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Lot 25
Non-Tertiary Coffee Machines

Task 5: Definition of Base-Cases – Final version

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5. TASK 5 – DEFINITION OF BASE-CASES

This task is comprised of an assessment of typical EU product(s), the so-called Base-Case(s) defined as "a conscious abstraction of reality". The description of Base-Case(s) is the synthesis of the results of Tasks 1 to 4. Most of the environmental and Life Cycle Cost (LCC) analysis is built on these Base-Cases throughout the rest of the study and it serves as the point-of-reference for Tasks 6-8. However, it has to be noted that any ecodesign requirements proposed by the consultants in Task 8 and those which will be adopted by the EU are not necessarily limited to the product types covered by the Base-Cases. Therefore, it could be possible later in the study to propose requirements on combo coffee machines even if a Base-Case is not defined for this specific category.

As already mentioned in previous tasks, the focus of this Ecodesign preparatory study is not on consumables but on coffee machines. Therefore, environmental impacts including those related to the end-of-life stage of coffee, filters, pad filters, hard caps or decalcifiers are not considered and not assessed with the EcoReport tool.

5.1. PRODUCT-SPECIFIC INPUTS

The MEEuP methodology indicates the analysis of one or two Base-Cases. However, in order to cover the broad range of technical specifications and functionalities of coffee machines properly, this study defined five Base-Cases as summarised in Table 5-1. The main reasons and assumptions for selecting these as the most representative Base-Cases are:

- A different Base-Case for major product categories sold on the market is the main driving factor for selection. The Base-Cases selected must best represent the most common categories of non-tertiary coffee maker in as few cases as possible.
- Technical differences can justify the distinction of a new Base-Case, such as significant differences in the energy use, materials used, and process for making coffee.
- The expected improvement potential of the product's environmental impact is another consideration that must be used to distinguish a Base-Case. For this reason, moka pots and other products not directly consuming energy themselves do not have a Base-Case, because they are not expected to have a higher potential improvement.
- Other functionalities such as automatic on/off options will be modelled through Base-Cases as they are important, however they will not justify the distinction of Base-Cases.

Following the previous analysis, the Base-Cases for Lot 25 are specified in Table 5-1.

Table 5-1: Choice of Base-Cases

Base-Case / Product Case	Technical data: BoM	Technical data: Energy consumption	Market data (sales & stock for 2010)
(1) Drip filter coffee machine	Typical BoM of Drip filter coffee machine (4.2.1)	Table 4-13	Table 2-8
(2) Pad filter coffee machine	Typical BoM of Pad filter coffee machine (4.2.2)	Table 4-13	Table 2-8
(3) Hard cap espresso machine	Typical BoM of Hard cap espresso machine (4.2.3)	Table 4-13	Table 2-8
(4) Semi-automatic espresso machine (mix between automatic and manual)	Typical BoM of Semi-automatic espresso machine (4.2.4)	Table 4-13	Table 2-8
(5) Fully automatic espresso machine	Typical BoM of Fully automatic espresso machine (4.2.5)	Table 4-13	Table 2-8

5.1.1. Base-Case 1: Drip filter coffee machine

Base-Case 1 represents traditional filter coffee makers, using ground coffee. In terms of BoM it relates to the drip filter coffee machine described in Task 4. The detailed BoM for this coffee machine is presented in section 4.2.1 and Table 5-2 shows the aggregated BoM for this Base-Case according to various material categories.

Table 5-2: Base-Case 1 – BoM summary

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	**Total**			Disposal	Recycl.	**Total**	
	Materials	**unit**									
1	Bulk Plastics	g			**1375**			1238	138	**1375**	**0**
2	TecPlastics	g			**300**			270	30	**300**	**0**
3	Ferro	g			**579**			29	550	**579**	**0**
4	Non-ferro	g			**195**			10	185	**195**	**0**
5	Coating	g			**0**			0	0	**0**	**0**
6	Electronics	g			**67**			62	4	**67**	**0**
7	Misc.	g			**0**			0	0	**0**	**0**
	Total weight	g			**2516**			1609	907	**2516**	**0**

Energy data are derived from the analysis presented in Task 4.

5.1.2. Base-Case 2: Pad filter coffee machine

Base-Case 2 corresponds to a Pad filter coffee machine. This type of coffee machine is dedicated to preparing one or two cup(s) of coffee from water and a pod of ground coffee. In terms of BoM it relates to the Pad filter coffee machine described in Task 4. The detailed BoM for this coffee machine is presented in section 4.2.2 and Table 5-3 shows the aggregated BoM for this Base-Case according to various material categories.

Table 5-3: Base-Case 2 – BoM summary

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	**Total**			Disposal	Recycl.	**Total**	
	Materials	**unit**									
1	Bulk Plastics	g			**922**			830	92	**922**	**0**
2	TecPlastics	g			**328**			295	33	**328**	**0**
3	Ferro	g			**320**			16	304	**320**	**0**
4	Non-ferro	g			**154**			8	146	**154**	**0**
5	Coating	g			**0**			0	0	**0**	**0**
6	Electronics	g			**38**			19	19	**38**	**0**
7	Misc.	g			**80**			4	76	**80**	**0**
	Total weight	g			**1842**			1172	670	**1842**	**0**

Energy data are derived from the analysis presented in Task 4.

5.1.3. Base-Case 3: Hard cap espresso machine

Base-Case 3 represents a hard cap espresso coffee machine. This type of coffee machine is dedicated to preparing one or two cup(s) of coffee from water and a cap of ground coffee. In terms of BoM it relates to the hard cap espresso coffee machine described in Task 4. The detailed BoM for this coffee machine is presented in 4.2.3 and Table 5-4 shows the aggregated BoM for this Base-Case according to various material categories.

Table 5-4: Base-Case 3 – BoM summary

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	**Total**			Disposal	Recycl.	**Total**	
	Materials	**unit**									
1	Bulk Plastics	g			**1213**			1091	121	**1213**	**0**
2	TecPlastics	g			**310**			279	31	**310**	**0**
3	Ferro	g			**390**			19	370	**390**	**0**
4	Non-ferro	g			**784**			39	745	**784**	**0**
5	Coating	g			**0**			0	0	**0**	**0**
6	Electronics	g			**45**			40	5	**45**	**0**
7	Misc.	g			**226**			11	215	**226**	**0**
	Total weight	g			**2968**			1481	1487	**2968**	**0**

Energy data are derived from the statistical analyses presented in Task 4.

5.1.4. BASE-CASE 4: SEMI-AUTOMATIC ESPRESSO MACHINE

Base-Case 4 represents a typical semi-automatic espresso machine. These electric pump extraction machines automate the pump extraction process. The rest of the process is manual, such as the adding of pre-ground beans and the water. In terms of BoM, it relates to the semi-automatic espresso coffee machine described in Task 4. The detailed BoM for this coffee machine is presented in section 4.2.4 and Table 5-5 shows the aggregated BoM for this Base-Case according to various material categories.

Table 5-5: Base-Case 4 – BoM summary

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	Total			Disposal	Recycl.	Total	
	Materials	unit									
1	Bulk Plastics	g			2260			2034	226	2260	0
2	TecPlastics	g			255			229	25	255	0
3	Ferro	g			1103			55	1048	1103	0
4	Non-ferro	g			1088			54	1033	1088	0
5	Coating	g			0			0	0	0	0
6	Electronics	g			160			113	47	160	0
7	Misc.	g			0			0	0	0	0
	Total weight	g			4866			2486	2380	4866	0

Energy data are derived from the statistical analysis presented in Task 4.

5.1.5. BASE-CASE 5: FULLY AUTOMATIC ESPRESSO MACHINE

Base-Case 5 represents a fully-automatic coffee machine. This type of coffee machine is dedicated to preparing one or two cup(s) of coffee from water and coffee beans or ground coffee. In terms of BoM, it relates to the fully-automatic espresso machine described in Task 4. The detailed BoM for this coffee machine is presented in section 4.2.5 and Table 5-6 shows the aggregated BoM for this Base-Case according to various material categories.

Table 5-6: Base-Case 5 – BoM summary

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	Total			Disposal	Recycl.	Total	
	Materials	unit									
1	Bulk Plastics	g			5265			4739	527	5265	0
2	TecPlastics	g			205			185	21	205	0
3	Ferro	g			989			49	940	989	0
4	Non-ferro	g			270			14	257	270	0
5	Coating	g			0			0	0	0	0
6	Electronics	g			286			143	143	286	0
7	Misc.	g			1317			66	1251	1317	0
	Total weight	g			8332			5195	3137	8332	0

Energy data are derived from the statistical analysis presented in Task 4.

5.2. BASE-CASE ENVIRONMENTAL IMPACT ASSESSMENT

The aim of this subtask is to assess the environmental impacts of each Base-case following the MEEuP (EcoReport Unit Indicators) for each life cycle stage:

- Raw Materials Use and Manufacturing (Production phase);
- Distribution;
- Use;
- End-of-Life.

The Base-case environmental impact assessment will lead to an identification of basic technological design parameters being of outstanding environmental relevancy[1]. These parameters will be listed as they will serve as an important input to the identification of ecodesign improvement options.

