Preparatory Studies for Ecodesign Requirements of EuPs (III)

ENER Lot 20 – Local Room Heating Products
Task 5: Definition of Base-Cases

European Commission, DG ENER
25 June 2012

Developed by:

Project description

CLIENT	European Commission, DG ENER
CONTRACT NUMBER	TREN/D3/91-2007-Lot 20-SI2.519986
REPORT TITLE	ENER Lot 20 – Local Room Heating Products Task 5: Definition of Base-Cases
REPORT SUB-TITLE	Final report
PROJECT NAME	Preparatory Studies for Ecodesign Requirements of EuPs (III)
PROJECT CODE	EUP20
PROJECT TEAM	BIO Intelligence Service
DATE	25 June 2012
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Please cite this publication as:
BIO Intelligence Service (2012) Preparatory Studies for Ecodesign Requirements of EuPs (III), ENER Lot 20 – Local Room Heating Products - Task 5: Definition of Base-Cases. Prepared for the European Commission, DG ENER.

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Task 5: Definition of Base-Case

This task provides an environmental and economic assessment of the average EU local room heating products covered in the ENER Lot 20 preparatory study, also known as the "Base-Cases" (BCs). A 'BC' is *"a conscious abstraction of reality"* used to represent the average of a range of similar products on the market. The aim of the assessment is to quantify:

- the environmental impacts of the selected Base-Cases throughout its life
- the economic Life Cycle Costs (LCC)

The assessment includes all stages of the Base-Case's life from the extraction of the materials contained within its components, to the disposal of these materials at the end-of-life. The environmental impacts are determined by a well-established methodology known as Life Cycle Analysis (LCA). In this study a simplified LCA tool is used to calculate the environmental impacts and LCC. The tool, which is called EcoReport, is part of the MEEuP methodology, required by the European Commission for undertaking all preparatory studies under the Ecodesign Directive.[1]

While this study has been completed as comprehensively and accurately as possible, it relies on data which has been extrapolated from literature and information provided by stakeholders. The performance of real-life appliances can vary substantially from the data provided in this report. This is understood and mitigated as much as possible, while handling and calculating the data during the analysis, however rough approximations are ultimately unavoidable. The results of the study nevertheless are valuable as they represent the best indication to date of the environmental impacts of the local room heaters in the EU.

The description of the Base-Cases is the synthesis of the results of Tasks 1 to 4 of this preparatory study. The environmental and life cycle cost analyses of the selected Base-Cases provide the main results of this study and it serves as the point-of-reference for Task 6 (technical analysis of Best Available Technologies), Task 7 (improvement potential), and Task 8 (policy analysis).

5.1. Preliminary definitions

5.1.1 Criteria for defining Base-Cases

According to the Ecodesign Directive (2009/125/EC), the BCs should meet the following three criteria:

- Significant market share
- Significant environmental impact
- Significant improvement potential

[1] MEEuP – Methodology Study Eco-design of Energy Using Products. Kemna, R. et al. (VHK) for DG ENTR of the European Commission, MEEuP Methodology Final Report, 2005. Accessible at: ec.europa.eu/enterprise/eco_design/finalreport1.pdf

The implementing measures target appliances that are common on the EU market, bear a large environmental burden, and have the potential to improve their environmental performance. An appliance that does not meet any of these three criteria provides little opportunity for policy action, and therefore is not considered as a BC. The most appropriate BCs for this study were selected through discussion with stakeholders, using the above criteria as guidelines. As previously mentioned, BCs are not necessarily representative of real products. When two products have a similar bill of materials (BoM), technology and efficiency, they can be represented by a single BC. For further justification of the criteria for selecting Base-Cases, please refer to the MEEuP methodology[2].

5.1.2 Overview of the Base-Cases

Although Ecodesign preparatory studies typically select one or two BCs, nine BCs have emerged in this study. Such a high number of BCs is necessary to cover the broad range of local room heating products. Based on the market estimates obtained from Task 2 of this study, the BCs chosen here represent over two thirds of the total stock of residential local room heaters and over 85% of the total stock of non-residential heaters. The modest representation for residential applications is not only due to the large range of local room heaters, which differ widely in their functionality and use, but also because certain products can be considered improvement options for others (e.g. balanced flued gas heaters vs. open combustion gas heaters). The main parameters of the selected Base-Cases are presented in Table 5-1.

Table 5-1: Overview of local room heating product Base-Cases

	Name	Base-Case	Output power [kW]	Fixed	Portable	Primary	Secondary	Energy source	Control type		Fan
									Heater component (product)	Room thermo-stat	
Residential	Open combustion flued gas heater	BC 1	4.2	x		x		Natural gas	Manual on/off control[3]	No	No
	Open combustion flued gas fire	BC 2	4.2	x		x		Natural gas	Manual on/off control	No	No
	Portable electric fan heater	BC 3	1.0		X		x	Electricity	Manual on/off control	No	Yes
	Convector electric	BC 4[4]	1.0	x		x		Electricity	On/off (two	No	No

[2] MEEuP – Methodology Study Eco-design of Energy Using Products, Kemna, R. et. al. (VHK) for DG ENTR of the European Commission, MEEuP Methodology Final Report, 2005, accessible at ec.europa.eu/enterprise/eco_design/finalreport1.pdf

[3] Manual controllers have two possible output variables: on and off. They are used for the regulation of burner or electric heaters that cannot be modulated. For two stages burners or electric heaters with power stage switch, a pair of two-step controllers can be used, thus enabling a control with three output variables (off, stage 1 and stage 2).

[4] One manufacturer commented that fixed electric heaters are mainly used for secondary heating in Germany. However due to the relatively small market and lack of evidence, a separate Base-Case for secondary heating fixed electric was not considered. The use pattern associated with the fixed electric heaters for secondary heating is already considered in BC 3, which allows identifying the potential Best Available Technologies for electric secondary heating.

	Name	Base-	Output	rx ed	rta	ma	co nd	Energy	Control type		Fan
	fixed								step) control [5]		
	Static electric storage heater	BC 5a	2.5	x		x		Electricity	Manual charge control and manual output	No	No
	Dynamic electric storage heaters	BC 5b	3	x		x		Electricity	Electro-mechanical charge control and thermostat output control	Yes	Yes
	Electric underfloor heating	BC 6a	1.5[6]	x		x		Electricity	P control[7]	Yes	No
	Electric underfloor heating	BC 6b	0.4[8]	x			x	Electricity	P control	Yes	No
Non-residential	Warm air unit heater	BC 7	40	x		x		Natural gas	P control	Yes	Yes
	Radiant luminous heater	BC 8a	20	x	x	x		Natural gas/LPG	P control	Yes	No
	Radian tube heater	BC 8b	30	x		x		Natural gas/LPG	P control	Yes	Yes
	Air curtain	BC 9	18	x		N.A.		Hot water from gas-fired boiler	Manual on/off control	No	Yes

The two main types of gas heaters, flued gas heaters and flued gas fires are represented by each their own individual BC. Flueless gas heaters are not considered as a Base-Case since there is limited potential for design improvement without changing the typical usage patterns and application areas. The ventilation requirements in the heated spaces, where flueless heaters are used are already regulated by individual Member State legislation. Possible improvement potential could be related to use of controls, however flueless gas heaters are used for only 1.5 hours/day on an ad-hoc basis, hence leaving little scope for the optimisation of their use.

Three BCs are selected to represent fixed electric heaters. As installed convector heaters constitute the most common type of heater, this was selected as a BC. Electric storage heaters have the particular ability to store heat, therefore these have been selected as a separate BC with a division on static and dynamic storage heaters[9]. Underfloor heating systems differ considerably from the

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[5] On/off (two step) control is the traditional two-wire (bimetallic) thermostat.

[6] Assuming a electric underfloor primary heating surface area of 15 m^2

[7] Proportional controllers (P), proportional–integral controller (PI), and proportional-integral-derivative controllers (PID) are generic control loop feedback mechanisms providing steady control. They can be used with modulating appliances. P controllers give an answer that is proportional (in terms of heat output) to the error, meaning the difference between the measured temperature and the target temperature.

[8] Assuming a electric underfloor secondary heating surface area of 4 m^2

[9] Two sub-base cases are considered for electric storage heaters due to two very different markets covered by them. UK and Germany are the two major markets for electric storage heaters, together accounting for more than 80% of the

other heating products, so these are also represented by a separate BC. Based on stakeholder consultation and due to different use patterns for underfloor heaters, two sub-BCs are considered for underfloor electric heating: one as a primary heating and other as a comfort (secondary) heating.

No liquid fuel heaters (e.g. paraffin heaters or ethanol fires) are selected as BCs, because the overall energy consumption associated with the stock of paraffin/kerosene heaters in EU is insignificant (around 1%) compared to the energy consumed by the overall stock of residential heaters in the EU.

Gas-fired warm air heaters are by far the most common non-residential heater on the market and therefore selected as a BC. Oil-fired warm air heaters are not considered as a separate BC as they are expected to have similar improvement options as the BC 7 in terms of combustion efficiency, control performance and reduction of the flue gas losses.

A separate Base-Case is considered for non-residential radiant gas heaters. Due to significant differences in the construction materials used for luminous radiant heaters and radiant tube heaters, a sub-BC is considered for each one of them.

Finally, a BC was selected to represent air curtains, as the main function of these products is different from other local room heaters. Their function is to separate different climatic zones rather than to heat a room.

5.1.3 Heat demand

The heat demand calculations were based on existing EU average buildings and local rooms, where the average EU product is installed. The heat demand of a room is determined by the heat gains and heat losses. For the purposes of this study, we calculated the heat demand that is needed for each main type of application of local room heaters (depending on the representative average climate zone, size of the room, building characteristics and usage patterns that match the BCs). The two main reasons to heat losses are:

- Transmission – heat flowing through walls, windows and doors due to conduction
- Ventilation – air flowing through the room (infiltration and deliberate ventilation)

The heat gains come from various sources such as solar radiation, heat transfer from other rooms, (heated air) ventilation and internal heat sources such as people, lighting and other energy-using equipment. For the purposes of the preparatory study, it is assumed that all the heat sources (except the heater itself) are identical for all cases studied.

As there are many factors and different calculation methods to define the heat demand, stakeholders were asked to validate the estimates for the annual heat demand for an 'average EU room' that is typical for each Base-Case under agreed assumptions on the:

- size of the room

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electric storage heater sales in EU. The majority of storage heaters in the UK are static, which are typically installed, in smaller (low cost) rented homes to heat individual rooms. Typical users are elderly and disabled people (who spend most of their time at home). The majority of electric storage heaters in Germany are dynamic, which tend to heat larger spaces and are set up to compete against other central heating systems, which explains the greater focus on comfort and temperature controls.

- building characteristics
- usage patterns
- any other relevant factor

Each Base-Case has a specific heat demand depending on the size of the room, building characteristics, usage patterns, etc., but the heat demand for all Base-Cases do not change with improvement options. In consultation with the stakeholders, the average heat demand values for the various base cases were estimated and agreed upon as presented in Table 5-2.

Table 5-2: Heat demand values used for the various local room heater BCs

Application	Base-Cases	Main usage	Heating season (days)	Usage pattern (per day)	Heated floor area (m^2)	Ceiling height (m)	Annual heat demand (kWh)	Source
Residential applications	**BC 1, BC 2, BC 4 and BC 6a**	Primary heating	216	24 hours at 20°C	15	2.5	1 130	CECED
	BC 5a[10] **and BC 5b**	Primary heating	216	20 hours at 20°C	15	2.5	1 324	CECED
	BC 3	Secondary heating	216	1.5 hours at full load (1.0 kW) at 21°C from 16°C	15	2.5	324	CECED
	BC 6b	Secondary heating	216	1.5 hours at full load (0.4 kW)	4	2.5	130	CECED
Non-residential applications	**BC 7***	Primary heating	216	24 hours at 18°C	197	10	24 738	CEN TC 180 WG 4
	BC 8a*	Primary heating	216	24 hours at 18°C	97	10	12 150	CEN TC 180 WG 4
	BC 8b*	Primary heating	216	24 hours at 18°C	146	10	18 337	CEN TC 180 WG 4
	BC 9	Separate indoor from outdoor climate	92	8 hours at part load (50% of rated capacity of 18.0 kW)	N.A.	3**	6 624	Manufacturers

**Heat demand calculated based on the calculation methodology suggested in EN 12831*[11]
***3 m (ceiling height) & 2 m (width of the air curtain opening)*

[10] Due to the very limited possibility of static storage heaters (BC5a) to regulate the room temperature, the usage pattern is not really applicable for this case.
[11] EN 12831: Heating systems in buildings - Method for calculation of the design heat load

5.1.4 Energy consumption calculation

The annual energy consumption is one of the main parameters used in the preparatory study to determine the environmental impacts (i.e. it is an input to the EcoReport tool). The methodology presented in this section is a very simplified manner to determine the energy consumption of the Base-Cases for local room heaters. The assumptions used for this methodology are very transparent as they were shared and agreed with technical experts from industry associations and manufacturers.

Ideally the heating capacity should always match the heat demand. However, the energy delivered by a heater is not always the same as the energy consumed. Losses can occur during heat generation, storage, transmission and emission. The annual energy consumed for each type of heater to meet the heat demand depends on:

- the input power
- the duration of time the heater is working
- losses during heat generation, storage, transmission and emission
- controls
- energy consumption of auxiliary components

There are no heat transmission losses in case of local room heaters as all the generated heat is directly dissipated in the heated space.

For a given value of heat demand, total energy consumption of local room heaters can be calculated as follows.

(1) [12]

E_{heat} *total energy consumption (fuel/heat)*
Q *building/room heat demand*
η_{gen} *efficiency of heat generation/combustion, not taking into account effects of heat generation/combustion control*
$\eta_{gen,ctr}$ *efficiency of heat generation/combustion control*
η_{em} *efficiency of heat emission, not taking into account effects of room temperature control*
$E_{savings,EP}$ *energy savings resulting from extended product such as room temperature controls*

With the method, given by (1), only the fuel and electricity consumed and heat losses are taken into account – auxiliary energy is not.

5.1.4.1 Auxiliary energy

For some local room heaters, additional electrical energy is required in order to drive fans, feed electronics (control), etc. An exact calculation method of auxiliary energy demand would differ

[12] For use in electrical storage heaters, storage loss has to be considered. For a given storage efficiency, this can be done by multiplying the right term with the reciprocal storage efficiency $1/\eta_s$.

largely depending on the kind of device. Besides, a level of complexity might be reached, which is not appropriate for the present consideration. Therefore, a simple approach, calculating auxiliary energy as a certain percentage of heat demand, was applied.

(2)

E_{aux} *total auxiliary energy*
f_{aux} *auxiliary energy coefficient*
Q *building/room heat demand*

The f_{aux} values for the various BCs are presented in table below.

Table 5-3: Auxiliary energy coefficient, f_{aux} values used for the various local room heater BCs

Application area	Base-Cases	f_{aux} [%]
Residential buildings	BC 1, BC 2, BC 4 and BC 5a	0
	BC 3, BC 5b	2[13]
	BC 6a and BC 6b	0.1
Non-residential buildings	BC 7	1.7
	BC 8 a	0.2
	BC 8b	0.5
	BC 9	2

5.1.4.2 *Total Energy Consumption*

Total energy consumption or demand is given by the sum of E_{heat} and E_{aux}. A common and approved approach for all the Ecodesign preparatory studies is to do so by using primary energy factors.

(3)

E_{prim} *total primary energy*
E_{heat} *total energy consumption (heat)*
$f_{p,fuel}$ *primary energy factor, fuel*
E_{aux} *total auxiliary energy*
$F_{p,el}$ *primary energy factor, auxiliary energy*

[13] Some stakeholders (including CECED) argued that the energy for fan operation should not be considered as auxiliary energy in case of electric heaters due to following reasons:

a) The fan motor is operated by electricity like the heating element

b) One part of the electric energy (depending on the efficiency of the motor) is converted into mechanical energy (the airflow). Since friction effects continuously slow down the air, this mechanical energy is steadily converted into thermal energy/heat according to the basic laws of physics.

c) The rest of the energy is converted into heat directly by heating up the motor engine. Since the fan motor is inside the room also, this heat is directly transmitted to the room.

