.00%
Water (process)	ltr	1	0.00%	0	0.00%	137,322	100.00%	0	0.00%	137,323	100.00%
Water (cooling)	ltr	13	0.01%	0	0.00%	236,880	99.99%	0	0.00%	236,893	100.00%
Waste, non-haz./ landfill	g	288	0.28%	57	0.06%	102,997	99.66%	10	0.01%	103,353	100.00%
Waste, hazardous/ incinerated	g	1	0.05%	1	0.05%	2,047	96.37%	75	3.53%	2,124	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	5	0.02%	14	0.06%	22,874	99.91%	1	0.00%	22,894	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	2	0.34%	0	0.00%	582	99.49%	0	0.00%	585	100.00%
Heavy Metals	mg Ni eq	5	0.33%	3	0.20%	1,524	99.35%	2	0.13%	1,534	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	0	0.00%	31	5.88%	489	92.79%	7	1.33%	527	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	1	0.17%	0	0.00%	573	99.83%	0	0.00%	574	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

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	14	0.02%	64	0.10%	61,300	99.87%	2	0.00%	61,379	100.00%
of which, electricity (in primary MJ)	MJ	3	0.00%	0	0.00%	61,299	100.00%	0	0.00%	61,302	100.00%
Water (process)	ltr	1	0.00%	0	0.00%	94,758	100.00%	0	0.00%	94,758	100.00%
Water (cooling)	ltr	13	0.01%	0	0.00%	163,464	99.99%	0	0.00%	163,477	100.00%
Waste, non-haz./ landfill	g	288	0.40%	57	0.08%	71,076	99.50%	10	0.01%	71,432	100.00%
Waste, hazardous/ incinerated	g	1	0.07%	1	0.07%	1,413	94.83%	75	5.03%	1,490	100.00%
Emissions (Air)											
Greenhouse Gases in GWP100	kg CO2 eq	1	0.04%	5	0.19%	2,675	99.78%	0	0.00%	2,681	100.00%
Ozone Depletion, emissions	mg R-11 eq	neg		neg		neg		neg		neg	
Acidification, emissions	g SO2 eq	5	0.03%	14	0.09%	15,785	99.87%	1	0.01%	15,805	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	2	0.50%	0	0.00%	402	99.50%	0	0.00%	404	100.00%
Heavy Metals	mg Ni eq	5	0.47%	3	0.28%	1,052	99.15%	2	0.19%	1,061	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	0	0.00%	31	8.24%	337	89.63%	7	1.86%	376	100.00%
Emissions (Water)											
Heavy Metals	mg Hg/20	1	0.25%	0	0.00%	395	99.50%	0	0.00%	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%.