The assessment results are tracked back to the main contributing components, materials and features of the non-tertiary coffee machines.

The environmental impact assessments are carried out with the use of the EcoReport tool provided by the Commission. This tool includes a database which cannot be modified by the consultants. Therefore, any comparison with other assessments done with other tools has to be made with caution. Further, the definition of each environmental indicator is available in the MEEuP report (http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/files/finalreport1_en.pdf).

Finally, the objective of this task is not to compare several Base-Cases, which cannot be done directly as their lifetimes are different.

5.2.1. BASE-CASE 1: DRIP FILTER COFFEE MACHINE

5.2.1.1 PER LIFE CYCLE PHASE

The total environmental impacts over the life cycle for Base-Case 1 according to EcoReport calculations are listed in Table 5-7, and the contribution of each life cycle stage is presented in Figure 5-1. These figures are based on preparation of 1 700 ml of coffee per day (as in the draft CENELEC method) for 6 years.

Table 5-7: Base-Case 1 - Lifetime impact

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE			TOTAL
	Resources Use and Emissions		Material	Manuf.	**Total**			Disposal	Recycl.	**Total**	
	Other Resources & Waste							debet	credit		
8	Total Energy (GER)	MJ	236	79	**316**	**99**	**10673**	111	78	**33**	**11120**

[1] As far as the MEEuP EcoReport allows the identification of such indicators.

9	of which, electricity (in primary MJ)	MJ	69	47	**116**	**0**	**10671**	0	1	**-1**	**10786**
10	Water (process)	ltr	90	1	**90**	**0**	**4435**	0	1	**-1**	**4525**
11	Water (cooling)	ltr	154	22	**176**	**0**	**28454**	0	4	**-4**	**28627**
12	Waste, non-haz./ landfill	g	1884	250	**2134**	**74**	**12392**	155	4	**151**	**14751**
13	Waste, hazardous/ incinerated	g	42	0	**42**	**1**	**246**	1512	1	**1511**	**1801**
	Emissions (Air)										
14	Greenhouse Gases in GWP100	kg CO2 eq.	12	4	**17**	**7**	**466**	8	5	**3**	**493**
15	Ozone Depletion, emissions	mg R-11 eq.	negligible								
16	Acidification, emissions	g SO2 eq.	103	19	**122**	**21**	**2749**	17	7	**9**	**2901**
17	Volatile Organic Compounds (VOC)	g	0	0	**0**	**1**	**4**	0	0	**0**	**5**
18	Persistent Organic Pollutants (POP)	ng i-Teq	12	0	**12**	**0**	**70**	1	0	**1**	**84**
19	Heavy Metals	mg Ni eq.	80	1	**81**	**4**	**184**	30	0	**30**	**298**
	PAHs	mg Ni eq.	6	0	**6**	**4**	**30**	0	0	**0**	**40**
20	Particulate Matter (PM, dust)	g	10	3	**13**	**119**	**59**	144	0	**144**	**335**
	Emissions (Water)										
21	Heavy Metals	mg Hg/20	60	0	**60**	**0**	**69**	9	0	**9**	**138**
22	Eutrophication	g PO4	2	0	**3**	**0**	**0**	1	0	**1**	**3**
23	Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

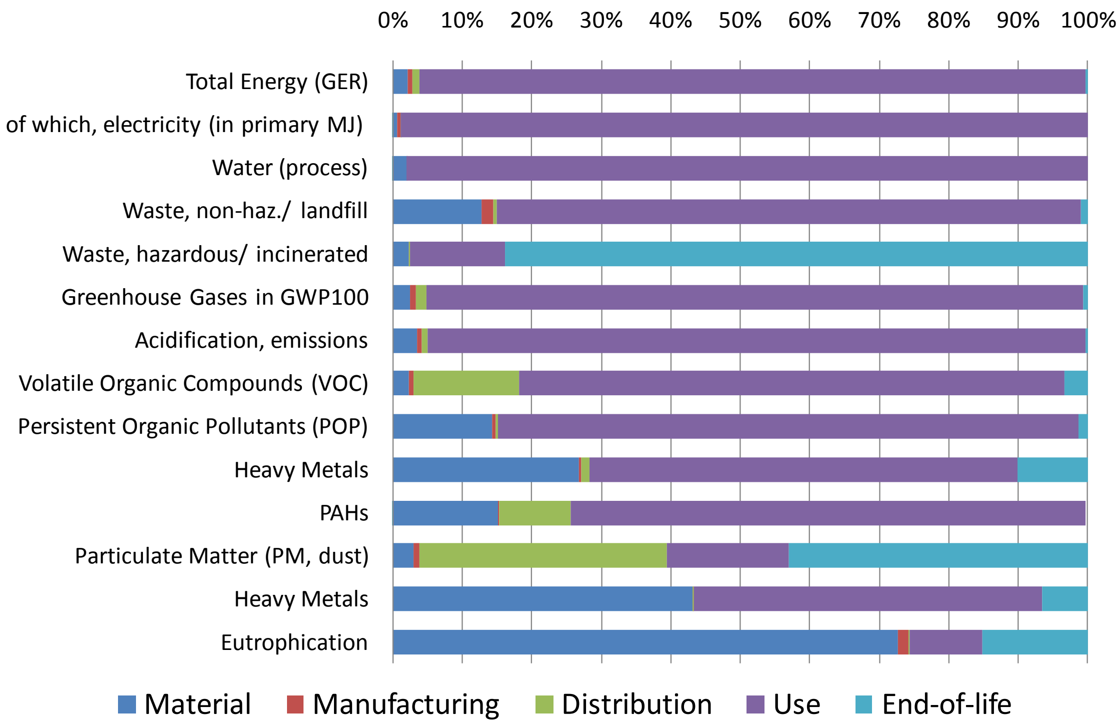


Figure 5-1: Base-Case 1 – Life cycle impact

The use phase is clearly dominating the total environmental impacts for the following categories:

- Total energy (96%), of which electricity (99%)
- Water process (98%), including the water consumption for producing electricity and for making the coffee cups
- Waste, non hazardous / landfill (84%)
- Greenhouse gases in GWP100 (95%)
- Acidification, emissions (95%)
- Volatile Organic Compounds (81%)
- Persistent Organic Pollutants (84%)
- Heavy Metals to air (62%) and to water (50%)

Manufacturing is not a large share (less than 2%) of the total environmental impact in any of the categories.

Distribution does not dominate any of the categories but contributes to the total impact for the categories[2]:

- Volatile Organic Compounds (VOC) (16%)
- PAHs (10%)
- Particulate Matter (PM, dust) (36%)

Materials acquisition dominates in the case of:

- Eutrophication (81%)

and contributes significantly in the case of:

- Heavy metals to water (43%)
- Waste, non-hazardous/landfill (13%)
- Persistent Organic Pollutants (14%)
- Heavy metals to air (27%)
- PAHs (15%)

End-of-life impacts dominate two categories:

[2] The high contribution of the distribution phase can be explained by the assumption related to transport in trucks from the retailer's central warehouse to the shop. The EcoReport tool does not allow specifying means of transport ant distances between the production place of the coffee machine and retailer's central warehouse; only the volume of the product is taken into consideration to assess environmental impacts of the transport. Nevertheless, 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 on distances is used for all Base-cases. This assumption can be considered as disadvantageous for appliances mainly produced in Europe.

- Waste, hazardous/incinerated (84%)
- Particulate Matter emissions to air (43%)

and contribute significantly in the case of:

- Eutrophication (17%)

5.2.1.2 PER COMPONENT[3]

The contributions of the main components to the environmental impacts of the Base-Case 1 (in the production phase) are presented in Figure 5-2. Housing and electric circuit are sharing the environmental impacts due to the quantity of plastics, stainless steel, and the electronic parts.