It further commented that in case of BC 3 the fan operation time will be identical to the operating time of the device, but for BC 5b the time of fan operation will be only a relative small portion of the total heating time.

The primary energy factor for electrical energy in the EU to be used within the study is set by the European Commission[14].

5.2 Inputs to the LCA calculation tool

This section provides a summary of the inputs used to model each BC in EcoReport. Many of the inputs used in EcoReport are identical for all BCs. Before describing the specific inputs for each of the BC, notes about the inputs that are common for all BCs are provided.

5.2.1 Material selection for the bill of materials (BoM)

A complete description of the materials used to perform the BC assessment is given in Table 5-4. For the assessment, some aspects are common to all BCs:

- Each type of material is associated with a default factory process (e.g. rolling for steel coils or sheets). A distinction is made between the impacts of the material acquisition and the impacts of their processing at the plant.
- Packaging is also accounted for in the Bill of Materials (BoM).
- Besides the fuel, spare parts for replacement or maintenance are accounted for during the use phase of local room heaters. Their weight is defined by default in the EcoReport as 1% of the appliance's weight.

As a result, the summary of materials in EcoReport comprises information on the total production of materials and the disposal methods at the end-of-life, but not on the distribution or use phases.

As not all possible types of materials are available in EcoReport, simplifications have been made for the material types that are not represented. Materials with similar environmental impacts have been used as approximation of materials not available in EcoReport. Assumptions have also been made when the descriptions of materials provided by manufacturers were not precise enough. The materials used to represent the BoMs of each BCs are shown in Table 5-4.

Table 5-4: Materials used in EcoReport to represent the BoM of the Base-Cases

Material mentioned by manufacturers in the BoM	Materials used in EcoReport to represent the BoMs of the Base-Cases		
Plastics	1-BulkPlastics	10-ABS	50%
	2-TecPlastics	12-PC	50%
FEP	1-BulkPlastics	2- HDPE	
XLPE	1-BulkPlastics	2- HDPE	
PVC	1-BulkPlastics	8-PVC	

[14] As used across all EuP preparatory studies. It is recognised that the actual primary energy factor varies according to how electricity is produced. The value used by the European Commission is determined by what would be a reasonable representation of average electricity generation in the EU.

Material mentioned by manufacturers in the BoM	Materials used in EcoReport to represent the BoMs of the Base-Cases		
PVDF	1-BulkPlastics	8-PVC	
PA	2-TecPlastics	11-PAC6	
Steel	3-Ferro	21-St sheet galv	50%
	3-Ferro	22-St tube/profile	50%
Chrome steel	3-Ferro	21-St sheet galv	50%
	3-Ferro	22-St tube/profile	50%
Cast iron	3-Ferro	23-Cast iron	
Iron oxide	3-Ferro	23-Iron ore	
Stainless steel	3-Ferro	25-Stainless 18-8 coil	
Non-ferrous metals	4-Non-ferro	27-Al die-cast	50%
	4-Non-ferro	30- Cu tube/sheet	50%
Aluminium	4-Non-ferro	27-Al die-cast	
Brass	4-Non-ferro	31-CuZn38 cast	
Ni-Cr alloy	4-Non-ferro	27-Al die-cast	
Coatings	5- Coatings	39- powder coating	
Epoxy paintings	5- Coatings	39- powder coating	
Total electronics	6-Electronics	98-Controller board	
Glass,	7- Miscellaneous	54-Glass for lamps	
Ceramics	7- Miscellaneous	54-Glass for lamps	
Paper manual	7- Miscellaneous	57-Office paper	
Glass wool	2-TecPlastics	18- E-glass fibre	
Microporous insulation	2-TecPlastics	18- E-glass fibre	

Sheetmetal scrap is estimated to be 5% for all BCs.

5.2.2 Inputs to the distribution phase

The EcoReport calculations related to the distribution phase are based on the volume of the packaged product. EcoReport applies different calculation models to the distribution phase depending on the product type. For example, ICT (Information and Communication Technology) or consumer electronics products of less than 15 kg are assumed to have certain transportation mixes and volumes. This is not the case for local room heaters. EcoReport assumes 10% of heating appliances to be imported and no use of air freight. The trucking/rail ratio for the EU is 70:30. EcoReport further differentiates whether the product is installed or not.

5.2.3 Inputs to the use phase

The energy consumption during the use phase is expected to be a major contributor to the environmental impacts for all local room heaters. The annual energy consumption is defined in Section 5.1.4. The product lifetime is also required as inputs into EcoReport and are used to calculate the Life Cycle Costs (LCC). The distance travelled for maintenance is assumed to be 6 km per visit[15] for the gas and oil fired heaters.

5.2.4 Inputs to the end-of-life phase

As stated in the Task 4, the recycling rate of the collected big household appliances is 77% and the total recovery (including energy recovery) is 84% assuming that the WEEE Directive objectives for 2009 are met. As calculated in Task 4 and assuming that these shares apply to plastics, the entries in the EcoReport are as follows:

- Landfill: 15% [16]
- Plastics: 0% reused, 77% recycled, 7% thermal recycled[17]. For its use in the EcoReport tool, the reuse, recycling and incineration rates have been recalculated to sum up 100% of the plastic fraction, and are assumed 0%, 92% and 8%, respectively.
- It is assumed that Printed Wiring Boards (PWB) are easy to disassemble[18]

The same inputs for end-of-life are used for all BCs.

5.2.5 Inputs for the economic assessment

In order to assess the economic impacts of local room heaters at the EU level, inputs on sales, stock and average price data are required, as well as the price of the fuel used. The data is taken from Eurostat for the year 2009. These inputs were presented in Task 2. The discount rate is defined as the interest rate minus the inflation rate. A discount rate of 4%[19] (same for all Base-Cases) is used for the Life Cycle Cost (LCC) analysis.

Before the impacts at EU level can be calculated, the overall improvement ratio must be estimated. This ratio represents the energy efficiency improvement potential of an appliance currently available on the market compared to an average appliance currently installed (stock). The average installed product is assumed to be about half of the product's lifetime. The overall improvement ratio is assumed to be 1.3 for all BCs. This indicates that the average sold product today has the same efficiency as the average installed product in the stock.

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[15] Kemna, R. et al. (VHK) for DG ENER of the European Commission, ENER Lot 1 preparatory study. Final Report, 2007

[16] According to the information provided by manufacturers.

[17] See ENER Lot 20 - Task 4 report

[18] According to the information provided by manufacturers.

[19] This is in line with the value suggested for discount rate in the Commission's revised Impact Assessment Guidelines (2009). See: http://ec.europa.eu/governance/impact/commission_guidelines/docs/iag_2009_en.pdf (page39)

The average price of fuel used for all BCs is:

- Natural gas price for residential customers: 15.4 €/GJ
- Natural gas price for non-residential customers: 11.6 €/GJ
- LPG price: 0.60 €/L, i.e 23.1 €/GJ
- Electricity price for residential customers: 0.163€/kWh (0.109€/kWh for storage heaters)[20]
- Electricity price for non-residential customers: 0.156€/kWh

5.2.6 BC 1 – Open Combustion/chimney Connected Flued Gas Heater

Flued gas heaters are fixed to the walls through a flue gas system and are usually connected to a gas supply. The BC for flued gas heaters represents a hypothetical mix of appliances fed with LPG or natural gas. The BC is characterised by open fronted combustion, chimney for evacuation of flue gases and manual control.

5.2.6.1 Inputs in the production phase

The material consumption entries in the EcoReport tool are made with the following assumptions:

- steel is manufactured as galvanized steel sheets and steel tubes/profiles in the same proportions;
- non-ferrous metals are typically aluminium die-cast and copper tubes or sheets;
- plastics are constituted of half PC and half ABS;
- coatings are powder coatings;
- ceramics can be assimilated with glass for lamps.

The BoM of the appliance is presented in Table 5.6.

Table 5-5: BC 1 - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	25	25	17 820	792	792	0	346	19 800
Weight (%)	0%	0%	90%	4%	4%	0%	2%	100%

5.2.6.2 Inputs in the distribution phase

For a typical open combustion flued gas heater, the volume of the packaged product is estimated to be 0.035 m^3. An open combustion flued gas heater is considered to be an installed appliance.

[20] Off-peak tariff is assumed to be 67% of the regular price

5.2.6.3 Inputs in the use phase

The inputs to EcoReport for the use phase of BC 1 are:

- Product life: 20 years
- Output capacity: 4.2 kW
- Heating season duration: 5184 hours/year
- Net thermal efficiency (based on NCV[21]): 65%
- Efficiency of heat generation (taking into account heat losses associated with use of pilot flame and due to the on/off operation of the heater, based on NCV): 62%
- Efficiency of heat generation control: 100%
- Efficiency of heat emission: 100%
- Number of kilometres travelled for maintenance and repair: 120 km (assuming one maintenance visit per year)

5.2.6.4 Economic inputs

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 1 are:

- Sales for the year 2009: 175 000
- Stock for the year 2009: 3 500 000
- Average product purchase price in 2009: € 600
- Average installation costs: € 250
- Repair and maintenance costs: € 430
- Overall improvement ratio: 1.0

5.2.7 BC 2 – Open Combustion/chimney connected Flued Gas Fire

The BC for gas fires is wall mounted and connected to a flue system. It uses natural gas as a fuel. The BC is characterised by open fronted combustion, live flame effect, chimney for evacuation of flue gases and manual control.

5.2.7.1 Inputs in the production phase

The bill of material entries in the EcoReport tool are based on data provided by four manufacturers. This was used to determine the following inputs:

- the plastic used in components is mainly PC and ABS;
- ceramic is in the form of glass;
- steel in the form of half galvanized steel sheets and half steel tubes/profiles.

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[21] NCV: Net Calorific Value

The BoM of the appliance is presented in Table 5.7.

Table 5-6: BC 2 - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	145	145	18 589	1 313	129	0	1 753	22 529
Weight (%)	1%	1%	83%	6%	1%	0%	8%	100%

5.2.7.2 *Inputs in the distribution phase*

The EcoReport calculations related to the distribution phase are based on the volume of the packaged product (0.5 m^3). An open combustion flued gas fire is considered to be an installed appliance.

5.2.7.3 *Inputs in the use phase*

The inputs to EcoReport for the use phase of BC 2 are:

- Product life: 20 years
- Output capacity: 4.2 kW
- Heating season duration: 5184 hours/year
- Net thermal efficiency (based on NCV): 42%
- Efficiency of heat generation (taking into account heat losses associated with use of pilot flame and due to the on/off operation of the heater, based on NCV): 40%
- Efficiency of heat generation control: 100%
- Efficiency of heat emission: 100%
- Number of kilometres travelled for maintenance and repair: 120 km (assuming one maintenance visit per year)

5.2.7.4 *Economic inputs*

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 2 are:

- Sales for the year 2009: 280 000
- Stock for the year 2009: 5 600 000
- Average product purchase price in 2009: € 600
- Average installation costs: € 250
- Repair and maintenance costs: € 430
- Overall improvement ratio: 1.0

5.2.8 BC 3 – Electric Portable Fan Heater

The BC for electric portable heaters is portable fan heater. The BC is characterised by only a manual control (on/off switch) that uses a fan to ensure forced convection.

5.2.8.1 Inputs in the production phase

The plastic composition was detailed by the manufacturers into PC and ABS plastics. However, for ferrous metal, only the steel that is used was specified. The following assumptions were used for BC 3:

- half of the ferrous metal is galvanized steel sheets and the rest is steel tubes or profiles.
- non-ferrous metals are assumed to be aluminium die cast and copper tube/sheets.
- the electronics are reported as a controller board.

The BoM of the appliance is presented in Table 5.8.

Table 5-7: BC 3 - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	195	650	195	195	0	65	0	1,300
Weight (%)	15%	50%	15%	15%	0%	5%	0%	100%

5.2.8.2 Inputs in the distribution phase

The EcoReport calculations related to the distribution phase are based on the volume of the packaged product, which is considered 0.03 m^3. BC 3 is a portable product that does not require installation.

5.2.8.3 Inputs in the use phase

The inputs required to calculate the environmental impacts in the use phase are as follows:

- Product life: 12 years
- Output capacity: 1.0 kW
- Number of hours of operation per year: 324 hours/year
- Efficiency of heat generation: 100%
- Efficiency of heat generation control: 100%
- Efficiency of heat emission: 100%
- Number of kilometres travelled for maintenance and repair: 0 km (the product does not require professional maintenance, neither is it repaired)

5.2.8.4 *Economic inputs*

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 3 are:

- Sales for the year 2009: 7 200 000
- Stock for the year 2009: 61 400 000
- Average product purchase price in 2009: € 30
- No installation costs
- Repair and maintenance costs : € 0
- Overall improvement ratio: 1.0

5.2.9 BC 4 – Convector Electric Fixed

The BC for fixed electric residential heaters is a convector panel heater. The heat transfer is based on natural convection. The BC is characterised by a two-step (bimetallic) controller.

5.2.9.1 *Inputs in the production phase*

The Bill of Material entries in the EcoReport tool are made with the following assumption:

- steel is manufactured half as galvanized steel sheets half as steel tubes/profiles;
- epoxy painting is a powder coating;
- plastics are made of PC and ABS in the same proportions.
- the quantities of aluminium and Ni/Cr alloy were provided by stakeholders.

The BoM of the appliance is presented in Table 5.9.

Table 5-8: BC 4 - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	300	300	3 750	614	311	0	0	5 275
Weight (%)	6%	6%	71%	12%	6%	0%	0%	100%

5.2.9.2 *Inputs in the distribution phase*

Stakeholders reported that the average volume of the packaged product is of 0.068 m^3. BC 4 is an installed appliance.

5.2.9.3 *Inputs in the use phase*

The inputs to EcoReport for the use phase of BC 4 are:

- Product life: 12 years

- Output capacity: 1 kW
- Heating season duration: 5184 hours/year
- Efficiency of heat generation: 100%
- Efficiency of heat generation control: 100%
- Efficiency of heat emission: 100%
- Number of kilometres travelled for maintenance and repair: 0 km

5.2.9.4 Economic inputs

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 4 are:

- Sales for the year 2009: 11 360 000
- Stock for the year 2009: 102 600 000
- Average product purchase price in 2009: € 120
- Average installation costs: € 30
- Repair and maintenance costs : € 0
- Overall improvement ratio: 1.0

5.2.10 BC 5a – Static Electric Storage Heater

The BC for static storage heaters is a fixed appliance that generates and stores heat using electricity during the night and releases it during the day. Both natural convection and thermal radiation are used to transfer heat into the heated space. The BC uses an electro-mechanical thermostat as a control.

5.2.10.1 Inputs in the production phase

The material consumption entries in the EcoReport tool are made with the following assumptions:

- all plastics are PA (as suggested by stakeholders);
- steel is assumed to be made of galvanized steel sheets and steel tubes/profiles in the same proportions;
- core bricks made of iron oxide should be referenced as iron ore;
- paints are assumed to be powder coatings; and
- mineral wool and microporous insulation are both assumed to be a part of the E-glass fibre category in EcoReport.

The BoM of the appliance is presented in Table 5.10.

Table 5-9: BC 5a - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	0	3 000	118 000	100	100	0	0	121 265
Weight (%)	0%	3%	97%	0%	0%	0%	0%	100%

5.2.10.2 *Inputs in the distribution phase*

According to the stakeholders inputs, the volume of the packaged product of BC 5a is 0.14 m^3. BC 5a is an installed appliance.

5.2.10.3 *Inputs in the use phase*

The inputs to EcoReport for the use phase of BC 5a are:

- Product life: 20 years
- Input capacity: 2.5 kW
- Heating season duration: 4 320 hours/year
- Efficiency of heat generation: 100%
- Efficiency of heat generation control: 100%
- Efficiency of heat emission: 100%
- Number of kilometres travelled for maintenance and repair: 0 km (manufacturers did not report any need for maintenance)

5.2.10.4 *Economic inputs*

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 5a are:

- Sales for the year 2009: 240 000
- Stock for the year 2009: 9 000 000
- Average product purchase price in 2009: €375
- Average installation costs: €80
- Repair and maintenance costs: €0
- Overall improvement ratio: 1.0

Storage heaters only consume electricity during the base load period (off-peak tariff), which, is around 33% cheaper than peak load electricity price. Therefore, a 33% lower value for electricity price has been used for BC 5a and BC 5b compared to that for other electric heaters.

5.2.11 BC 5b – Dynamic Electric Storage Heater

5.2.11.1 *Inputs in the production phase*

The material consumption entries in the EcoReport tool are made with the following assumptions:

- all plastics are PA (as suggested by stakeholders);
- steel is assumed to be made of galvanized steel sheets and steel tubes/profiles in the same proportions;
- core bricks made of iron oxide should be referenced as iron ore;
- paints are assumed to be powder coatings; and
- mineral wool and microporous insulation are both assumed to be a part of the E-glass fibre category in EcoReport.

The BoM of the appliance is presented in Table 5.11.

Table 5-10: BC 5b - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	0	3 702	145 614	123	123	0	0	149 643
Weight (%)	0%	3%	97%	0%	0%	0%	0%	100%

5.2.11.2 *Inputs in the distribution phase*

According to the stakeholders inputs, the volume of the packaged product of BC 5b is 0.17 m^3. BC 5b is an installed appliance.

5.2.11.3 *Inputs in the use phase*

The inputs to EcoReport for the use phase of BC 5b are:

- Product life: 20 years
- Input capacity: 3 kW
- Heating season duration: 4 320 hours/year
- Efficiency of heat generation: 100%
- Efficiency of heat generation control: 100%
- Efficiency of heat emission: 100%
- Number of kilometres travelled for maintenance and repair: 0 km (manufacturers did not report any need for maintenance)

5.2.11.4 *Economic inputs*

The inputs for EU totals and the economic life cycle costs to EcoReport for BC5b are:

- Sales for the year 2009: 90 000
- Stock for the year 2009: 4 800 000
- Average product purchase price in 2009: €600
- Average installation costs: €80
- Repair and maintenance costs : €0
- Overall improvement ratio: 1.0

5.2.12 BC 6a and BC 6b – Electric Underfloor Heating

BC6 represents underfloor primary (BC 6a) and secondary (BC 6b) heating systems. It is a hypothetical mix of cable mats embedded either in the floor (biggest part of the EU-market) or in the wall (more rare). The cables transform electricity into heat, which is then transferred to the room primarily by radiant effect. The control system is a simple two-step (on/off) controller. BC 6a is assumed to cover a surface of 15 m^2, whereas BC 6b to cover a surface of 4 m^2.

5.2.12.1 *Inputs in the production phase*

The Bill of Material entries in the EcoReport tool is obtained by calculating the average of three products:

- the quantities of copper and aluminium used are provided by stakeholders
- the quantities of PVC, PVDF, XLPE and FEP plastics are provided by stakeholders
- PVDF is classed as HDPE[22]
- FEP and XLPE are polyethylene and classed as HDPE
- Glass fibre is assumed to correspond to E-glass fibre

The BoM of the appliance is presented in Table 5-11.

Table 5-11: BC6a and BC6b - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	560	2 503	50	560	0	0	300	1 720
Weight (%)	33%	15%	3%	33%	0%	0%	17%	100%

[22] PVDF was classified as HDPE but not as PVC, since even though PVDF and PVC can be defined as related compounds as thermoplastic polymers, environmental impact from them differs significantly. PVC contributes to dioxin and chlorine formation, whereas PVDF does not produce such hazardous compounds, thus, it is closer to HDPE.

5.2.12.2 Inputs in the distribution phase

The volume of the average packaged product (0.03 m^3) was obtained from stakeholders' inputs. BC 6a and BC 6b are installed into buildings.

5.2.12.3 Inputs in the use phase

The use phase of BC 6a and BC 6b is calculated using the following data:

- Product life: 40 years
- Output capacity for BC 6a: 1.5 kW (assuming an average room surface of 15 m^2)
- Output capacity for BC 6b: 0.4 kW (assuming an average room surface of 4 m^2)
- Heating season duration for BC 6a: 5184 hours/year
- Number of hours of operation per year for BC 6b: 324 hours/year
- Efficiency of heat generation: 100%
- Efficiency of heat generation control: 100%
- Efficiency of heat emission: 100%
- Number of kilometres travelled for maintenance and repair: 0 km (no maintenance or repair is necessary for this appliance)

5.2.12.4 Inputs in the end-of-life phase

Underfloor heating is classified as a C&D waste since they are part of a building construction.

According to the latest research[23], average recycling rate of C&D waste for Europe is 46%. The rest percentage is shared between other ways of material recovery (reuse, landfill). It should however be noted that these numbers are rough because recycling and landfill rate varies depending on a country/region, see Table 5-12:

Table 5-12: Recycling and landfill rates in EU countries/regions

Country/region	Recycling and reuse (%)	Landfill (%)
Germany	93.4	8.6
Flanders	89.2	10.8
Spain	7.5	94.5

Assuming that thermal recycling can be neglected in C&D waste, the entries in the EcoReport for BC 6a and BC 6b are as follows:

[23] BIO Intelligence Service (2011), Service Contract on Management of Construction and Demolition of waste - SR1. Available at: www.eu-smr.eu/cdw/docs/BIO_Construction%20and%20Demolition%20Waste_Final%20report_09022011.pdf

- Landfill: 54%
- Plastics: 0% reused, 46% recycled, 0% thermal recycled

5.2.12.5 *Economic inputs*

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 6a and BC 6b are:

- Sales for the year 2009: 1 300 000 (20% BC 6a and 80% BC 6b)
- Stock for the year 2009: 13 000 000 (20% BC 6a and 80% BC 6b)
- Average product purchase price in 2009 of BC 6a: €560
- Average product purchase price in 2009 of BC 6b: €150
- Average installation costs for BC 6a: €375 (€25/m^2 for a 15 m^2 mat)
- Average installation costs for BC 6b: €100 (€25/m^2 for a 4 m^2 mat)
- Repair and maintenance costs: € 0
- Overall improvement ratio: 1.0

5.2.13 BC 7 – Warm Air Unit Heater

The typical warm air unit heaters for non-residential purposes are indirect gas-fired. It includes a fan and provides heat by forced convection. It is assumed to be controlled by a proportional (P) controller.

5.2.13.1 *Inputs in the production phase*

The Bills of Material's entries in the EcoReport tool are made using inputs from three manufacturers:

- the ferrous components is well detailed by the stakeholders
- chrome steel is not available in the EcoReport tool, and was therefore replaced by steel and split between aluminized steel sheets and steel tubes/profiles
- plastics are assumed to be PC or ABCepoxy paints are powder paints

The BoM of the appliance is presented in Table 5.13.

Table 5-13: BC 7 - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	0	0	318 978	20 263	0	4 451	0	343 868
Weight (%)	0%	0%	93%	6%	0%	1%	0%	100%

5.2.13.2 Inputs in the distribution phase

The EcoReport calculations related to the distribution phase are based on the volume of the packaged product, which is considered to be 1-2 m^3. BC 7 is an installed heater.

5.2.13.3 Inputs in the use phase

The inputs to EcoReport for the use phase of BC 7 are:

- Product life: 15 years
- Output capacity: 40 kW
- Heating season duration: 5184 hours/year
- Thermal efficiency (based on NCV): 89%
- Efficiency of heat generation (taking into account heat losses associated with use of pilot flame and due to the on/off operation of the heater, based on NCV): 85%
- Efficiency of heat generation control: 100%
- Efficiency of heat emission: 86%
- Number of kilometres travelled for maintenance and repair: 120 km (assuming one maintenance visit per year)

5.2.13.4 Economic inputs

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 7 are:

- Sales for the year 2009: 50 000
- Stock for the year 2009: 1 100 000
- Average product purchase price in 2009: € 3 700
- Average installation costs: € 250
- Repair and maintenance costs: € 1530
- Overall improvement ratio: 1.0

5.2.14 BC 8a – Luminous Radiant Heater

BC 8a is gas-fired luminous radiant heater.

5.2.14.1 Inputs in the production phase

The BoM of the appliance is presented in Table 5.14.

Table 5-14: BC8a - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	0	0	17 000	0	800	400	1 800	20 000
Weight (%)	0%	0%	85%	0%	4%	2%	9%	100%

5.2.14.2 *Inputs in the distribution phase*

The volume of the packaged product is considered to be 0.2 m^3.

5.2.14.3 *Inputs in the use phase*

The inputs to EcoReport for the use phase of BC 8a are:

- Product life: 15 years
- Output capacity: 20 kW
- Heating season duration: 5184 hours/year
- Efficiency of heat generation (based on NCV): 96%
- Efficiency of heat generation control: 94%
- Efficiency of heat emission: 90%
- Number of kilometres travelled for maintenance and repair: 120 km (assuming one maintenance visit per year)

5.2.14.4 *Economic inputs*

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 8a are:

- Sales for the year 2009: 24 000
- Stock for the year 2009: 450 000
- Average product purchase price in 2009: € 1 300
- Average installation costs: €250
- Repair and maintenance costs: €1 520
- Overall improvement ratio: 1

5.2.15 BC 8b – Radiant Tube Heater

BC 8b is gas-fired radiant tube heaters.

5.2.15.1 *Inputs in the production phase*

The Bill of Material of this appliance is very simple (steel, cast iron and electronics) and the only assumption that was made is that the steel is constituted half of galvanized steel sheets and half of steel tubes or profiles. The BoM of the appliance is presented in Table 5-15.

Table 5-15: BC 8b - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	0	0	76 500	0	3 600	1 800	8 100	90 000
Weight (%)	0%	0%	85%	0%	4%	2%	9%	100%

5.2.15.2 *Inputs in the distribution phase*

The volume of the packaged product is considered to be 1 m^3. Gas radiant tube heaters are installed appliances.

5.2.15.3 *Inputs in the use phase*

The inputs to EcoReport for the use phase of BC 8b are:

- Product life: 15 years
- Output capacity: 30 kW
- Heating season duration: 5184 hours/year
- Efficiency of heat generation (based on NCV): 85%
- Efficiency of heat generation control: 94%
- Efficiency of heat emission: 90%
- Number of kilometres travelled for maintenance and repair: 120 km (assuming one maintenance visit per year)

5.2.15.4 *Economic inputs*

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 8b are:

- Sales for the year 2009: 24 000
- Stock for the year 2009: 540 000
- Average product purchase price in 2009: €1 900
- Average installation costs: €250
- Repair and maintenance costs: €1 530
- Overall improvement ratio: 1.0

5.2.16 BC 9 – Air Curtains

The air curtain Base-Case use hot water from gas-fired boiler as the heat source.

5.2.16.1 *Inputs in the production phase*

The BoM of the BC 9 is presented in Table 5.16.

Table 5-16: BC 9 - BoM summary

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc.	Total weight
Weight (g)	300	0	76 000	14 000	100	300	300	100 000
Weight (%)	3%	0%	76%	14%	1%	3%	3%	100%

5.2.16.2 *Inputs in the distribution phase*

The volume of the packaged product is considered to be 1 m^3.

5.2.16.3 *Inputs in the use phase*

The inputs to EcoReport for the use phase of BC 9 are:

- Product life: 10
- Output capacity: 18 kW (operates on average at 50% of nominal output capacity)
- Number of hours per year: 739 h/year
- Fuel type: hot water from a gas-fired boiler
- Number of kilometres travelled for maintenance and repair: 90 km

5.2.16.4 *Economic inputs*

The inputs for EU totals and the economic life cycle costs to EcoReport for BC 9 are:

- Sales for the year 2009: 60 000 units[24]
- Stock for the year 2009: 450 000 units[25]
- Average product purchase price in 2009: €2 500
- Average installation costs: €1 000
- Repair and maintenance costs: €1 000
- Overall improvement ratio: 1.0

[24, 17] Data for the United Kingdom. Ireland. Luxembourg, Belgium, Netherlands and Denmark

5.3 Base-Case Environmental Impact Assessment

The aim of this subtask is to assess the environmental impacts of each BC using the MEEuP (EcoReport Unit Indicators) methodology for each of the life cycle stages:

- Raw materials use and manufacturing (production phase);
- Distribution;
- Use;
- End-of-life.

The BC environmental impact assessment leads to the identification of basic technological design parameters (such as energy efficiency) of environmental relevance[26]. These parameters will serve as an important input to the identification of ecodesign options.

As mentioned in section 5.2.2 the EcoReport tool does not allow the means of transport and distances to be specified. Only the volume of the packaged product is taken into consideration in the assessment of the environmental impacts from transport. According to the MEEuP methodology (section 5.3.6, page 96), a mix of means of transport (trucking, rail, sear freight and air freight) with assumptions for distances is used for all BCs. Consequently, this percentage is an approximation and should be treated as such in the following sections.

5.3.1 BC 1 – Open Combustion/Chimney Connected Flued Gas Heater

The following table shows the total life cycle environmental impacts of a common open combustion connected flued gas heater. Table 5.17 presents the contribution of each life cycle stage to the overall environmental impacts.

[26] As part of the MEEuP EcoReport allows the identification of such indicators.

Table 5-17: Life cycle analysis of BC 1 (flued gas heater) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF- LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	850	153	1 003	90	141 359	225	11	214	142 666
of which, electricity (in primary MJ)	MJ	119	91	211	0	2	0	0	0	213
Water (process)	ltr	35	1	37	0	0	0	0	0	37
Water (cooling)	ltr	314	42	356	0	4	0	2	-2	357
Waste, non-haz./ landfill	g	26 449	547	26 996	67	270	4 009	1	4 008	31 341
Waste, hazardous/ incinerated	g	17	0	17	1	0	9	0	9	27
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	56	9	65	7	7 822	17	1	16	7 909
Ozone Depletion, emissions	mg R-11 eq.	negligible								
Acidification, emissions	g SO2 eq.	184	37	221	19	2 296	33	1	32	2 568
Volatile Organic Compounds (VOC)	g	2	0	2	1	107	1	0	1	112
Persistent Organic Pollutants (POP)	ng i-Teq	356	5	361	0	4	28	0	28	393
Heavy Metals	mg Ni eq.	69	12	81	3	63	66	0	66	213
PAHs	mg Ni eq.	10	0	10	4	66	0	0	0	81
Particulate Matter (PM, dust)	g	48	6	54	120	1 098	295	0	295	1 567
Emissions (Water)										
Heavy Metals	mg Hg/20	64	0	64	0	1	19	0	19	83
Eutrophication	g PO4	9	0	9	0	0	1	0	1	10
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

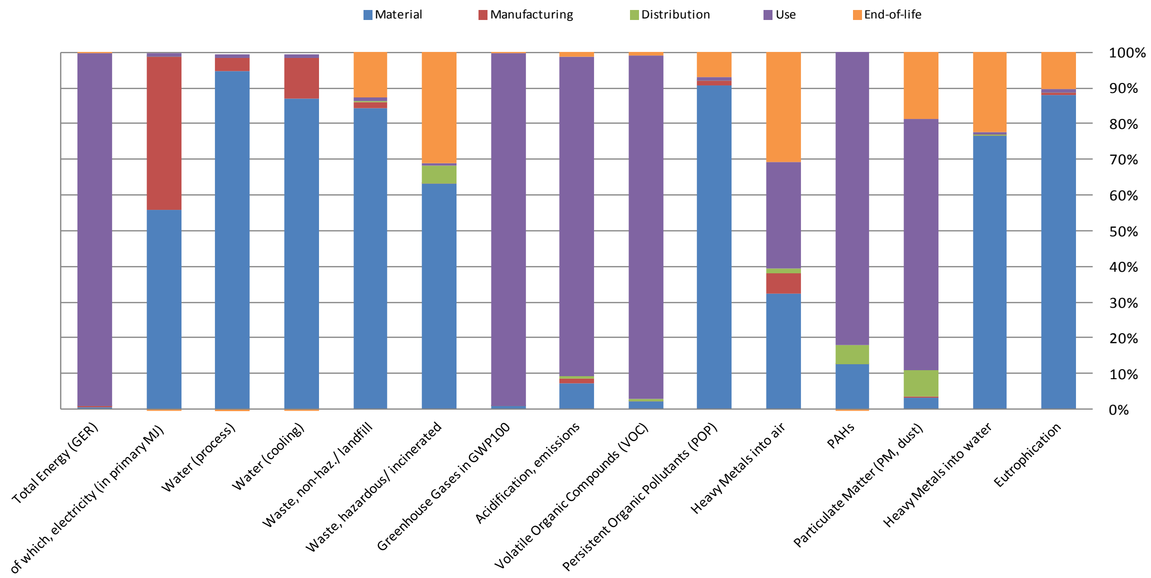

Figure 5-1: Distribution of the BC 1's (flued gas heater) environmental impacts by life cycle phase

The material acquisition phase and use phase are clearly the two predominant phases contributing to the environmental impacts of a flued gas heater's life cycle.