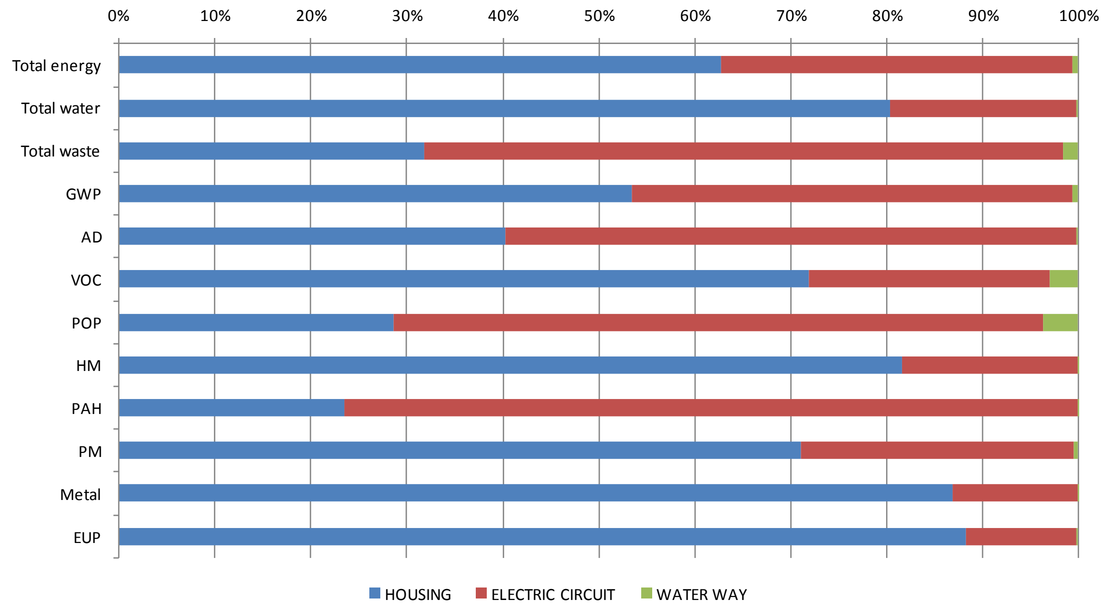


Figure 5-2: Base-case 1 – Environmental impacts of main components within the production phase

5.2.2. BASE-CASE 2: PAD FILTER COFFEE MACHINE

5.2.2.1 PER LIFE CYCLE PHASE

The total environmental impacts over the life cycle for Base-Case 2 according to EcoReport calculations are listed in Table 5-8, and the contribution of each life cycle stage is presented in Figure 5-3. These figures are based on preparation of 720 ml of coffee per day (as in the draft CENELEC method) for 7 years.

[3] GWP=Global Warming Potential; AD=Acidification; VOC=Volatil Organic Compound; POP=Persistent Organic Pollutants; HM=Heavy Metals to air; PAH=Polycyclic Aromatic Hydrocarbons; PM=Particulate Matters; Metal=Heavy Metals to water; EUP=Eutrophication

Table 5-8: Base-Case 2 - Lifetime Impact

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE			TOTAL
	Resources Use and Emissions		Material	Manuf.	**Total**			Disposal	Recycl.	**Total**	
	Other Resources & Waste							debet	credit		
8	Total Energy (GER)	MJ	158	61	**219**	**95**	**11914**	84	64	**20**	**12249**
9	of which, electricity (in primary MJ)	MJ	19	34	**53**	**0**	**11912**	0	3	**-3**	**11962**
10	Water (process)	ltr	31	1	**32**	**0**	**2634**	0	2	**-2**	**2663**
11	Water (cooling)	ltr	148	17	**165**	**0**	**31765**	0	3	**-3**	**31927**
12	Waste, non-haz./ landfill	g	3209	183	**3392**	**73**	**13845**	113	8	**105**	**17414**
13	Waste, hazardous/ incinerated	g	66	0	**66**	**1**	**275**	1144	3	**1141**	**1484**
	Emissions (Air)										
14	Greenhouse Gases in GWP100	kg CO2 eq.	8	3	**11**	**7**	**520**	6	4	**2**	**540**
15	Ozone Depletion, emissions	mg R-11 eq.					negligible				
16	Acidification, emissions	g SO2 eq.	77	15	**93**	**20**	**3068**	13	7	**5**	**3186**
17	Volatile Organic Compounds (VOC)	g	0	0	**0**	**1**	**4**	0	0	**0**	**6**
18	Persistent Organic Pollutants (POP)	ng i-Teq	6	0	**6**	**0**	**78**	1	0	**1**	**85**
19	Heavy Metals	mg Ni eq.	33	0	**34**	**4**	**205**	23	0	**22**	**265**
	PAHs	mg Ni eq.	6	0	**6**	**4**	**84**	0	0	**0**	**94**
20	Particulate Matter (PM, dust)	g	6	3	**9**	**111**	**66**	109	0	**109**	**294**
	Emissions (Water)										
21	Heavy Metals	mg Hg/20	44	0	**44**	**0**	**77**	7	1	**6**	**127**
22	Eutrophication	g PO4	2	0	**2**	**0**	**0**	0	0	**0**	**2**
23	Persistent Organic Pollutants (POP)	ng i-Teq					negligible				

Figure 5-3 illustrates the contribution of different life-cycle phases to each of the impact categories for Base-Case 2.

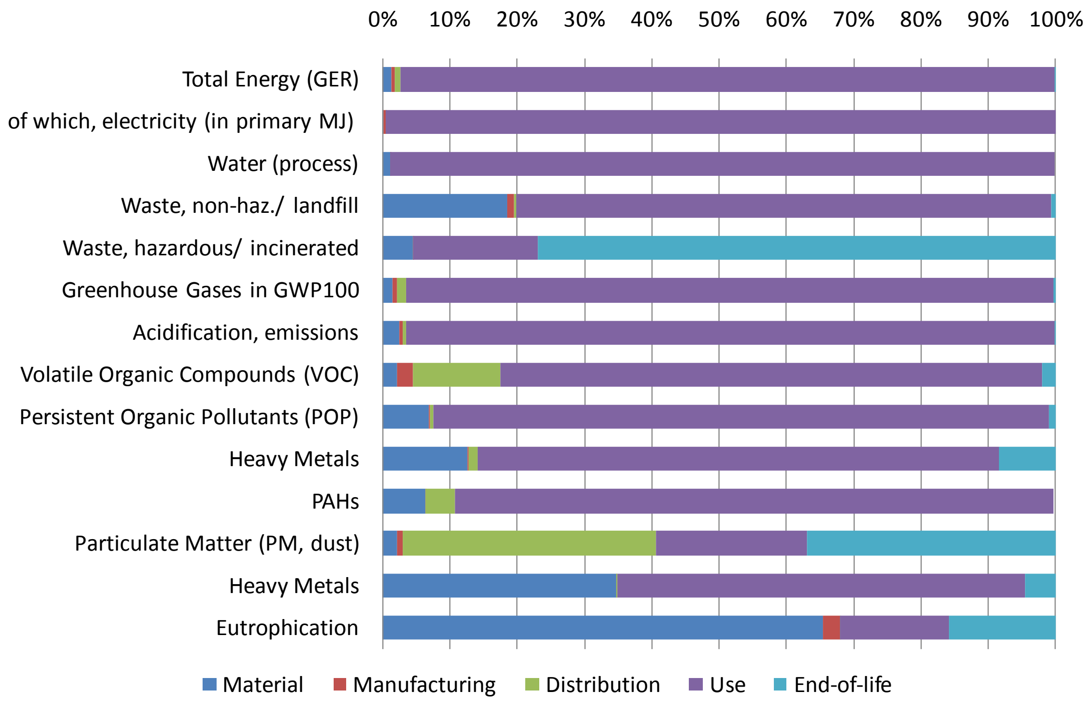


Figure 5-3: Base-Case 2 – Life cycle impact

Materials acquisition dominates the environmental impacts for the following categories:

- Eutrophication (100%)

and contributes significantly to the categories:

- Heavy metals emissions to air (13%) and to water (35%)
- Waste, non-hazardous / landfill (18%)

Manufacturing is not significant (less than 2%) in any of the environmental indicators.

Distribution accounts for all of the total environmental impacts for the following category:

- Volatile Organic Compounds (VOC) (18%)
- Particulate Matter (PM, dust) (38%)

The **use phase** is clearly dominating in the case of:

- Total Energy (97%), of which electricity (99.6%)
- Water process (99%), including the water consumption for producing electricity and for making the coffee cups
- Greenhouse gases (96%)
- Acidification emissions (96%)
- Persistent Organic Pollutants to air (92%)

- Waste, non-hazardous / landfill (80%)
- Volatile Organic Compounds (82%)
- Heavy metals to air (78%) and to water (61%)
- PAHs (89%)

and contributes significantly to :

- Particulate Matter emissions to air (22%)

End-of-life impacts dominate the category:

- Waste, hazardous / incinerated (77%)

and contribute significantly in the case of:

- Particulate Matter emissions to air (37%)

5.2.2.2 PER COMPONENT

The contributions of the main components to the environmental impacts of the Base-Case 2 (in the production phase) are presented in Figure 5-4. Plastic parts, stainless steel and electronic parts are the main contributors to the environmental impacts. Furthermore, it is important to notice that the power cable (copper wire) has a major impact at end-of-life phase, as a non-hazardous waste.