- The following 8 out of the 17 impacts related to the appliance's life cycle occur mostly during the material acquisition phase:
  - Electricity consumption: 56.2%
  - Water (process): 96.0%
  - Water (cooling): 87.8%
  - Waste, non-hazardous / landfill: 84.4%
  - Waste, hazardous / incinerated: 63.2%
  - Persistent Organic Pollutants: 90.7%
  - Heavy metals to water: 76.7%
  - Eutrophication: 88.2%

These impacts are mainly due to the production of steel, non-ferrous metals and powder coatings.

- The following 6 out of the 17 impacts related to the appliance's life cycle occur mostly during the use phase:
  - Total energy (GER): 99.0%
  - Greenhouse gas emissions: 98.8%
  - Acidification: 88.9%

- Volatile organic compounds: 96.1%
- PAHs: 82.1%
- Particulate Matter (PM, dust): 70.1%

The results of the EcoReport modelling indicate that 7.7% of the particulate matter emissions (PM, dust) to the air occur during the distribution phase.

The end-of-life phase also has a contribution of 53.2% to heavy metal emission to air and of about 44.9% to the following impacts: waste (non-hazardous/landfill and hazardous/incinerated), particulate matter (PM, dust) and heavy metals to water.

The manufacturing phase's highest contribution is to electricity consumption (42.9%). Its other impacts are lower and less than 12% for water (cooling).

5.3.2 BC 2 – Open Combustion/Chimney Connected Flued Gas Fire

The following table shows the environmental impacts of a common open combustion connected flued gas fire over its whole life cycle. Table 5.18 presents the contribution of each life cycle stage to the overall environmental impacts.

Table 5-18: Life cycle analysis of BC 2 (gas fire) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END- OF -LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	1 261	174	1 435	607	218 564	318	27	291	220 897
of which, electricity (in primary MJ)	MJ	384	104	487	1	5	0	1	-1	492
Water (process)	ltr	441	2	443	0	4	0	1	-1	447
Water (cooling)	ltr	139	48	187	0	2	0	5	-5	184
Waste, non-haz./ landfill	g	30 503	617	31 120	278	311	5 652	4	5 648	37 357
Waste, hazardous/ incinerated	g	304	0	304	6	3	23	1	23	335
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	78	10	88	37	12 090	24	1	22	12 238
Ozone Depletion, emissions	mg R-11 eq.	Negligible								
Acidification, emissions	g SO2 eq.	396	42	438	112	3 541	47	2	45	4 136
Volatile Organic Compounds (VOC)	g	6	0	6	10	164	1	0	1	181
Persistent Organic Pollutants (POP)	ng i-Teq	383	5	389	2	4	39	0	39	433
Heavy Metals	mg Ni eq.	138	13	150	14	64	93	0	93	321
PAHs	mg Ni eq.	44	0	44	25	69	0	0	0	137
Particulate Matter (PM, dust)	g	56	6	62	1 709	1 120	420	0	420	3 311
Emissions (Water)										
Heavy Metals	mg Hg/20	243	0	243	0	2	26	0	26	272
Eutrophication	g PO4	14	0	14	0	0	2	0	1	16
Persistent Organic Pollutants (POP)	ng i-Teq	Negligible								

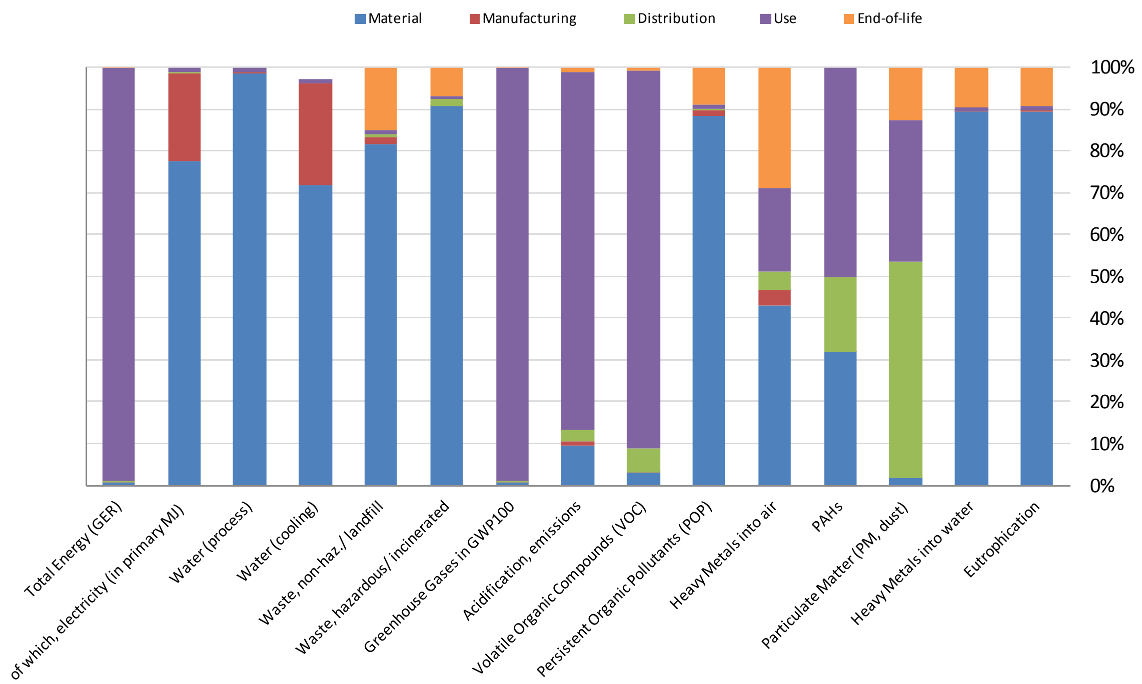

Figure 5-2: Distribution of the BC 2's (gas fire) environmental impacts by life cycle phase

The material acquisition phase and use phase are clearly the two predominant phases contributing to the environmental impacts of an open combustion connected flued gas fire's life cycle.

- The following 8 out of the 17 impacts related to the appliance's life cycle occur mostly during the material acquisition phase:
  - Electricity consumption: 77.9%
  - Water (process): 98.8%
  - Water (cooling): 75.9%
  - Waste, non-hazardous / landfill: 81.7%
  - Waste, hazardous / incinerated: 90.7%
  - Persistent Organic Pollutants: 88.5%
  - Heavy metals into water: 83.9%
  - Eutrophication: 89.2%

These impacts are mainly due to steel and electronics production.

- The following 4 out of the 17 impacts related to the appliance's life cycle occur mostly during the use phase:
  - Total energy (GER): 98.9%
  - Greenhouse gas emissions: 98.8%

- Acidification: 85.6%
- Volatile organic compounds: 88.3%

The results of the EcoReport modelling indicate that 44.2% of the particulate matter emissions (PM, dust) to air occur during the distribution phase.

- The end-of-life phase also has a considerable contribution, especially on the following impacts:
  - Waste, non-hazardous/ landfill 15.1%
  - Heavy Metals to air: 28.9%
  - Particulate matter (PM, dust) 12.7%

The manufacturing phase has a lower impact. Its highest contributions are to water consumption for cooling (26%) and to electricity consumption (21%). The manufacturing phase only contributes to small amounts of other environmental impact categories.

5.3.3 BC 3 – Electric Portable Fan Heater

The following table shows the environmental impacts of a common electric portable fan heater over its whole life cycle. Table 5.19 presents the contribution of each life cycle stage to the overall environmental impacts.

Table5-19: Life cycle analysis of BC3 (portable electric heater) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END- OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	170	40	209	92	41 582	27	37	-10	41 874
of which, electricity (in primary MJ)	MJ	50	24	74	0	41 581	0	2	-2	41 653
Water (process)	ltr	48	0	49	0	2 772	0	2	-2	2 820
Water (cooling)	ltr	115	11	126	0	110 881	0	14	-14	110 994
Waste, non-haz./ landfill	g	1 355	126	1 481	71	48 224	324	10	314	50 091
Waste, hazardous/ incinerated	g	51	0	51	1	959	62	2	60	1 071
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO_2 eq.	9	2	11	7	1 815	2	1	1	1 834
Ozone Depletion, emissions	mg R-11 eq.	Negligible								
Acidification, emissions	g SO_2 eq.	58	10	67	19	10 708	5	2	2	10 797
Volatile Organic Compounds (VOC)	g	0	0	0	1	16	0	0	0	17
Persistent Organic Pollutants (POP)	ng i-Teq	8	0	8	0	273	2	0	2	284
Heavy Metals	mg Ni eq.	9	0	9	4	713	7	0	7	733
PAHs	mg Ni eq.	7	0	7	4	82	0	0	0	93
Particulate Matter (PM, dust)	g	7	1	9	103	229	49	0	49	389
Emissions (Water)										
Heavy Metals	mg Hg/20	27	0	27	0	268	2	0	2	297
Eutrophication	g PO_4	1	0	1	0	1	0	0	0	2
Persistent Organic Pollutants (POP)	ng i-Teq	Negligible								

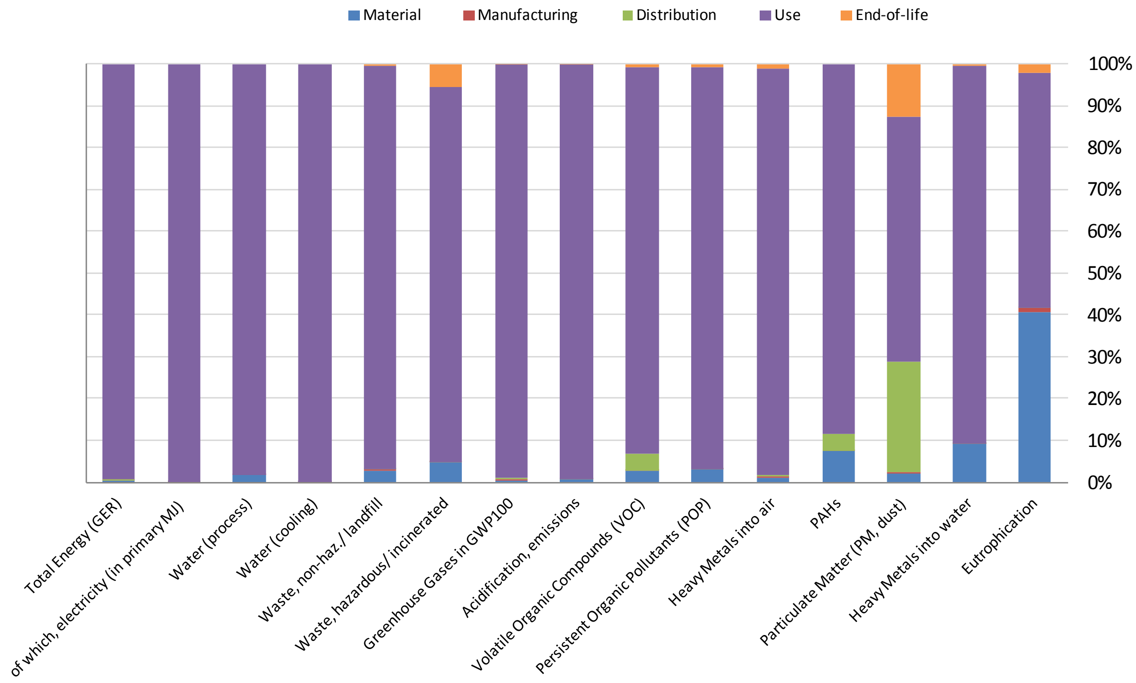

Figure 5-3: Distribution of the BC 3's (portable electric heater) environmental impacts by life cycle phase

Several observations can be made based on this analysis:

- The use phase is the predominant phase, 13 out of the 17 impacts due to the electric portable fan heater occur mostly during this phase.
  - Total energy (GER): 99.3%
  - Electricity consumption: 99.8%
  - Water (process): 98.3%
  - Water (cooling): 99.9%
  - Waste, non-haz/landfill: 96.3%
  - Waste, hazardous/ incinerated: 89.5%
  - Greenhouse gas emissions: 99.0%
  - Acidification: 99.2%
  - Volatile Organic Compounds (VOC): 92.2%
  - Persistent Organic Pollutants (POP): 96.1%
  - Heavy metals to air: 97.3%
  - PAHs: 88.5%
  - Heavy metals into water: 90.3%

The material acquisition phase mostly impacts eutrophication and heavy metal emissions to water with respective contributions of 40.7% and 9.1%. This is mainly due to the production of Ni-Cr alloy and powder coatings. The material acquisition phase also attributes 7.3% of PAHs and 4.8% of waste, hazardous/ incinerated.

The results of the EcoReport modelling indicate that 26.4% of particulate matter emissions (PM, dust) to air and 4.0% Volatile Organic Compounds (VOC) emissions occur during the distribution phase.

The end-of-life phase mostly impacts emissions of particulate matter (PM, dust) to the air with 12.6%.

The manufacturing phase does not have any significant contributions to environmental impacts. Its highest contribution being eutrophication, which is around 1%.

5.3.4 BC 4 – Convector Electric Fixed

The following table shows the total life cycle environmental impacts of a common fixed electric convector life cycle. The contribution of each life cycle stage to the overall environmental impacts is presented in Table 5.20.

Table 5-20: Life cycle analysis of BC 4 (fixed electric heater) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	324	60	384	127	142 510	66	33	33	143 054
of which, electricity (in primary MJ)	MJ	40	36	76	0	142 507	0	2	-2	142 581
Water (process)	ltr	17	1	17	0	9 501	0	1	-1	9 517
Water (cooling)	ltr	205	17	222	0	380 018	0	12	-12	380 228
Waste, non-haz./ landfill	g	5 911	201	6 112	82	165 289	1 063	8	1 055	172 538
Waste, hazardous/ incinerated	g	13	0	13	2	3 284	51	1	50	3 348
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO_2 eq.	19	3	22	9	6 219	5	1	4	6 254
Ozone Depletion, emissions	mg R-11 eq.	Negligible								
Acidification, emissions	g SO_2 eq.	71	14	85	26	36 696	10	2	8	36 815
Volatile Organic Compounds (VOC)	g	1	0	1	1	54	0	0	0	56
Persistent Organic Pollutants (POP)	ng i-Teq	94	1	95	0	935	7	0	7	1 038
Heavy Metals	mg Ni eq.	14	2	16	4	2 445	19	0	19	2 484
PAHs	mg Ni eq.	13	0	13	6	281	0	0	0	299
Particulate Matter (PM, dust)	g	17	2	20	233	784	99	0	99	1 135
Emissions (Water)										
Heavy Metals	mg Hg/20	17	0	17	0	919	5	0	5	941
Eutrophication	g PO_4	4	0	4	0	4	0	0	0	8
Persistent Organic Pollutants (POP)	ng i-Teq	Negligible								