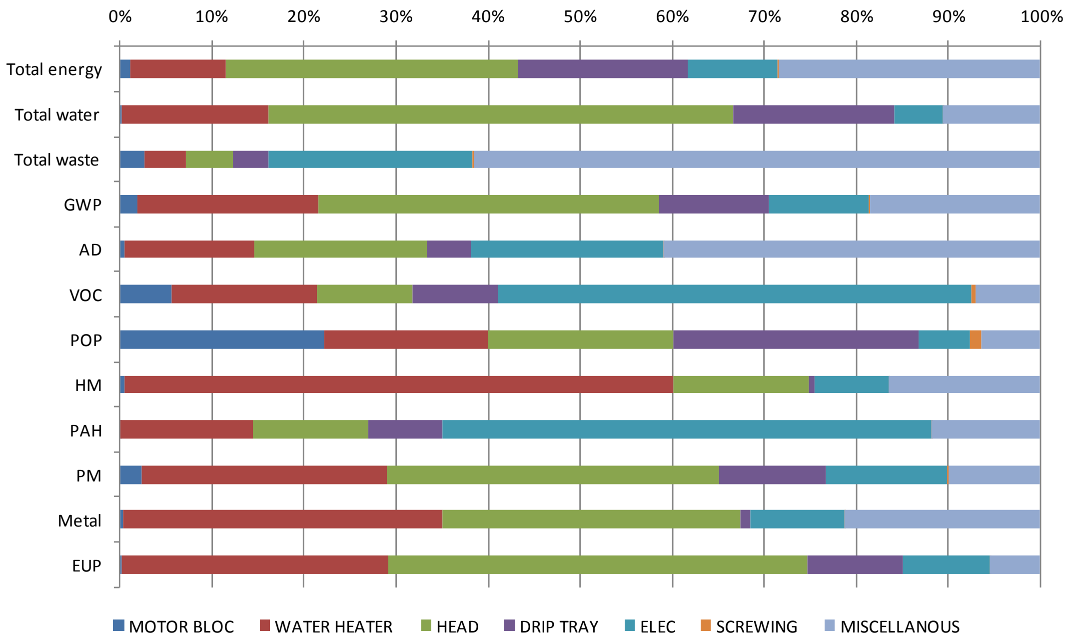


Figure 5-4: Base-case 2 – Environmental impacts of main components within the production phase

5.2.3. Base-Case 3: Hard cap espresso machine

5.2.3.1 Per life cycle phase

The total environmental impacts over the life cycle for Base-Case 3 according to EcoReport calculations are listed in Table 5-9, and the contribution of each life-cycle stage is presented in Figure 5-5. These figures are based on preparation of 720 ml of espresso per day (as in the draft CENELEC method) for 7 years.

Table 5-9: Base-Case 3 - Lifetime Impact

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE			TOTAL
	Resources Use and Emissions		Material	Manuf.	Total			Disposal	Recycl.	Total	
	Other Resources & Waste							debet	credit		
8	Total Energy (GER)	MJ	237	71	**308**	**83**	**8856**	104	70	**33**	**9280**
9	of which, electricity (in primary MJ)	MJ	40	42	**82**	**0**	**8854**	0	1	**-1**	**8935**
10	Water (process)	ltr	67	1	**67**	**0**	**2430**	0	1	**-1**	**2497**
11	Water (cooling)	ltr	257	20	**277**	**0**	**23610**	0	3	**-3**	**23884**
12	Waste, non-haz./ landfill	g	3480	223	**3703**	**66**	**10301**	183	4	**179**	**14250**
13	Waste, hazardous/ incinerated	g	39	0	**39**	**1**	**204**	1376	1	**1375**	**1620**
	Emissions (Air)										
14	Greenhouse Gases in GWP100	kg CO2 eq.	12	4	**16**	**6**	**386**	8	5	**3**	**412**
15	Ozone Depletion, emissions	mg R-11 eq.	negligible								
16	Acidification, emissions	g SO2 eq.	114	17	**131**	**18**	**2281**	16	7	**9**	**2438**
17	Volatile Organic Compounds (VOC)	g	0	0	**0**	**1**	**3**	0	0	**0**	**4**
18	Persistent Organic Pollutants (POP)	ng i-Teq	45	0	**45**	**0**	**58**	1	0	**1**	**105**
19	Heavy Metals	mg Ni eq.	66	1	**67**	**3**	**153**	28	0	**28**	**251**
	PAHs	mg Ni eq.	6	0	**6**	**4**	**78**	0	0	**0**	**88**
20	Particulate Matter (PM, dust)	g	10	3	**13**	**78**	**49**	134	0	**134**	**274**
	Emissions (Water)										
21	Heavy Metals	mg Hg/20	52	0	**52**	**0**	**58**	9	0	**8**	**118**
22	Eutrophication	g PO4	2	0	**2**	**0**	**0**	0	0	**0**	**3**
23	Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

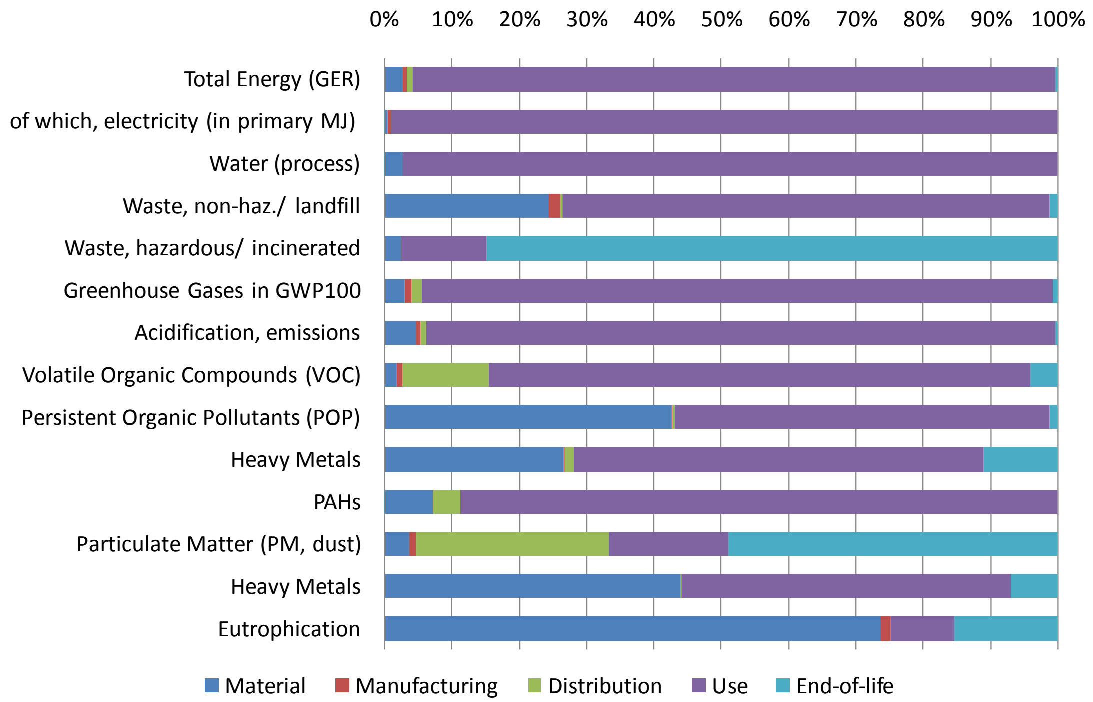


Figure 5-5: Base-Case 3 – Life cycle impact

Materials acquisition is dominating the environmental impacts for the following categories:

- Eutrophication to water (76.8%)

and contributes significantly to the categories:

- Heavy metals emissions to air (26%) and to water (44%)
- Waste, non-hazardous / landfill (24%)
- Persistent Organic Pollutants (POP) to air (43%)

Manufacturing is not significant (less than 2%) in any of the environmental indicators.

Distribution contributes to the category:

- Particulate Matter (29%)

The **use phase** is clearly dominating in the case of:

- Total Energy (95%), of which electricity (99%)
- Water process (97%), including the water consumption for producing electricity and for making the coffee cup
- Greenhouse gases (94%)
- Acidification emissions (94%)
- Waste, non-hazardous / landfill (72%)
- Persistent Organic Pollutants to air (56%)

- Heavy metals to air (61%) and to water (49%)
- PAHs (89%)
- Volatile Organic Compounds (86%)

and contributes significantly in the case of:

- Particulate Matter emissions to air (18%)
- Waste, hazardous / incinerated (13%)

End-of-life impacts dominate the following categories:

- Waste, hazardous / incinerated (85%)
- Particulate Matter emissions to air (49%)

and contribute significantly in the case of:

- Eutrophication (18%)

5.2.3.2 PER COMPONENT

The contributions of the main components to the environmental impacts of the Base-Case 3 (in the production phase) are presented in Figure 5-6. Housing, percolator system and electric circuit are the main contributors to the environmental impacts due to their plastic and stainless steel components and to electronic parts.

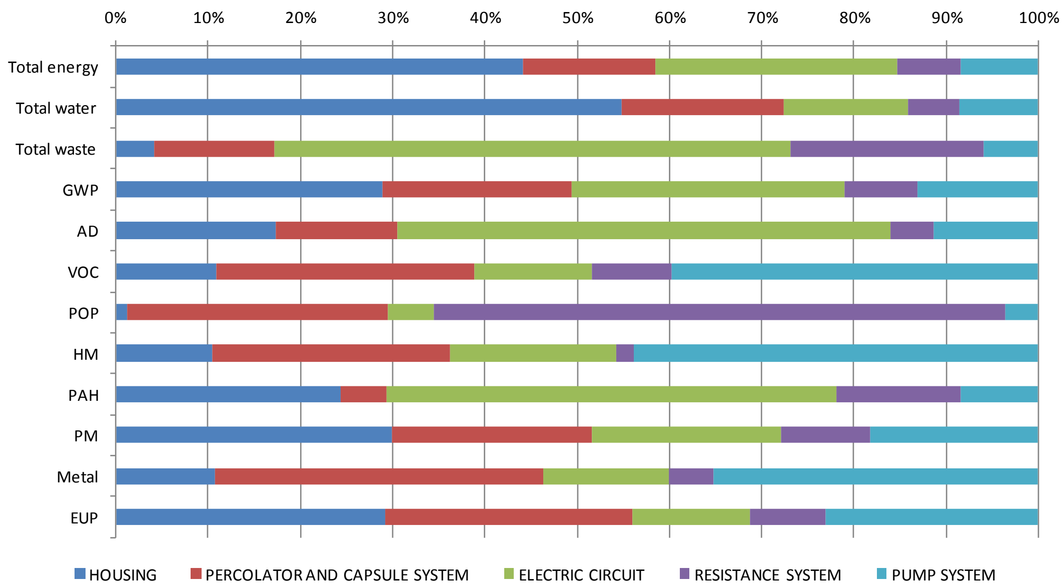


Figure 5-6: Base-case 3 – Environmental impacts of main components within the production phase

5.2.4. Base-Case 4: Semi-automatic espresso machine

5.2.4.1 Per life cycle phase

The total environmental impacts over the life cycle for Base-Case 4 according to EcoReport calculations are listed in Table 5-10, and the contribution of each life cycle stage is presented in Figure 5-7. These figures are based on preparation of 720 ml of espresso per day (as in the draft CENELEC method) for 7 years.

Table 5-10: Base-Case 4 – Life-time Impact

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE			TOTAL
	Resources Use and Emissions		Material	Manuf.	**Total**			Disposal	Recycl.	**Total**	
	Other Resources & Waste							debet	credit		
8	Total Energy (GER)	MJ	433	136	**569**	**92**	**14358**	175	124	**51**	**15070**
9	of which, electricity (in primary MJ)	MJ	87	75	**162**	**0**	**14354**	0	6	**-6**	**14510**
10	Water (process)	ltr	116	2	**118**	**0**	**2798**	0	6	**-6**	**2910**
11	Water (cooling)	ltr	409	38	**447**	**0**	**38278**	0	6	**-6**	**38720**
12	Waste, non-haz./ landfill	g	5982	406	**6388**	**71**	**16705**	325	19	**306**	**23470**
13	Waste, hazardous/ incinerated	g	295	0	**296**	**1**	**334**	2310	7	**2303**	**2934**
	Emissions (Air)										
14	Greenhouse Gases in GWP100	kg CO2 eq.	21	8	**29**	**7**	**627**	13	9	**5**	**667**
15	Ozone Depletion, emissions	mg R-11 eq.	negligible								
16	Acidification, emissions	g SO2 eq.	187	34	**221**	**19**	**3698**	26	15	**12**	**3950**
17	Volatile Organic Compounds (VOC)	g	0	0	**1**	**1**	**5**	0	0	**0**	**7**
18	Persistent Organic Pollutants (POP)	ng i-Teq	70	1	**71**	**0**	**95**	2	0	**2**	**168**
19	Heavy Metals	mg Ni eq.	70	1	**72**	**4**	**247**	47	1	**47**	**369**
	PAHs	mg Ni eq.	23	0	**23**	**4**	**29**	0	1	**-1**	**56**
20	Particulate Matter (PM, dust)	g	18	6	**24**	**102**	**79**	227	0	**226**	**432**
	Emissions (Water)										
21	Heavy Metals	mg Hg/20	67	0	**67**	**0**	**93**	15	3	**12**	**172**
22	Eutrophication	g PO4	3	0	**3**	**0**	**0**	1	0	**1**	**5**
23	Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

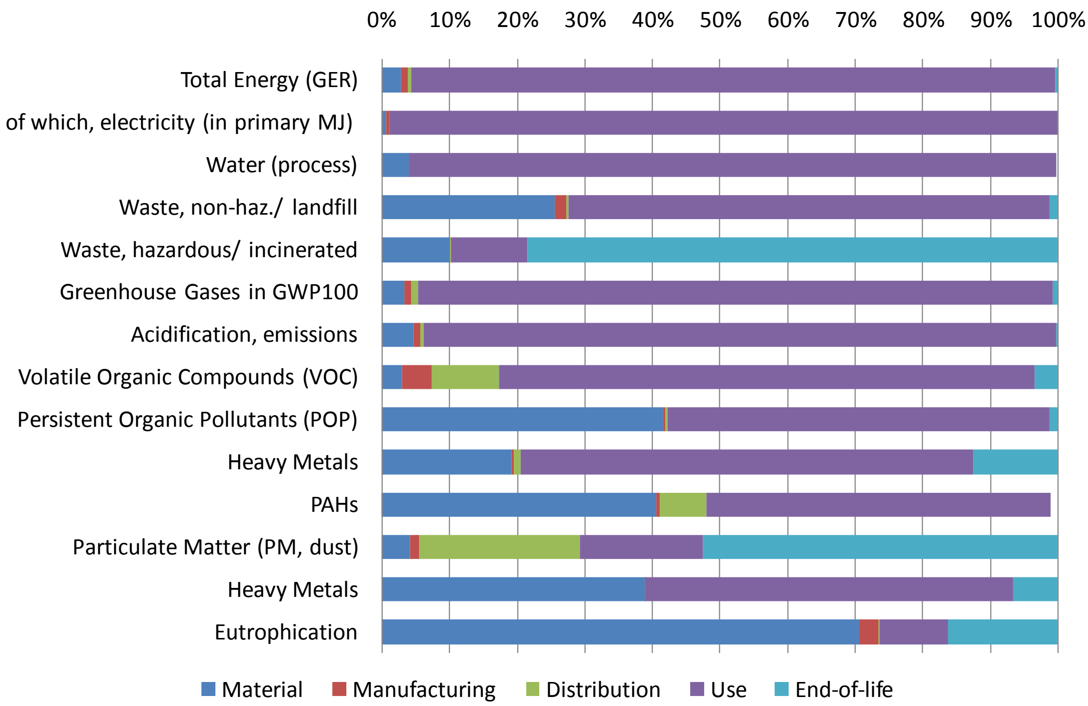


Figure 5-7: Base-Case 4 – Life-cycle impact

Materials acquisition dominates the environmental impacts for the category:

- Eutrophication to water (79%)

and contributes significantly to the categories:

- PAHs (42%)
- Persistent Organic Pollutants (POP) to air (42%)
- Heavy metals to air (19%) and to water (39%)
- Waste, non-hazardous / landfill (25%)

Manufacturing is not significant (less than 2%) in any of the environmental indicator.

Distribution accounts for all of the total environmental impacts for the following category:

- Volatile Organic Compounds (VOC) (11%)
- Particulate Matter (PM, dust) (24%)

The **use phase** is clearly dominating in the case of:

- Total Energy (95%), of which electricity (99%)
- Water process (96%), including the water consumption for producing electricity and for making the coffee cup
- Greenhouse gases (94%)
- Waste, non-hazardous / landfill (71%)

- Volatile Organic Compounds (89%)
- Heavy metals to air (67%) and to water (54%)
- Acidification emissions (94%)
- Persistant Organic Pollutants to air (56%)
- PAHs (53%)

and contributes significantly in the case of:

- Particulate Matter (PM, dust) (18%)

End-of-life impacts are dominating in the following categories:

- Waste, hazardous / incinerated (79%)
- Particulate Matter emissions to air (52%)

and contributes significantly in the case of:

- Heavy metals to air (13%)
- Eutrophication (19%)

5.2.4.2 PER COMPONENT

The contributions of the main components to the environmental impacts of the Base-Case 4 (in the production phase) are presented in Figure 5-8. Housing and electric circuit are again the main contributors to the environmental impacts.

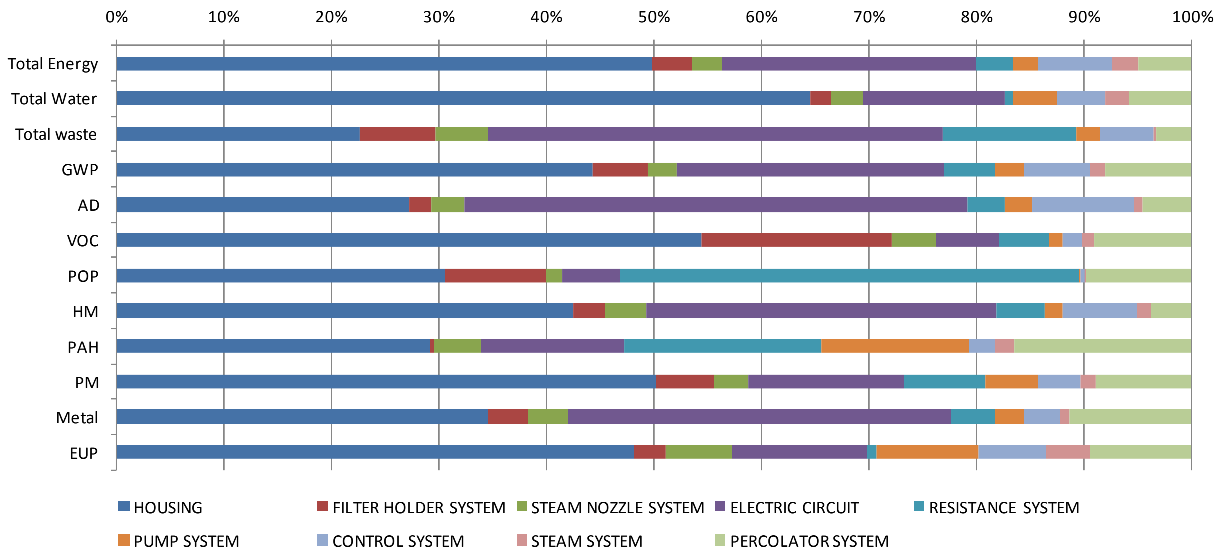


Figure 5-8: Base-case 4 – Environmental impacts of main components in the production phase

5.2.5. BASE-CASE 5: FULLY-AUTOMATIC ESPRESSO MACHINE

5.2.5.1 PER LIFE CYCLE PHASE

The total environmental impacts over the life cycle for Base-Case 5 according to EcoReport calculations are listed in Table 5-11, and the contribution of each life cycle stage is presented in Figure 5-9. These figures are based on preparation of 720 ml of espresso per day (as in the draft CENELEC method) for 10 years.