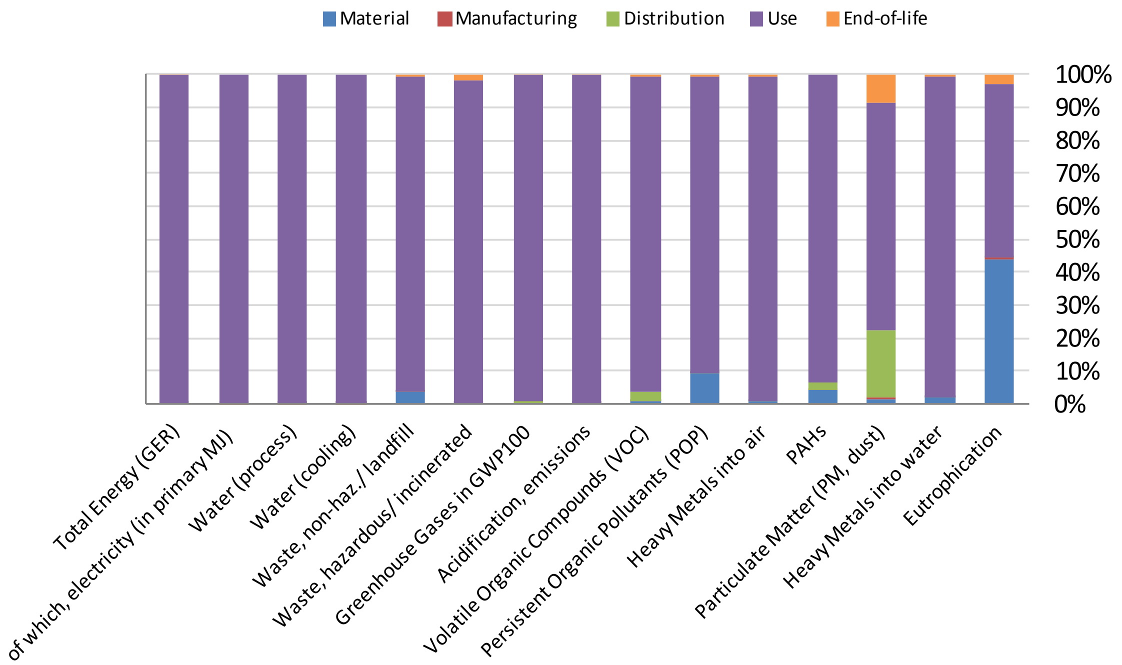

Figure 5-4: Distribution of the BC4's (fixed electric heater) environmental impacts by life cycle phase

Several observations can be made based on this analysis:

- The use phase is clearly the predominant phase, 15 out of the 17 impacts due to the fixed electric convector occur mostly during this phase:
  - Total energy (GER): 99.6%
  - Electricity consumption: 99.9%
  - Water (process): 99.8%
  - Water (cooling): 99.9%
  - Waste, non-hazardous / landfill: 95.8%
  - Waste, hazardous / incinerated: 98.1%
  - Greenhouse gas emissions: 99.4%
  - Acidification: 99.7%
  - Volatile organic compounds: 95.8%
  - Persistent Organic Pollutants: 90.1%
  - Heave metals into air: 98.4%
  - PAHs: 93.8%
  - Particulate matter 69.1%
  - Heavy metals to water: 97.7%
  - Eutrophication: 52.8%

With 43.8% of the eutrophication impact occurring during the material acquisition phase, it is the second most important phase. This is mainly due to the production of Ni-Cr alloy and powder coatings. Persistent Organic Pollutants emissions contributes to 9.1%, PAH give 4.3% from the total impacts and the rest impacts are less than 1%.

The results of the EcoReport modelling indicate that 20.5% of the particulate matter emissions (PM, dust) to air occur during the distribution phase.

The end-of-life phase mostly impacts on particulate matter emission (8.7%).

The manufacturing phase has no significant contribution to environmental impacts. Its highest contribution is to particulate matter (PM, dust) and euthrophication, which is less than 1%.

5.3.5 BC 5a – Static Electric Storage Heater

The following table shows the environmental impacts of a common static electric storage heater over its whole life cycle. Table 5.21 presents the contribution of each life cycle stage to the overall environmental impacts.

Table 5-21: Life cycle analysis of BC 5a (static storage heater) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	1 896	525	2 422	207	278 064	1 302	168	1 134	281 827
of which, electricity (in primary MJ)	MJ	201	315	516	0	278 045	0	12	-12	278 550
Water (process)	ltr	328	5	333	0	18 539	0	8	-8	18 865
Water (cooling)	ltr	1 220	147	1 367	0	741 454	0	65	-65	742 756
Waste, non-haz./ landfill	g	59 401	1 723	61 124	115	322 983	22 661	45	22 616	406 837
Waste, hazardous/ incinerated	g	72	0	72	2	6 408	281	7	274	6 755
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO_2 eq.	166	29	195	14	12 135	97	4	93	12 438
Ozone Depletion, emissions	mg R-11 eq.					Negligible				
Acidification, emissions	g SO_2 eq.	568	126	694	40	71 602	194	10	184	72 520
Volatile Organic Compounds (VOC)	g	15	0	15	3	105	6	0	6	128
Persistent Organic Pollutants (POP)	ng i-Teq	988	6	994	1	1 832	156	0	156	2 982
Heavy Metals	mg Ni eq.	265	14	279	6	4 773	379	0	379	5 437
PAHs	mg Ni eq.	7	0	7	9	548	0	1	-1	563
Particulate Matter (PM, dust)	g	1 419	19	1 439	479	1 544	1 765	1	1 764	5 225
Emissions (Water)										
Heavy Metals	mg Hg/20	311	0	311	0	1 796	107	0	107	2 213
Eutrophication	g PO_4	14	0	15	0	9	6	0	6	29
Persistent Organic Pollutants (POP)	ng i-Teq					Negligible				

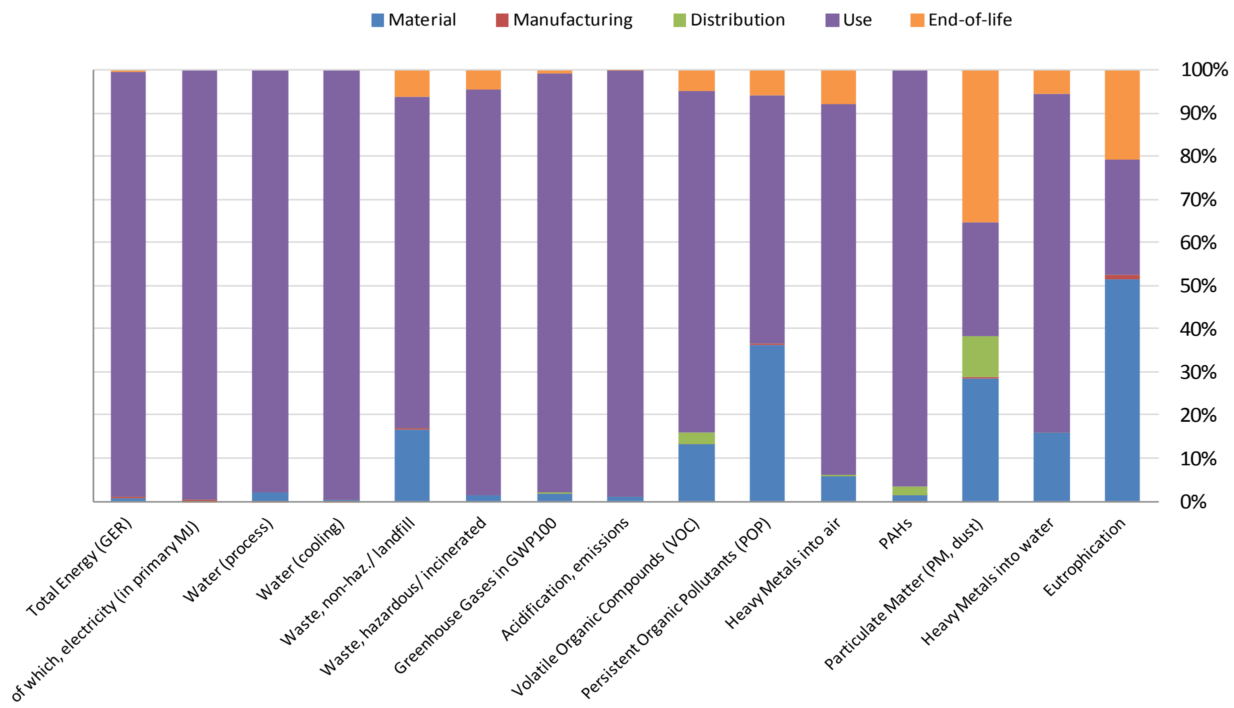

Figure 5-5: Distribution of the BC 5a's (static storage heater) environmental impacts by life cycle phase

Several observations can be made based on this analysis:

- The use phase is the predominant phase. The following 13 out of 17 impacts due to the static electric storage heater occur mostly during this phase :
  - Total energy (GER): 98.4%
  - Electricity consumption: 99.8%
  - Water (process): 98.0%
  - Water (cooling): 99.8%
  - Waste, non-haz/landfill: 76.7%
  - Waste, hazardous/ incinerated: 94.0%
  - Greenhouse gas emissions: 97.2%
  - Acidification: 98.5%
  - Volatile Organic Compounds (VOC): 79.2%
  - Persistent Organic Pollutants (POP): 57.6%
  - Heavy metals to air: 86.0%
  - PAHs: 96.8%
  - Heavy metals into water: 78.6%

The material acquisition phase mostly impacts the Eutrophication with 51.6% and Persistent Organic Pollutants (POP) with a contribution of 36.4%. This is mainly due to the production of Ni-Cr alloy and powder coatings. The material acquisition phase also contributes to 28.4% of particulate matter emissions, 16.5% of Waste (non-hazardous/landfill), 15.9% of heavy metals emission to water and 13.1% Volatile Organic Compounds (VOC) emissions.

The results of the EcoReport modelling indicate that 9.6% of the particulate matter emissions occur during the distribution phase.

The end-of-life phase mostly impacts on the emission of particulate matter (PM, dust) to air with a contribution of 35.3%. The end-of-life phase also contributes to 21.8% to eutrophication, 4.8% to waste, hazardous/incinerated and 6.3% to waste, non-hazardous/landfill.

The manufacturing phase does not have any significant contributions to environmental impacts.

5.3.6 BC 5b – Dynamic Electric Storage Heater

The following table shows the environmental impacts of a common dynamic electric storage heater over its whole life cycle. Table 5.22 presents the contribution of each life cycle stage to the overall environmental impacts.

Table 5-22: Life cycle analysis of BC 5b (dynamic storage heater) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	2 340	648	2 988	240	278 070	1 607	207	1 400	282 698
of which, electricity (in primary MJ)	MJ	248	389	637	0	278 046	0	14	-14	278 670
Water (process)	Ltr	405	6	411	0	18 540	0	10	-10	18 942
Water (cooling)	Ltr	1 505	182	1 687	0	741 457	0	80	-80	743 064
Waste, non-haz./ landfill	G	73 298	2 126	75 424	128	323 126	27 964	56	27 908	426 586
Waste, hazardous/ incinerated	G	88	0	88	3	6 408	347	9	338	6 836
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	205	36	241	16	12 136	120	5	115	12 508
Ozone Depletion, emissions	mg R-11 eq.	Negligible								
Acidification, emissions	g SO2 eq.	700	156	856	46	71 604	239	12	227	72 733
Volatile Organic Compounds (VOC)	G	18	0	18	4	105	7	0	7	134
Persistent Organic Pollutants (POP)	ng i-Teq	1 219	7	1 226	1	1 835	192	0	192	3 254
Heavy Metals	mg Ni eq.	328	17	344	7	4 774	468	0	468	5 592
PAHs	mg Ni eq.	9	0	9	10	548	0	1	-1	566
Particulate Matter (PM, dust)	G	1 752	24	1 776	581	1 547	2 178	2	2 177	6 081
Emissions (Water)										
Heavy Metals	mg Hg/20	383	0	383	0	1 797	131	0	131	2 311
Eutrophication	g PO4	18	0	18	0	9	8	0	7	34
Persistent Organic Pollutants (POP)	ng i-Teq	Negligible								

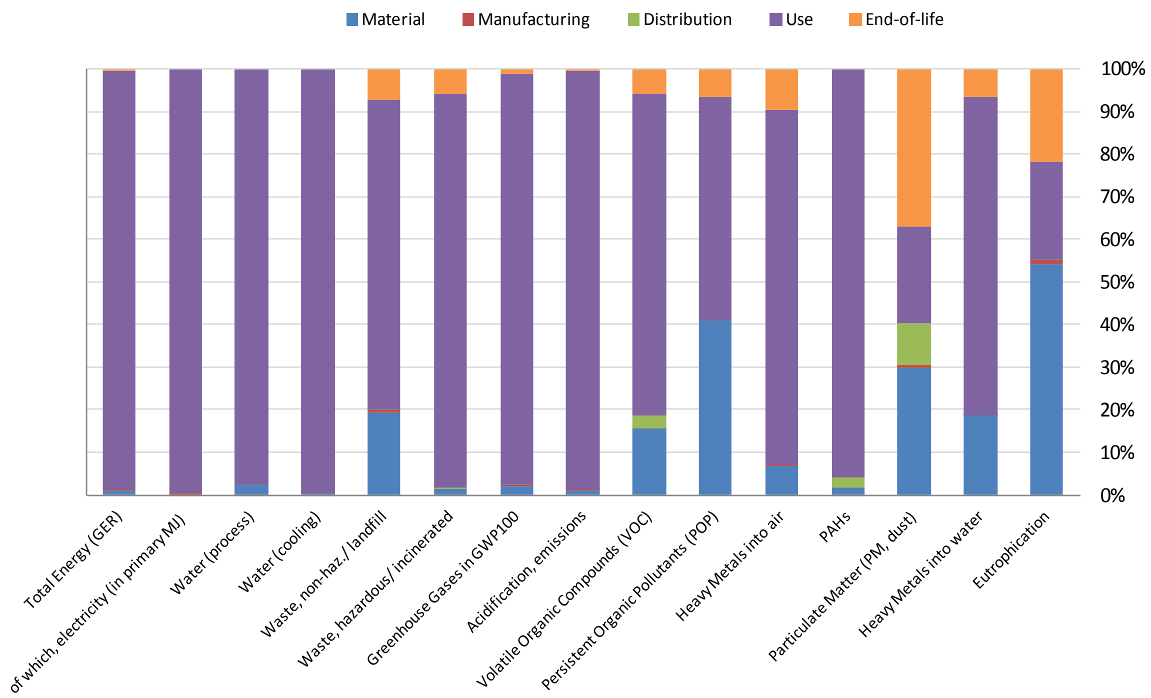

Figure 5-6: Distribution of the BC 5b's (dynamic storage heater) environmental impacts by life cycle phase

Several observations can be made based on this analysis:

- The use phase is the predominant phase. The following 13 out of 17 impacts due to the static electric storage heater occur mostly during this phase :
  - Total energy (GER): 98.1%
  - Electricity consumption: 99.7%
  - Water (process): 97.5%
  - Water (cooling): 99.7%
  - Waste, non-haz/landfill: 72.7%
  - Waste, hazardous/ incinerated: 92.7%
  - Greenhouse gas emissions: 96.5%
  - Acidification: 99.2%
  - Volatile Organic Compounds (VOC): 75.6%
  - Persistent Organic Pollutants (POP): 52.5%
  - Heavy metals to air: 83.3%
  - PAHs: 96.2%
  - Heavy metals into water: 74.9%

The material acquisition phase mostly impacts the Eutrophication with 54.3% and Persistant Organic Pollutants (POP) with a contribution of 40.8%. This is mainly due to the production of Ni-Cr alloy and powder coatings. The material acquisition phase also contributes to 29.9% of particulate matter emissions, 19.3% of Waste (non-hazardous/landfill), 18.7% of heavy metals emission to water and 15.4% Volatile Organic Compounds (VOC) emissions.

The results of the EcoReport modelling indicate that 9.9% of particulate matter emissions occur during the distribution phase.

The end-of-life phase mostly impacts on the emission of particulate matter (PM, dust) to air with a contribution of 37.2%. The end-of-life phase also contributes to 22.9% to eutrophication, 5.9% to waste hazardous/incinerated and 7.4% to waste, non-hazardous/landfill.

The manufacturing phase does not have any significant contributions to environmental impacts.

5.3.7 BC 6a – Electric Underfloor Heating

The following table shows the total life cycle environmental impacts of a common electric underfloor heating (primary heating) covering a surface of 15 m^2. The contribution of each life cycle stage to the overall environmental impacts is presented in Figure 5-4.