Table 5-11: Base-Case 5 – Life-cycle impacts

	Life Cycle phases -->		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE			TOTAL
	Resources Use and Emissions		Material	Manuf.	**Total**			Disposal	Recycl.	**Total**	
	Other Resources & Waste							debet	credit		
8	Total Energy (GER)	MJ	628	273	**901**	**134**	**11901**	373	293	**80**	**13017**
9	of which, electricity (in primary MJ)	MJ	82	143	**225**	**0**	**11894**	0	19	**-19**	**12101**
10	Water (process)	ltr	176	6	**181**	**0**	**3423**	0	16	**-16**	**3588**
11	Water (cooling)	ltr	655	77	**733**	**0**	**31720**	0	15	**-15**	**32438**
12	Waste, non-haz./ landfill	g	8006	778	**8783**	**91**	**13876**	512	56	**456**	**23207**
13	Waste, hazardous/ incinerated	g	521	1	**522**	**2**	**279**	5066	20	**5046**	**5849**
	Emissions (Air)										
14	Greenhouse Gases in GWP100	kg CO2 eq.	24	16	**39**	**9**	**519**	28	20	**8**	**576**
15	Ozone Depletion, emissions	mg R-11 eq.	negligible								
16	Acidification, emissions	g SO2 eq.	260	71	**331**	**27**	**3066**	56	37	**19**	**3442**
17	Volatile Organic Compounds (VOC)	g	0	1	**1**	**1**	**4**	1	1	**0**	**8**
18	Persistent Organic Pollutants (POP)	ng i-Teq	24	0	**24**	**1**	**78**	4	0	**3**	**106**
19	Heavy Metals	mg Ni eq.	53	1	**55**	**5**	**205**	100	2	**98**	**362**
	PAHs	mg Ni eq.	57	1	**58**	**5**	**25**	0	2	**-2**	**86**
20	Particulate Matter (PM, dust)	g	24	13	**37**	**208**	**66**	483	1	**482**	**793**
	Emissions (Water)										
21	Heavy Metals	mg Hg/20	77	0	**77**	**0**	**77**	31	10	**22**	**176**
22	Eutrophication	g PO4	4	0	**4**	**0**	**0**	2	0	**2**	**6**
23	Persistent Organic Pollutants (POP)	ng i-Teq	negligible								

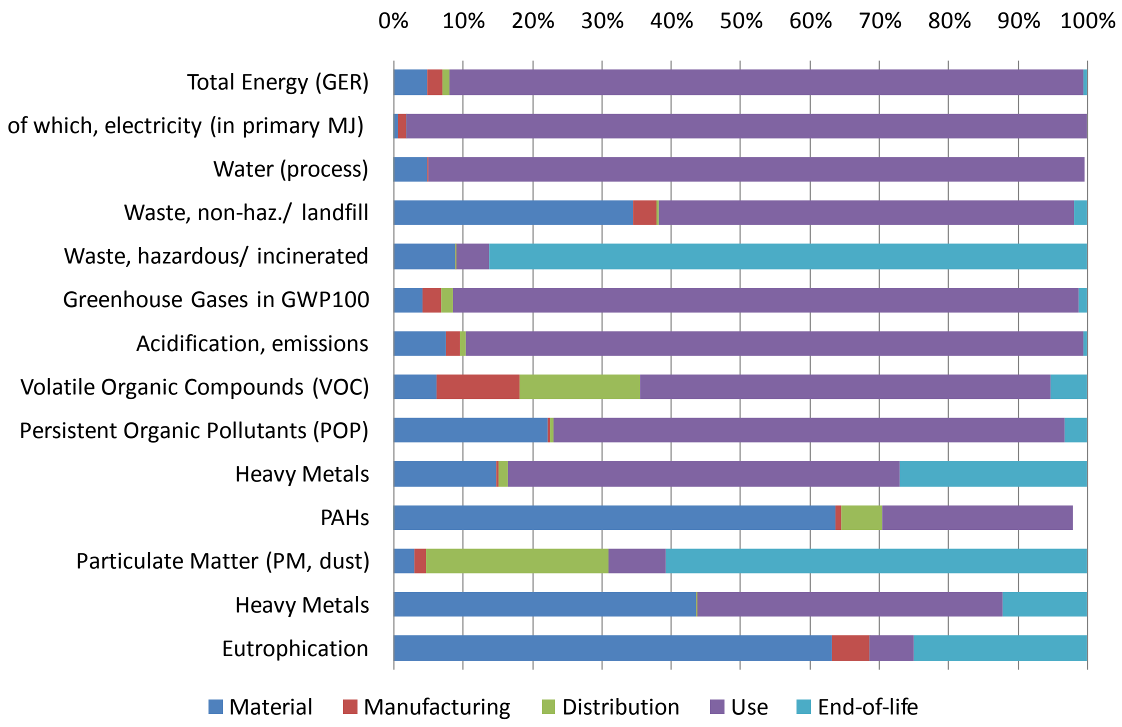


Figure 5-9: Base-Case 5 – Life cycle impact

Materials acquisition is dominating the environmental impacts for the following categories:

- Eutrophication to water (67%)
- PAHs (67%)

and contributes significantly to the categories:

- Persistent Organic Pollutants (POP) to air (23%)
- Heavy metals to water (15%)
- Waste, non-hazardous / landfill (35%)

Manufacturing is not significant (less than 2%) in any of the environmental indicators except for the Volatile Organic Compounds (VOC) (15%).

Distribution accounts for environmental impacts in the following categories:

- Particulate Matter (PM, dust) (26%)
- Volatile Organic Compounds (VOC) (15%)

The **use phase** is clearly dominating in the case of:

- Total Energy (91%), of which electricity (98%)
- Water process (95%), including the water consumption for producing electricity and for making the coffee cup
- Greenhouse gases (90%)

- Waste, non-hazardous / landfill (60%)
- Volatile Organic Compounds (69%)
- Heavy metals to air (57%) and to water (44%)
- Acidification emissions (89%)
- Persistant Organic Pollutants to air (74%)

and contributes significantly in the case of:

- PAHs (29%)

End-of-life impacts are dominating in the following categories:

- Waste, hazardous / incinerated (86%)
- Particulate Matter emissions to air (61%)

and contributes significantly in the case of:

- Heavy metals to air (27%)
- Eutrophication (33%)

5.2.5.2 PER COMPONENT

The contributions of the main components to the environmental impacts of the Base-Case 5 (in the production phase) are presented in Figure 5-10. As for the other Base-Cases, housing (plastic) and electronic parts are the main contributors to environmental impacts. Polystyrene (PS) used in the coffee lid is also a high contributor in PAHs.

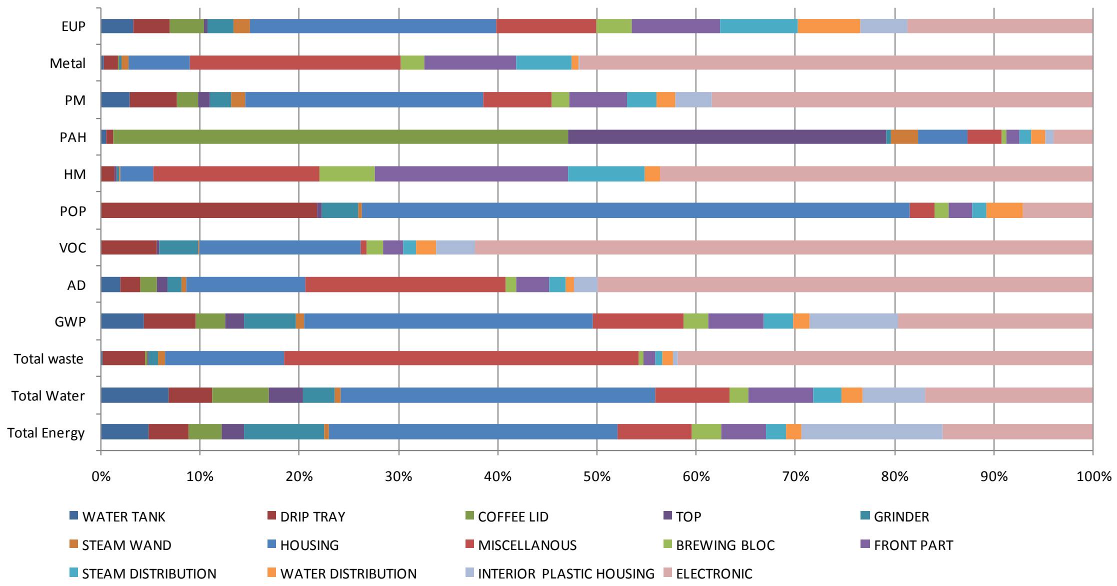


Figure 5-10: Base-case 5 – Environmental impacts of main components within the production phase

5.2.6. SUMMARY

Table 5-12 presents the results of the environmental assessment for the five Base-Cases, based on the impacts presented for each Base-Case in Table 5-7 to Table 5-11. Even if the aim is not to compare one product type with another, it can be noticed that semi-automatic and fully automatic espresso machines are much heavier than the other Base-Cases and thus consume more materials (including electronics). Therefore, their environmental impacts over their lifetime are more important for most of the indicators, except for "Water (process)", for which Base-Case 1 is more impacting as this type of coffee machine (drip filter) consumes more water during the coffee periods.

As explained above, the use phase is by far the most impacting phase for most of the environmental indicators, and especially for the electricity consumption.

Table 5-12: Summary of the results for the five Base-Cases[4]

	Base-Case 1		Base-Case 2		Base-Case 3		Base-Case 4		Base-Case 5	
	TOTAL	USE	TOTAL	USE	TOTAL	USE	TOTAL	USE	TOTAL	USE
Materials, TOTAL (kg)	**2 516**		**1 842**		**2 968**		**4 866**		**8 332**	
of which, Disposal (kg)	**1 609**		**1 172**		**1 481**		**2 486**		**5 195**	
Recycled (kg)	**907**		**670**		**1487**		**2380**		**3137**	
Total Energy (GER)	**11 120**	10 673	**12 248**	11 914	**9 279**	8 856	**15 070**	14 358	**13 016**	11 901
of which, electricity (in primary MJ)	**10 786**	10 671	**11 962**	11 912	**8 935**	8 854	**14 510**	14 354	**12 100**	11 894
Water (process)	**4 525**	4 435	**2 664**	2 634	**2 497**	2 430	**2 910**	2 798	**3 589**	3 423
Waste, non-haz./landfill	**14 751**	12 392	**17 415**	13 845	**14 250**	10 301	**23 470**	16 705	**23 207**	13 876
Waste, hazardous/ incinerated	**1 801**	246	**1 483**	275	**1 620**	204	**2 933**	334	**5 849**	279
Greenhouse Gases in GWP100	**492**	466	**540**	520	**412**	386	**668**	627	**576**	519
Acidification, emissions	**2 900**	2 749	**3 185**	3 068	**2 439**	2 281	**3 950**	3 698	**3 443**	3 066
Volatile Organic Compounds (VOC)	**5**	4	**5**	4	**4**	3	**6**	5	**6**	4
Persistent Organic Pollutants (POP)	**84**	70	**85**	78	**105**	58	**168**	95	**106**	78
Heavy Metals to air	**298**	184	**264**	205	**250**	153	**369**	247	**362**	205
PAHs	**40**	30	**94**	84	**88**	78	**55**	29	**86**	25
Particulate Matter (PM, dust)	**335**	59	**295**	66	**274**	49	**431**	79	**793**	66
Heavy Metals to water	**138**	69	**127**	77	**119**	58	**172**	93	**176**	77
Eutrophication	**3**	0	**2**	0	**3**	0	**4**	0	**6**	0

[4] In this table the value 0 is not an absolute zero but it is a rounded value.

5.3. BASE-CASE LIFE CYCLE COSTS

The Life-Cycle Costs (LCC) of the five Base-Cases are presented in Table 5-13. They were calculated with the EcoReport tool using the product price, energy and water consumption and their associated rates, consumption of other consumables (e.g. coffee, filters) and their associated rates, and repair and maintenance costs (decalcification) (see section 2.4.3).

Table 5-13: EcoReport outcomes of the LCC calculations of the five Base-Cases

	Base-Case 1	Base-Case 2	Base-Case 3	Base-Case 4	Base-Case 5
Product price (€)	35	81	156	103	595
Energy costs (€)	147	161	120	195	152
Coffee costs (€)	1 952	3 943	7 887	2 208	2 984
Other costs (water, filter) (€)	124	4	4	4	6
Repair and maintenance costs (€)	0	72	72	72	194
LCC (€)	**2 257**	**4 262**	**8 239**	**2 582**	**3 931**

The coffee price represents the biggest part of the LCC. The coffee is more expensive for Base-Case 3 because of the caps. From a consumer point of view, an increase in energy efficiency will be more visible for Base-Cases 1 to 4, as the LCC will be reduced in a bigger way (the product price for Base-Case 5 represents 58% of the life cycle cost apart from coffee costs, see Figure 5-12).

Other costs for the drip filter coffee machine (Base-Case 1) are high compared to the other Base-Cases as they include the filters besides the water cost (see Figure 5-11).

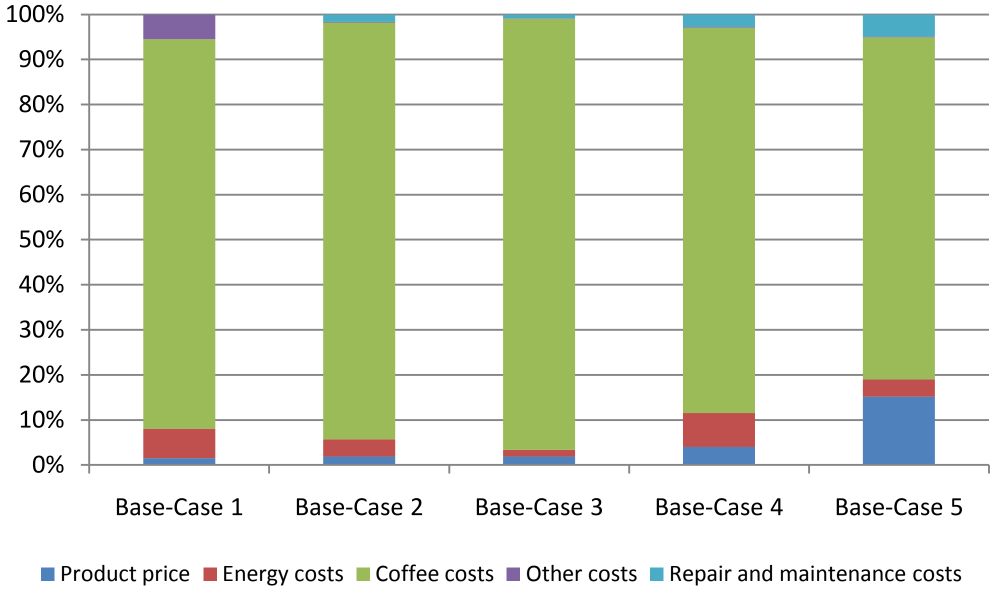


Figure 5-11: Contribution of various costs to the LCC of the Base-Cases, including coffee costs

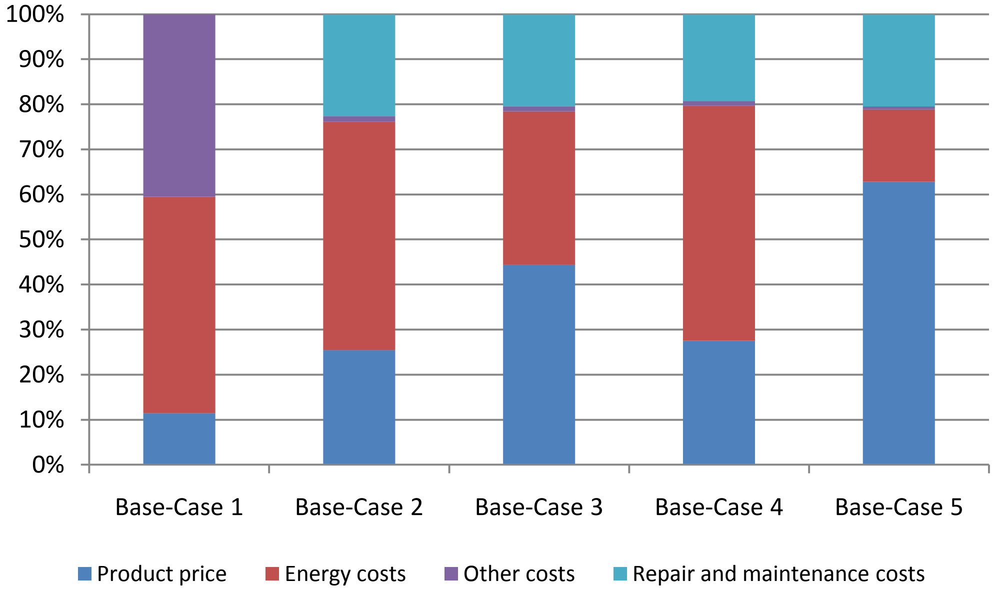


Figure 5-12: Contribution of various costs to the LCC of the Base-Cases, excluding coffee costs

5.4. EU TOTALS

This section provides the environmental assessment of the Base-cases at the EU-27 level using stock and market data from Task 2 for the year 2010.