Table 5-23: Life cycle analysis of BC 6a (primary underfloor heating) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	93	40	133	85	475 021	69	40	28	475 267
of which, electricity (in primary MJ)	MJ	12	24	36	0	475 020	0	3	-3	475 053
Water (process)	ltr	20	0	20	0	31 668	0	2	-2	31 686
Water (cooling)	ltr	94	11	105	0	1 266 721	0	16	-16	1 266 810
Waste, non-haz./ landfill	g	2 640	127	2 767	65	550 786	1 141	11	1 130	554 748
Waste, hazardous/ incinerated	g	5	0	5	1	10 946	0	2	-2	10 950
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO_2 eq.	4	2	6	6	20 730	5	1	4	20 747
Ozone Depletion, emissions	mg R-11 eq.	negligible								
Acidification, emissions	g SO_2 eq.	36	10	45	18	122 318	11	2	9	122 390
Volatile Organic Compounds (VOC)	g	0	0	0	1	179	0	0	0	180
Persistent Organic Pollutants (POP)	ng i-Teq	13	0	13	0	3 114	8	0	8	3 135
Heavy Metals	mg Ni eq.	10	0	10	3	8 150	20	0	20	8 183
PAHs	mg Ni eq.	7	0	7	4	936	0	0	0	946
Particulate Matter (PM, dust)	g	5	1	6	103	2 613	107	0	107	2 829
Emissions (Water)										
Heavy Metals	mg Hg/20	25	0	25	0	3 063	5	0	5	3 094
Eutrophication	g PO_4	1	0	1	0	15	0	0	0	16
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

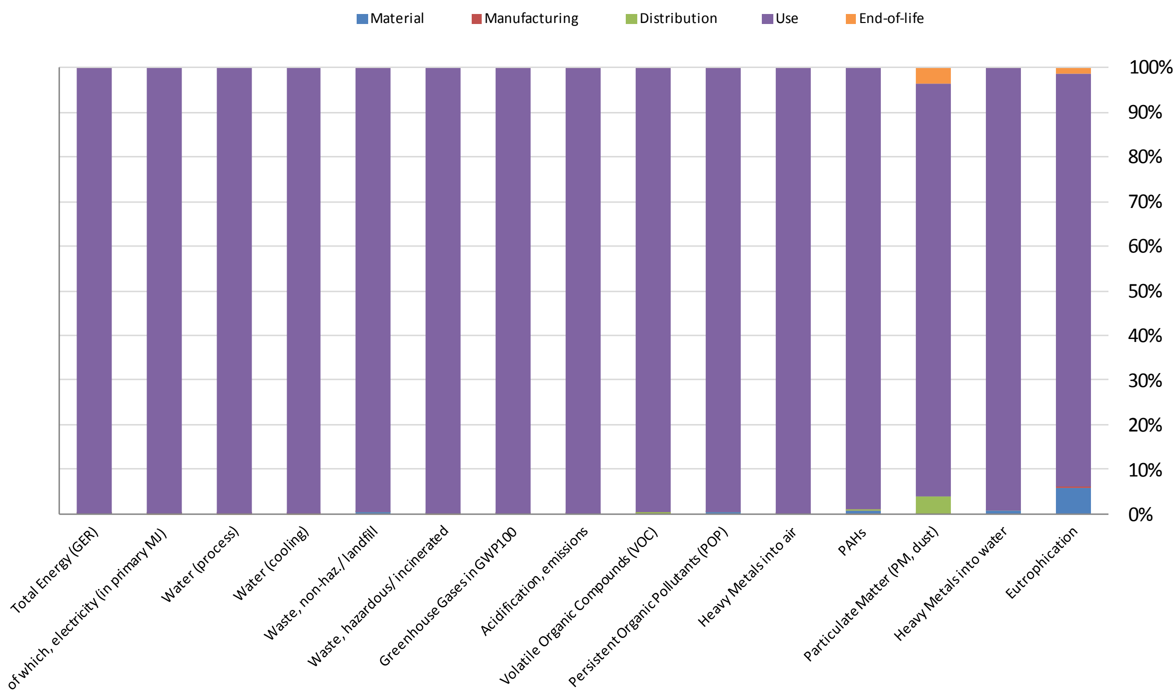

Figure 5-7: Distribution of the BC 6a's (primary underfloor heating) environmental impacts by life cycle phase

Several observations can be made based on this analysis:

- The use phase is clearly the predominant phase. All the described impacts due to the electric underfloor heating occur mostly during this phase.
  - Total energy (GER): 99.9%
  - Electricity consumption: 100.0%
  - Water (process): 99.9%
  - Water (cooling): 100.0%
  - Waste, non-hazardous / landfill: 99.3%
  - Waste, hazardous / incinerated: 99.9%
  - Greenhouse gas emissions: 99.9%
  - Acidification: 99.9%
  - Volatile organic compounds: 99.4%
  - Persistent Organic Pollutants: 99.3%
  - Heavy metals to air: 99.6%
  - PAHs: 98.9%
  - Particulate matter (PM, dust): 92.4%

- Heavy metals to water: 99.0%
- Eutrophication: 92.5%

The exceptionally high contribution of the use phase is due to the very long life span of the appliance (40 years), as well as its low weight (1.3 kg). Indeed, a longer life implies that the heater is used for several heating seasons and thus higher energy consumption during the entire life cycle. Additionally, a lower weight involves lower impacts in the material extraction and production phases. Distribution and end-of-life impacts are also influenced by the product weight. However, it should be noted that the materials used for concrete and floor covering are not accounted in this life cycle analysis.

Material acquisition phase constitutes 5.9% of the total eutrophication impacts. This is mainly due to the production of glass fibre and PVC.

The end-of-life phase contributes mostly to the emission of particulate matter (PM, dust), about 3.8%. It also contributes to eutrophication with a share of 1.9%.

The manufacturing phase has no significant contribution to environmental impacts. Its highest contribution is to eutrophication, which is 0.1%.

5.3.8 BC 6b – Electric Underfloor Heating

The following table shows the total life cycle environmental impacts of a common electric underfloor heating (secondary heating) covering a surface of 4 m^2. The contribution of each life cycle stage to the overall environmental impacts is presented in Figure 5-4.

Table 5-24: Life cycle analysis of BC 6b (secondary underfloor heating) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	93	40	133	85	54 601	69	40	28	54 847
of which, electricity (in primary MJ)	MJ	12	24	36	0	54 600	0	3	-3	54 633
Water (process)	ltr	20	0	20	0	3 640	0	2	-2	3 658
Water (cooling)	ltr	94	11	105	0	145 601	0	16	-16	145 690
Waste, non-haz./ landfill	g	2 640	127	2 767	65	63 333	1 141	11	1 130	67 295
Waste, hazardous/ incinerated	g	5	0	5	1	1 258	0	2	-2	1 262
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	4	2	6	6	2 383	5	1	4	2 400
Ozone Depletion, emissions	mg R-11 eq.	negligible								
Acidification, emissions	g SO2 eq.	36	10	45	18	14 060	11	2	9	14 132
Volatile Organic Compounds (VOC)	g	0	0	0	1	21	0	0	0	22
Persistent Organic Pollutants (POP)	ng i-Teq	13	0	13	0	358	8	0	8	380
Heavy Metals	mg Ni eq.	10	0	10	3	937	20	0	20	970
PAHs	mg Ni eq.	7	0	7	4	108	0	0	0	118
Particulate Matter (PM, dust)	g	5	1	6	103	300	107	0	107	516
Emissions (Water)										
Heavy Metals	mg Hg/20	25	0	25	0	352	5	0	5	383
Eutrophication	g PO4	1	0	1	0	2	0	0	0	3
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

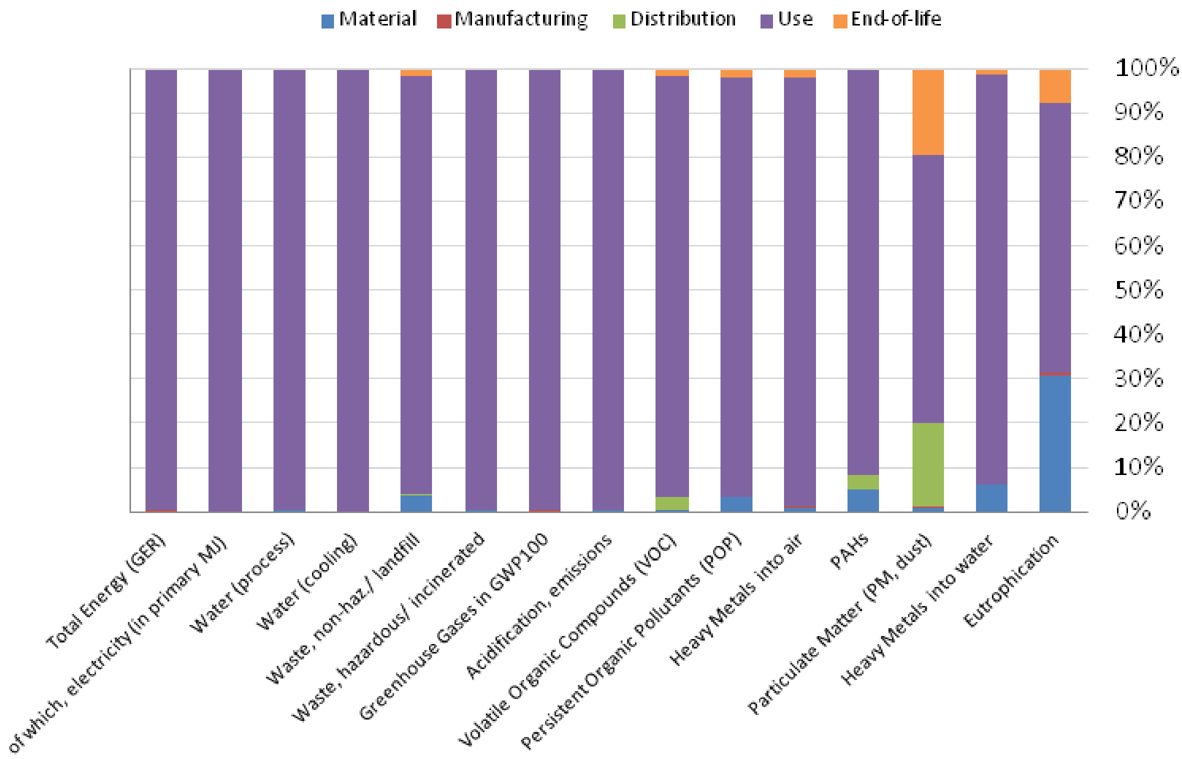

Figure 5-8: Distribution of the BC 6b's (secondary underfloor heating) environmental impacts by life cycle phase

Several observations can be made based on this analysis:

- The use phase is clearly the predominant phase. All the described impacts due to the electric underfloor heating occur mostly during this phase.
  - Total energy (GER): 99.6%
  - Electricity consumption: 99.9%
  - Water (process): 99.5%
  - Water (cooling): 99.9%
  - Waste, non-hazardous / landfill: 94.1%
  - Waste, hazardous / incinerated: 99.7%
  - Greenhouse gas emissions: 99.3%
  - Acidification: 99.5%
  - Volatile organic compounds: 94.9%
  - Persistent Organic Pollutants: 94.3%
  - Heavy metals to air: 96.6%
  - PAHs: 91.2%

- Particulate matter (PM, dust): 58.2%
- Heavy metals to water: 92.0%
- Eutrophication: 58.7%

The exceptionally high contribution of the use phase is due to the very long life span of the appliance (40 years), as well as its low weight (1.3 kg). Indeed, a longer life implies that the heater is used for several heating seasons and thus higher energy consumption during the entire life cycle. Additionally, a lower weight involves lower impacts in the material extraction and production phases. Distribution and end-of-life impacts are also influenced by the product weight. However, it should be noted that the materials used for concrete and floor covering are not accounted in this life cycle analysis.

Material acquisition phase constitutes 32.3% of the total eutrophication impacts. This is mainly due to the production of glass fibre and PVC.

The end-of-life phase contributes mostly to the emission of particulate matter (PM, dust), about 20.8%. It also contributes to eutrophication with a share of 10.5%.

The manufacturing phase has no significant contribution to environmental impacts. Its highest contribution is to eutrophication, which is less than 1%.

5.3.9 BC 7– Warm Air Unit Heater

The following table shows the environmental impacts of a common warm air heater over its whole life cycle. Table 5.25 presents the contribution of each life cycle stage to the overall environmental impacts.

Table 5-25: Life cycle analysis of BC 7 (warm industrial unit heaters) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	12 918	2 538	15 456	1 717	2 380 469	3 706	137	3 569	2 401 211
of which, electricity (in primary MJ)	MJ	3 667	1 512	5 179	4	66 359	0	7	-7	71 535
Water (process)	ltr	3 451	22	3 473	0	4 455	0	5	-5	7 924
Water (cooling)	ltr	728	697	1 424	0	176 834	0	40	-40	178 218
Waste, non-haz./ landfill	g	393 455	8 969	402 423	732	80 904	66 060	28	66 032	550 091
Waste, hazardous/ incinerated	g	2 919	0	2 919	15	1 557	174	4	170	4 661
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO_2 eq.	951	142	1 093	102	130 847	277	5	272	132 314
Ozone Depletion, emissions	mg R-11 eq.	negligible								
Acidification, emissions	g SO_2 eq.	4 107	612	4 719	312	54 397	545	9	535	59 964
Volatile Organic Compounds (VOC)	g	74	1	75	31	1 715	16	0	15	1 836
Persistent Organic Pollutants (POP)	ng i-Teq	6 279	77	6 356	4	498	454	0	454	7 312
Heavy Metals	mg Ni eq.	1 486	180	1 666	37	1 217	1 084	0	1 084	4 003
PAHs	mg Ni eq.	639	0	639	69	264	0	0	0	971
Particulate Matter (PM, dust)	g	1 242	94	1 336	5 127	2 084	4 868	1	4 868	13 415
Emissions (Water)										
Heavy Metals	mg Hg/20	2 492	0	2 492	1	452	307	0	307	3 253
Eutrophication	g PO_4	107	1	108	0	3	18	0	17	128
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

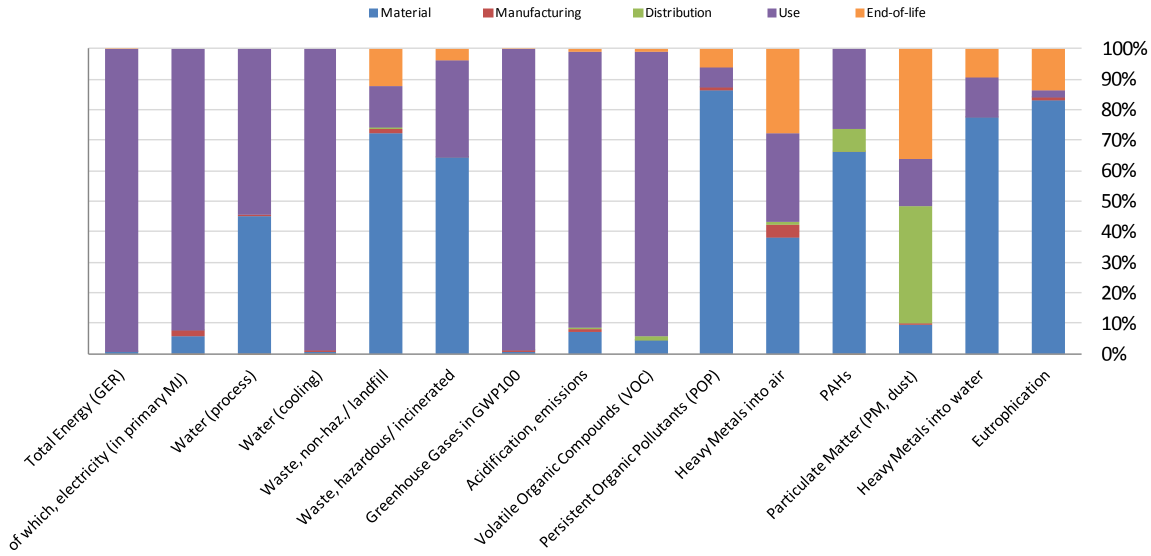

Figure 5-9: Distribution of the BC 7's (warm industrial unit heaters) environmental impacts by life cycle phase

The use phase is clearly the predominant phase contributing to the environmental impacts of a warm air unit heater's life cycle.

Once again, these impacts are mainly due to steel and powder coatings production.

- The following 7 out of the 17 impacts related to the appliance's life cycle occur mostly during the use phase:
  - Total energy (GER): 99.1%
  - Electricity consumption: 92.3%
  - Water (process): 54.5%
  - Water (cooling): 99.2%
  - Greenhouse gas emissions: 98.9%
  - Acidification, emissions: 90.5%
  - Volatile organic compounds: 93.4%
- The following 7 out of the 17 impacts related to the appliance's life cycle occur mostly during the material acquisition phase.
  - Waste, non-hazardous / landfill: 72.2%
  - Waste, hazardous / incinerated: 64.1%
  - Persistent Organic Pollutants: 86.2%
  - Eutrophication : 83.3%
  - Heavy metals to air: 37.9%
  - PAHs: 66.4%
  - Heavy metals to water: 77.3%

The results of the EcoReport modelling indicate that 38.3% of the particulate matter emissions (PM, dust) occur during the distribution phase. The end-of-life's highest contributions are 36.4% of particulate matter, 27.6% of heavy metals into air and 13.7% of eutrophication. The manufacturing phase does not contribute much to the overall environmental impacts. Its highest contribution is 4.6% of the total heavy metal emissions to air.

5.3.10 BC 8a – Luminous Radiant Heater

The following table shows the environmental impacts of a common gas-fired luminous radiant heater over its whole life cycle. Table 5.26 presents the contribution of each life cycle stage to the overall environmental impacts.

Table 5-26: Life cycle analysis of BC 8a (luminous radiant heater) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	1 067	128	1 195	274	1 160 987	205	5	200	1 162 655
of which, electricity (in primary MJ)	MJ	339	76	416	1	3 831	0	0	0	4 247
Water (process)	ltr	239	1	240	0	258	0	0	0	497
Water (cooling)	ltr	353	35	388	0	10 210	0	0	0	10 598
Waste, non-haz./ landfill	g	21 652	458	22 111	142	4 659	3 678	0	3 678	30 589
Waste, hazardous/ incinerated	g	278	0	278	3	91	0	0	0	371
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	71	7	78	18	64 150	15	0	15	64 261
Ozone Depletion, emissions	mg R-11 eq.	negligible								
Acidification, emissions	g SO2 eq.	319	31	350	52	19 638	30	0	30	20 070
Volatile Organic Compounds (VOC)	g	5	0	5	4	848	1	0	1	858
Persistent Organic Pollutants (POP)	ng i-Teq	313	4	317	1	28	25	0	25	372
Heavy Metals	mg Ni eq.	81	10	92	7	129	60	0	60	288
PAHs	mg Ni eq.	25	0	25	11	103	0	0	0	139
Particulate Matter (PM, dust)	g	65	5	70	684	1 404	267	0	267	2 424
Emissions (Water)										
Heavy Metals	mg Hg/20	176	0	176	0	26	17	0	17	219
Eutrophication	g PO4	11	0	11	0	0	1	0	1	12
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

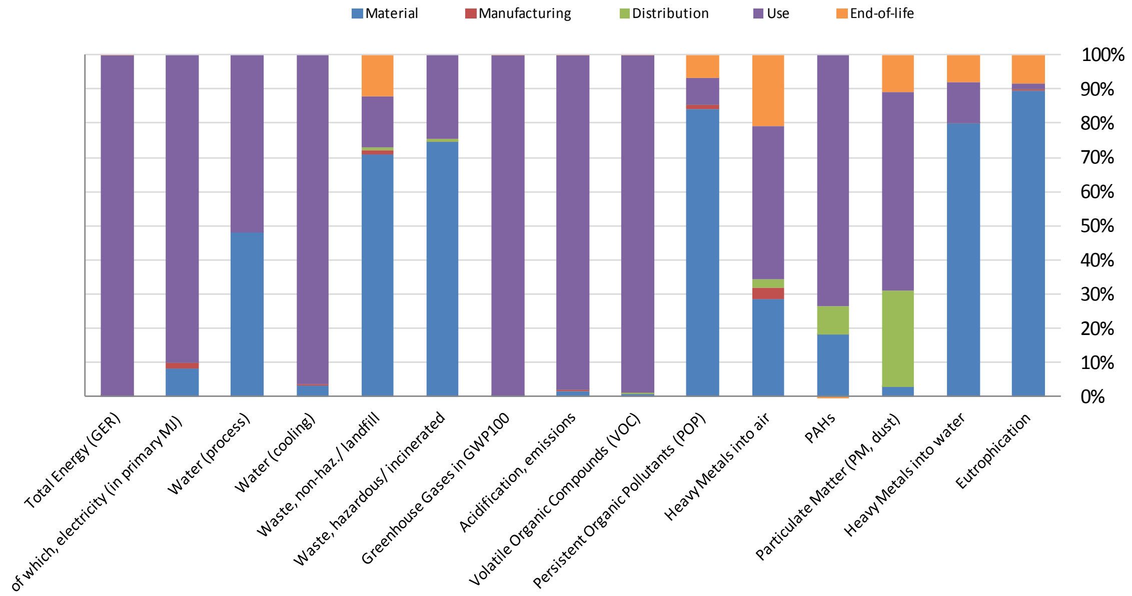

Figure 5-10: Distribution of the BC 8a's (luminous radiant heater) environmental impacts by life cycle phase

The use phase is clearly the predominant phase contributing to the environmental impacts of a luminous radiant heater's life cycle.

Once again, these impacts are mainly due to steel powder coatings production.

- The following 10 out of the 17 impacts related to the appliance's life cycle occur mostly during the use phase:
  - Total energy (GER): 99.9%
  - Electricity consumption: 90.2%
  - Water (process): 51.8%
  - Water (cooling): 96.3%
  - Greenhouse gas emissions: 99.8%
  - Acidification, emissions: 97.9%
  - Volatile organic compounds: 98.9%
  - Heavy Metals to air: 44.8%
  - PAHs: 73.7%
  - Particulate Matter (PM, dust): 57.9%
- The following 5 out of the 17 impacts related to the appliance's life cycle occur mostly during the material acquisition phase:
  - Waste, non-hazardous / landfill: 70.8%
  - Waste, hazardous / incinerated: 74.7%

- Persistent Organic Pollutants: 84.2%
- Heavy Metals to water: 80.1%
- Eutrophication: 89.5%

The results of the EcoReport modelling indicate that 28.2% of the particulate matter emissions (PM, dust) occur during the distribution phase. The end-of-life phase's contribution to overall environmental impacts is significant. Its highest contribution is 11% of particulate matter emissions and 20.8% of heavy metal emissions to air.

The manufacturing phase has a lower contribution to overall impacts. Its highest contribution is 3.5% of heavy metals into air.

5.3.11 BC 8b – Radiant Tube Heater

The following table shows the environmental impacts of a common gas-fired radiant heater over its whole life cycle. Table 5.27 presents the contribution of each life cycle stage to the overall environmental impacts.

Table 5-27: Life cycle analysis of BC8b (radiant tube heater) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	4 831	587	5 419	1 162	1 750 074	922	23	900	1 757 555
of which, electricity (in primary MJ)	MJ	1 534	349	1 883	3	14 462	0	0	0	16 348
Water (process)	ltr	1 071	5	1 076	0	974	0	0	0	2 050
Water (cooling)	ltr	1 582	161	1 742	0	38 531	0	0	0	40 274
Waste, non-haz./ landfill	g	99 328	2 105	101 432	505	17 760	16 550	0	16 550	136 247
Waste, hazardous/ incinerated	g	1 249	0	1 249	10	345	0	0	0	1 605
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	321	33	354	70	96 596	69	2	67	97 087
Ozone Depletion, emissions	mg R-11 eq.	negligible								
Acidification, emissions	g SO2 eq.	1 440	142	1 581	212	31 697	135	2	133	33 624
Volatile Organic Compounds (VOC)	g	21	0	22	21	1 274	4	0	4	1 320
Persistent Organic Pollutants (POP)	ng i-Teq	1 434	20	1 454	3	109	114	0	114	1 680
Heavy Metals	mg Ni eq.	369	47	416	26	314	270	0	270	1 026
PAHs	mg Ni eq.	113	0	113	47	141	0	0	0	301
Particulate Matter (PM, dust)	g	268	22	290	3 418	1 626	1 201	0	1 201	6 536
Emissions (Water)										
Heavy Metals	mg Hg/20	794	0	794	1	101	77	0	77	972
Eutrophication	g PO4	48	0	48	0	1	4	0	4	53
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

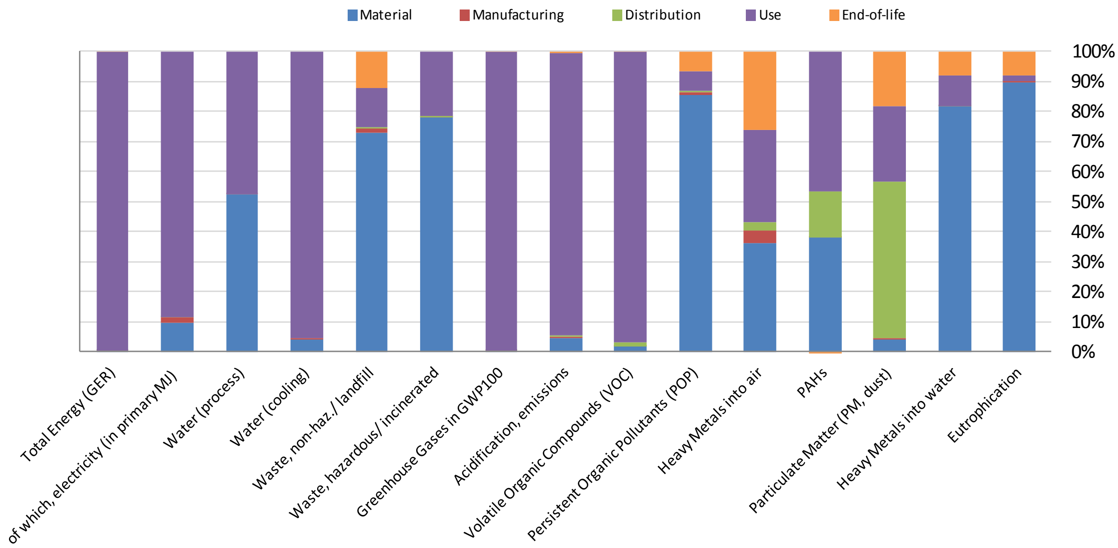

Figure 5-11: Distribution of the BC 8b's (gas-fired radiant tube heater) environmental impacts by life cycle phase

The use phase is clearly the predominant phase contributing to the environmental impacts of a gas radiant heater's life cycle.

Once again, these impacts are mainly due to steel powder coatings production.

- The following 7 out of the 17 impacts related to the appliance's life cycle occur mostly during the use phase:
  - Total energy (GER): 99.7%
  - Electricity consumption: 88.5%
  - Water (cooling): 95.7%
  - Greenhouse gas emissions: 99.5%
  - Acidification, emissions: 94.3%
  - Volatile organic compounds: 96.5%
  - PAHs: 46.8%
- The following 7 out of the 17 impacts related to the appliance's life cycle occur mostly during the material acquisition phase:
  - Water (process): 52.2%
  - Waste, non-hazardous /landfill: 72.9%
  - Waste, hazardous /incinerated: 77.8%
  - Persistent Organic Pollutants: 85.4%
  - Heavy metals into air: 36.0%
  - Heavy metals to water: 81.6%
  - Eutrophication: 89.6%

The results of the EcoReport modelling indicate that 52.3% of the particulate matter emissions (PM, dust) occur during the distribution phase. The end-of-life phase's contribution to overall environmental impacts is significant. Its highest contribution is 26.3% to heavy metals into air and 18.4% of particulate matter emissions. The manufacturing phase has a lower contribution to overall impacts. Its highest contribution is 4.6% of heavy metals into air.

5.3.12 BC 9 – Air Curtains

The following table shows the environmental impacts of a common air curtain using hot water from a gas-fired boiler as the heat source over its whole life cycle. Table 5.28 presents the contribution of each life cycle stage to the overall environmental impacts.

Table 5-28: Life cycle analysis of BC 9 (air curtain) using the EcoReport tool

Life Cycle phases -->		PRODUCTION			DISTRI-BUTION	USE	END-OF-LIFE			TOTAL
	Unit	Material	Manuf.	Total			Disposal	Recycl.	Total	
Total Energy (GER)	MJ	2 332	608	2 940	351	291 381	836	15	820	295 492
of which, electricity (in primary MJ)	MJ	416	362	778	1	35 708	0	1	-1	36 486
Water (process)	ltr	176	5	181	0	2 382	0	1	-1	2 562
Water (cooling)	ltr	150	167	317	0	95 203	0	6	-6	95 515
Waste, non-haz./ landfill	g	106 265	2 162	108 427	174	42 476	14 933	4	14 929	166 006
Waste, hazardous/ incinerated	g	201	0	201	3	825	24	1	23	1 052
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	182	34	216	22	15 699	62	0	62	16 000
Ozone Depletion, emissions	mg R-11 eq.	negligible								
Acidification, emissions	g SO2 eq.	702	147	848	66	13 331	123	1	122	14 367
Volatile Organic Compounds (VOC)	g	12	0	12	6	203	3	0	3	224
Persistent Organic Pollutants (POP)	ng i-Teq	1 428	19	1 447	1	248	103	0	103	1 799
Heavy Metals	mg Ni eq.	315	45	360	9	663	244	0	244	1 276
PAHs	mg Ni eq.	68	0	68	14	125	0	0	0	208
Particulate Matter (PM, dust)	g	264	23	286	923	1 065	1 094	0	1 094	3 368
Emissions (Water)										
Heavy Metals	mg Hg/20	370	0	370	0	234	69	0	69	673
Eutrophication	g PO4	7	0	7	0	1	4	0	4	12
Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

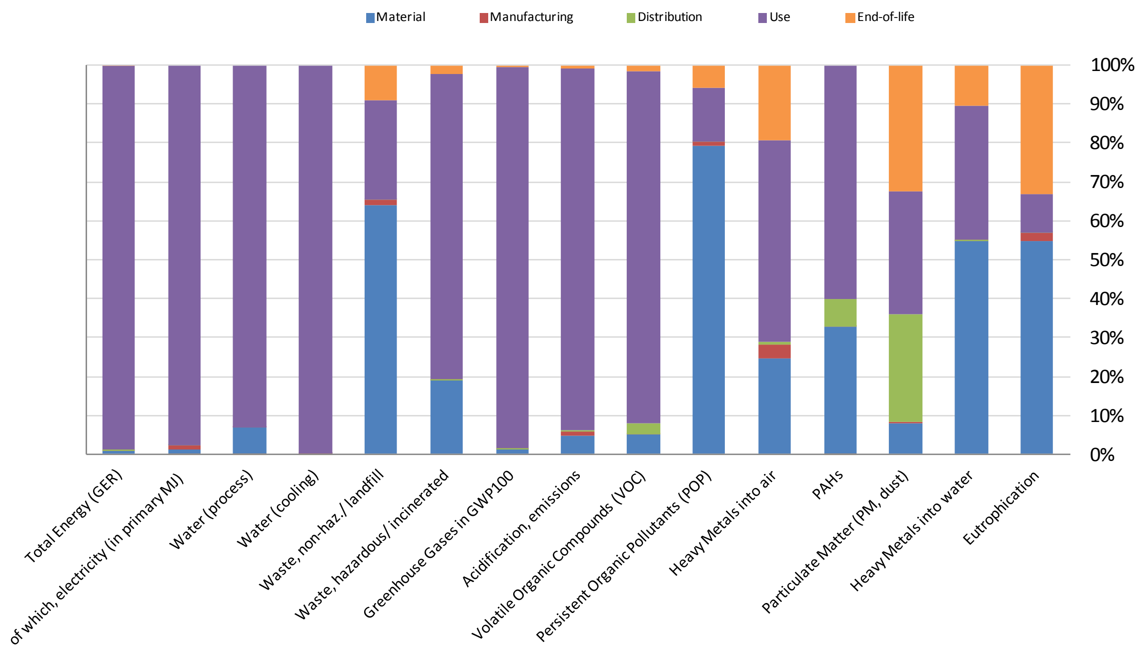

Figure 5-12: Distribution of the BC 9's (air curtain) environmental impacts by life cycle phase

Several observations can be made based on this analysis:

- The use phase is clearly the predominant phase, 10 of 17 occur mostly during this phase.
  - Total energy (GER): 98.6%
  - Electricity consumption: 97.9%
  - Water (process): 93.0%
  - Water (cooling): 99.7%
  - Waste, hazardous / incinerated: 78.4%
  - Greenhouse gas emissions: 98.1%
  - Acidification: 92.8%
  - Volatile organic compounds: 90.6%
  - Heavy metals to air: 52.0%
  - PAHs: 60.2%

The highest contribution in the material acquisition phase comes from Persistent Organic Pollutants with 79.4%, waste non-hazardous/landfill with 64.0%, heavy metals into air 54.9% and eutrophication with 54.9%.

The distribution phase highest contribution is impact of 27.4% of particulate matter emissions.

The end-of-life phase contributes mostly to the emission of particulate matter (PM, dust), about 32.5%. It also contributes to eutrophication with a share of 33.4%.

The manufacturing phase has no significant contribution to environmental impacts. Its highest contribution is to heavy metals into air, which is less than 4%.

As earlier stated, the primary functionality of the air curtain is to separate indoor (heated space inside a building in present case) and outdoor climatic zones. In case of the selected base case, the stakeholders estimated that approximately 9 600 kWh[27] of heat will be lost through the air curtain opening in an year. The loss of heat energy will be taken into account (on top of the energy consumed by the air curtain itself) during the selection of BATs for air curtains in Task 6.

5.4 Base-Case Life Cycle Costs

The life cycle cost calculation (LCC) for the local room heaters Base-Cases in the year 2009 requires the following data input:

- Average sales prices of the Base-Cases (in Euro)
- Average installation costs, if any (in Euro)
- Average repair and maintenance costs, if any (in Euro)
- Average electricity or fuel rates (Euro Cent/kWh)
- Average lifetime of the Base-Case (in years)
- Average annual energy consumption including on-mode, standby and off-mode (in kWh)

[27] The lost heat from the building via the air curtain opening is assumed to be generated using a gas-fired boiler with a typical efficiency of 80%. Hence, 9 600 kWh/year heat loos represents approximately 12 000 kWh/year loss in primary energy.

5.4.1 Residential appliances

The Life Cycle Costs (LCC) of the six residential Base-Cases are presented in Table 5-29.

Table 5-29: EcoReport outcomes of the LCC calculations for the six domestic Base-Cases

	BC 1		BC 2		BC 3		BC 4		BC 5a		BC 5b		BC 6a		BC 6b	
	[€]	%	[€]	%	[€]	%	[€]	%	[€]	%	[€]	%	[€]	%	[€]	%
Product price	600	*24*	600	*18*	30	*6*	120	*6*	375	*16*	600	*22*	560	*12*	150	*22*
Installation, acquisition costs	250	*10*	250	*8*	0	*0*	30	*2*	80	*3*	80	*3*	375	*8*	100	*15*
Fuel (gas, oil)	1 375	*55*	2 128	*65*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*
Electricity	0	*0*	0	*0*	505	*94*	1 730	*92*	1 961	*81*	2 001	*75*	3 649	*80*	419	*63*
Repair and maintenance costs	292	*12*	292	*9*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*
Total	**2 518**	*100*	**3 270**	*100*	**535**	*100*	**1 880**	*100*	**2 416**	*100*	**2 681**	*100*	**4 584**	*100*	**669**	*100*

There are similarities between BC 3, BC 4 concerning the life cycle cost. The product price represents less than 10% of the LCC and the electricity price more than 90% for these Base-Cases. For BC 1 and BC2, repair and maintenance costs are significant (up to 12%), whereas this is not the case for BC 3, BC 4, BC 5a, BC 5b, BC 6a and BC 6b. From a consumer point of view, an increase in energy efficiency will be less visible for Base-Cases: BC 1, BC 2, than the Base-Cases: BC 3, BC 4, BC 5a, BC 5b, BC 6a and BC 6b, as the LCC will be reduced in a smaller proportion.

5.4.2 Non-residential appliances

The Life Cycle Costs (LCC) of the three non-residential Base-Cases are presented in Table 5.30.

Table 5-30: EcoReport outcomes of the LCC calculations for the three non-residential Base-Cases

	BC7		BC8a		BC8b		BC9	
	[€]	%	[€]	%	[€]	%	[€]	%
Product price	3 700	*15*	1 300	*11*	1 900	*11*	2 500	*36*
Installation, acquisition costs	250	*1*	250	*2*	250	*1*	1 000	*14*
Fuel (gas, oil)	18 504	*76*	9 252	*77.3*	13 878	*80*	2 235	*32*
Electricity	680	*3*	42	*0.4*	159	*1*	430	*6*
Repair and maintenance costs	1 134	*5*	1 127	*9.3*	1 134	*7*	811	*12*
Total	**24 268**	*100*	**11 971**	*100*	**17 321**	*100*	**6 977**	*100*

Base-Cases BC 7 and BC 8a and BC 8b have similarities in the breakdown of their life cycle cost. For all three of them, the majority of the LCC can be attributed to the fuel consumption (>75%) whereas a small part is due to the product purchase price (up to 15%). The installation cost for all three of them has almost insignificant contribution to the overall LCC. In case of BC 9, the product price has the main contribution (36%) to the LCC followed closely by the fuel consumption (32%).

5.5 EU Totals

The total EU-27 life cycle environmental and economical impact for all the local room heaters' Base-Cases in the year 2009 requires the following data input:

- EU-27 market (stock) data for the household penetration of the Base-Cases (in 1 000 units)
- EU-27 annual sales for local room heating products (in 1 000 units)

5.5.1 Life Cycle Environmental Impacts

Figure 5-13 and Table 5.31 presents the total environmental impacts of all the Base-Cases at the EU-27 level in 2009. These figures have been calculated in the EcoReport tool by multiplying the environmental impacts of individual Base-Cases with their stock in 2009.

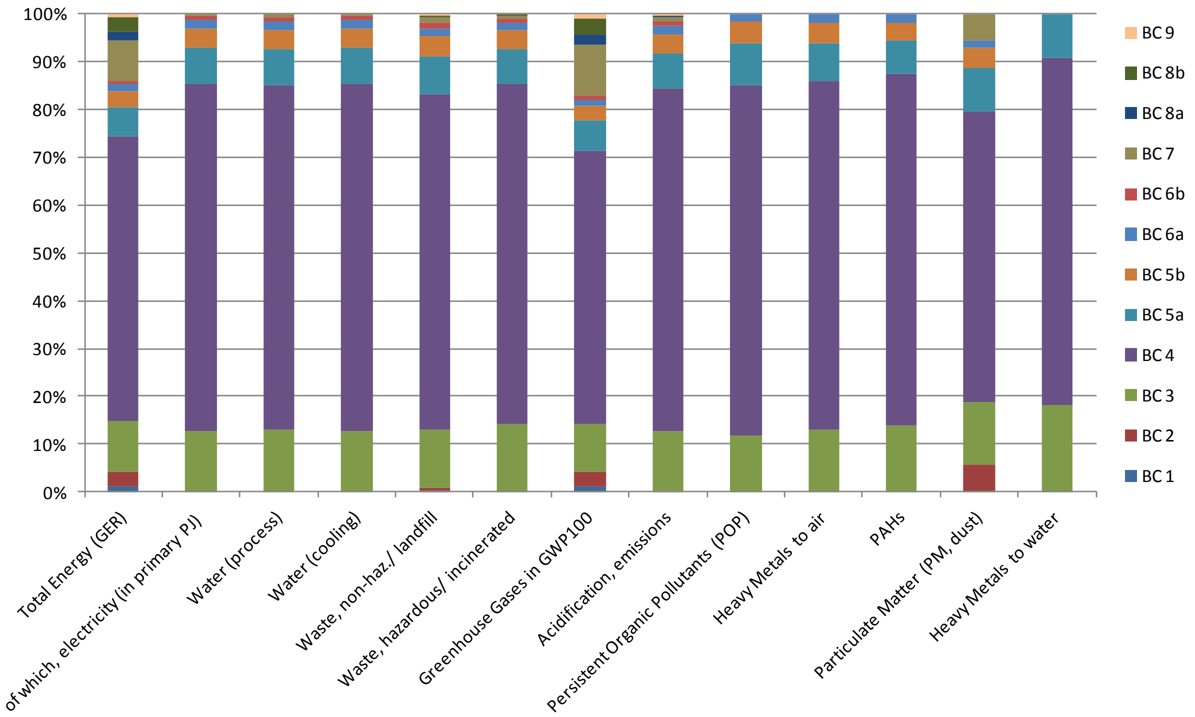

Figure 5-13: Overview of the contribution of individual ENER Lot 20 Base-Cases in the EU-27 to various environmental impact categories

Table 5-31: Environmental impacts of the EU stock of all BCs

Indicator	Unit	BC 1	BC 2	BC 3	BC 4	BC 5a	BC 5b	BC 6a	BC 6b	BC 7	BC 8a	BC 8b	BC 9	Total
Other Resources & Waste														
Total Energy (GER)	PJ	25	62	215	1 225	126	68	31	14	176	35	63	13	**2 053**
of which, electricity (in primary PJ)	TWh	0	0	213	1 219	125	68	31	14	5	0	1	2	**1 678**
Water (process)	mln. m3	0	0	15	81	8	5	2	1	1	0	0	0	**113**
Water (cooling)	mln. m3	0	0	568	3 252	334	182	82	38	13	0	1	4	**4 475**
Waste, non-haz./ landfill	kt	5	10	260	1 496	165	88	37	21	29	1	3	9	**2 125**
Waste, hazardous/ incinerated	kt	0	0	6	29	3	2	1	0	0	0	0	0	**41**
Emissions (Air)														
Greenhouse Gases in GWP100	mt CO_2 eq.	1	3	9	54	6	3	1	1	10	2	3	1	**94**
Ozone Depletion, emissions	t R-11 eq.	Negligible												
Acidification, emissions	kt SO_2 eq.	0	1	55	315	32	18	8	4	4	1	1	1	**440**
Persistent Organic Pollutants (POP)	g i-Teq	0	0	1	9	1	1	0	0	0	0	0	0	**13**
Heavy Metals to air	ton Ni eq.	0	0	4	21	2	1	1	0	0	0	0	0	**29**
PAHs	ton Ni eq.	0	0	0	3	0	0	0	0	0	0	0	0	**4**
Particulate Matter (PM, dust)	kt	0	1	2	11	2	1	0	0	1	0	0	0	**18**
Emissions (Water)														
Heavy Metals to water	ton Hg/20	0	0	2	8	1	0	0	0	0	0	0	0	**11**
Persistent Organic Pollutants (POP)	g i-Teq	Negligible												

The BC 4 (fixed electric convector), BC 3 (portable electric fan heater), BC 5a (static electric storage heaters) and BC 7 (warm air unit heaters) have the highest contribution to the overall environmental impacts at the EU level. They together represent more than 80% of both the overall energy consumption and the overall greenhouse gas emissions. This is due to the large number of fixed electric heaters (stock) represented by BC 3, BC 4 and BC 5a, and high annual energy consumption by BC 7.

The results presented above are based on a number of best estimates and assumptions, which were used in the absence of available data of average local room heaters and their use in the EU. Stakeholders were consulted to ensure that the results represent a reliable picture of the situation in the EU for local room heaters. In Task 8 of this study, a sensitivity analysis will be performed on the key variables that influence the results to check their uncertainty.

In order to provide an idea of the contribution of environmental impacts compared to other heating systems in the EU, Table 5-32 shows the energy consumption, greenhouse gas and acidification emissions estimates for the other heating related Ecodesign preparatory studies.

Table 5-32: Annual energy consumption and emissions of EU stock of space-heating products

	Products	Geographical scope	Energy consumption per year (PJ)	Emissions Mt CO_2 eq. per year	Emissions kt SO_2 eq. per year
ENER Lot 1[28]	Hydronic central heating (e.g. boilers)	EU-25	10 880	630	500
ENER Lot 10[29]	Residential heat pumps	EU-27	855	37	221
ENER Lot 15[30]	Solid fuel combustion appliances	EU-27	1 699	36	347
ENER Lot 20	Local room heaters	EU-27	2 053	94	440
ENER Lot 21	Air-based central heating	EU-27	770	41	78

Hydronic central heating products such as boilers have the greatest environmental impacts, but the contribution of environmental impacts of ENER Lot 20 products is also significant. In terms of energy consumption and greenhouse gas emissions, local room heating products are second to boilers and other hydronic based heating systems.

[28] VHK (2007) DG ENER Lot 1 preparatory study on CH-Boilers.

[29] ARMINES (2008) DG ENER Lot 10 preparatory study on residential air conditioning and ventilation.

[30] BIO Intelligence Service (2009) DG ENER Lot 15 preparatory study on solid fuel small combustion installations.

5.5.2 Life Cycle costs

Task 6: The outcomes of the EcoReport tool concerning the annual consumer expenditure at EU-27 level are presented Table 5.32.

Table 5-33: Total annual consumer expenditure in EU-27 in 2009 for the nine local room heaters Base-Cases

[million €]	BC 1	BC 2	BC 3	BC 4	BC 5a	BC 5b	BC 6a	BC 6b	BC 7	BC 8a	BC 8b	BC 9	TOTAL EU-27	Share of the annual consumer expenditure by item
Product price	105	168	216	1 363	90	54	146	156	185	31	46	150	2 710	8%
Installation, acquisition costs	44	70	0	341	19	7	98	104	13	6	6	60	768	2%
Fuel (gas, oil)	354	877	0	0	0	0	0	0	1 831	374	674	124	4 234	13%
Electricity	0	0	3 303	18 915	1 299	707	479	220	67	2	8	24	25 024	75%
Repair and maintenance costs	75	120	0	0	0	0	0	0	112	46	55	45	453	1%
Total	**578**	**1 235**	**3 519**	**20 619**	**1 408**	**768**	**722**	**480**	**2 208**	**459**	**788**	**403**	**33 189**	**100%**
Share of the annual consumer expenditure by BC	2%	4%	11%	62%	4%	2%	2%	1%	7%	1%	2%	1%	**100%**	

The energy costs (fuel and electricity) represent more than 85% of the total consumer expenditure at the EU-27 level in 2009. The BCs with the highest shares of the annual consumer expenditure are the fixed electric convectors (62%), portable fan heaters (11%) and warm aim heaters (7%).

6.1 Conclusions

This Task 5 report analysed the environmental impacts and economic costs of nine Base-Cases that are thought to represent the local room heating products most relevant for proposing Ecodesign requirements. The selection of Base-Cases and subsequent analysis was based upon the market analysis presented in Task 2, the consumer behaviour and existing infrastructure described in Task 3 and the technical analysis of products carried out in Task 4. The Base-Cases were constructed as an "abstraction" of the average product in the EU market representing the wide range of products considered in this ENER Lot 20 preparatory study. The Base-Cases are used to estimate the environmental impacts of local room heating products in the EU.

The overall energy consumption of the installed stock of all Base-Cases together is 2 053 PJ/year. Based on the environmental impact assessment carried out in this chapter using the EcoReport tool, some general findings are observed for all the local room heaters Base-Cases such as:

- The use phase is the most dominant phase of the entire life cycle in terms of Total Energy Consumption (TEC) and Greenhouse Gas (GHG) emissions
- The material acquisition phase is also a dominant phase in terms of use of process water, generation of hazardous and non-hazardous waste, POPs, heavy metals to water and eutrophication
- The production phase typically has a significant contribution to the indicators such as generation of non-hazardous waste, heavy metals emissions to air and water, and eutrophication
- The end-of-life phase has significant contribution to the indicators such as particulate matter, heavy metals to air, eutrophication and generation of hazardous and non-hazardous waste.

It must however be noted that the distribution of the environmental impacts varies considerably across the analysed Base-Cases. For example, more than 90% of impacts of indicators is due to the use phase for some Base-Cases, while for other Base-Cases, the use phase and the material acquisition phase have similar contributions (even if distributed differently on the impacts). This is due to the influence of the input parameters such as the weight of the appliance, its lifespan and its power output.

The environmental and economic analysis of the Base-Cases will serve as point of reference when evaluating the possible improvement potentials in Task 6 and the design options in Task 7.

25 June 2012

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