5.4.1. LIFE CYCLE ENVIRONMENTAL IMPACTS

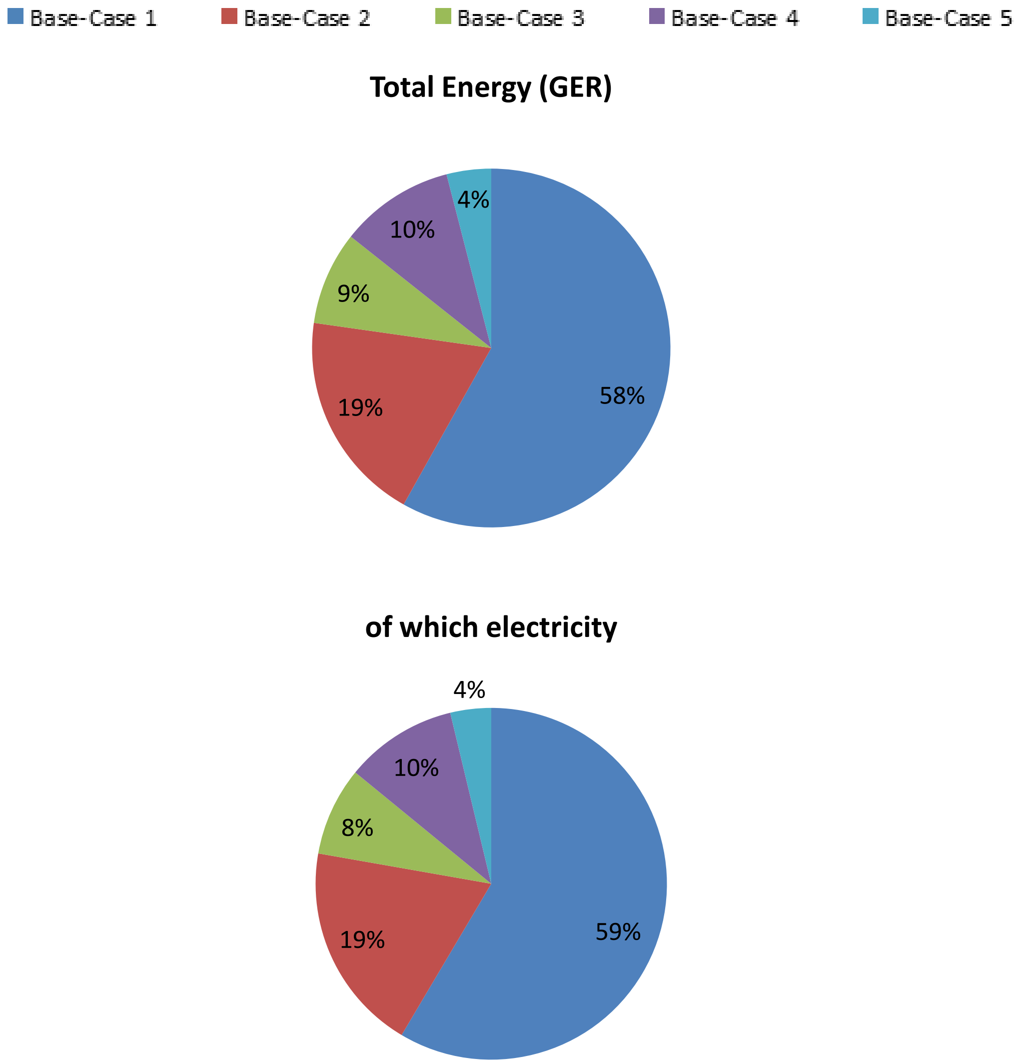
Table 5-14 shows the total environmental impacts of all products in operation in EU-27 in 2010, based on the extrapolation of the Base-Cases impacts (assuming that all coffee machines have the same impacts as the Base-Case of their category). These figures come from the EcoReport tool by multiplying the individual environmental impacts of a Base-Case with the stock of this Base-Case in 2010. In addition the total electricity consumption of the stock of coffee machines corresponds to about 17 TWh.

Table 5-14: Environmental impacts of the EU-27 stock in 2010 for all Base-cases

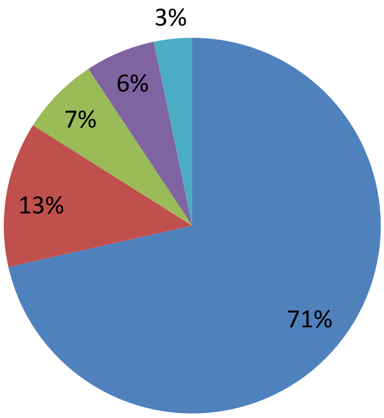
Environmental Impact	Base-Case 1	Base-Case 2	Base-Case 3	Base-Case 4	Base-Case 5	Total
Total Energy (GER) (in PJ)	108.76	35.77	15.76	19.31	7.51	187.11
of which electricity (in PJ)	105.67	34.76	14.73	18.66	6.77	180.58
Water process (in million m^3)	44.31	7.75	4.18	3.73	2.03	62.00
Waste,non-hazardous/landfill (in kt)	143.28	52.79	28.73	29.35	15.26	269.42
Waste, hazardous/ incinerated *(in kt)*	16.78	5.07	4.59	3.45	4.67	34.55
Emissions to air						
Greenhouse Gases in GWP100 (in Mt CO_2 eq.)	4.81	1.58	0.71	0.85	0.33	8.29
Acidification, emissions (in kt SO_2 eq.)	28.35	9.32	4.20	5.05	2.01	48.94
Volatile Organic Compounds (VOC) (in kt)	0.05	0.02	0.01	0.01	0.01	0.09
Persistent Organic Pollutants (POP) (in g i-Teq.)	0.81	0.25	0.24	0.21	0.07	1.58
Heavy Metals emissions to the air (in ton Ni eq.)	2.86	0.81	0.54	0.46	0.24	4.91
PAHs (in ton Ni eq.)	0.39	0.28	0.16	0.07	0.06	0.96
Particulate Matter (PM, dust) (in kt)	3.13	1.00	0.76	0.51	0.63	6.02
Emissions to water						

Environmental Impact	Base-Case 1	Base-Case 2	Base-Case 3	Base-Case 4	Base-Case 5	Total
Heavy Metals emissions to water (in ton Hg/20)	1.32	0.40	0.28	0.21	0.12	2.33
Eutrophication (in kt PO_4)	0.03	0.01	0.01	0.01	0.01	0.06

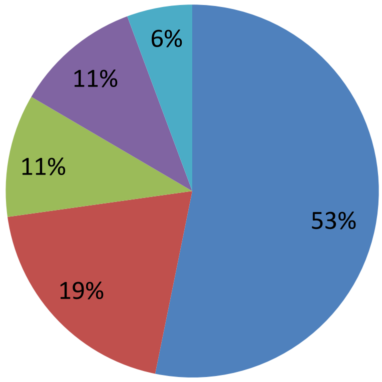
A summary of environmental impacts of the Base-Cases as a percentage of total impacts is presented in Figure 5-13.



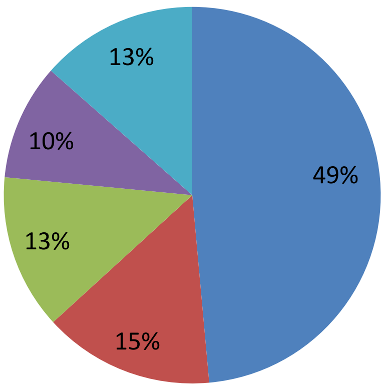
Water process



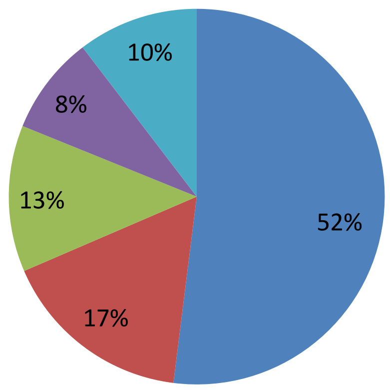
Waste,non-hazardous/landfill



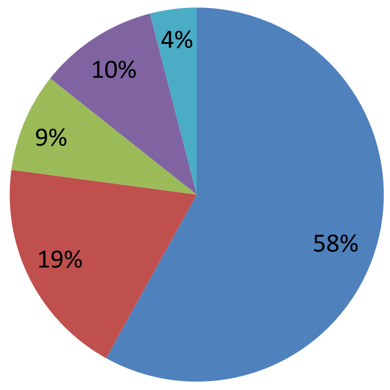
Waste, hazardous/ incinerated



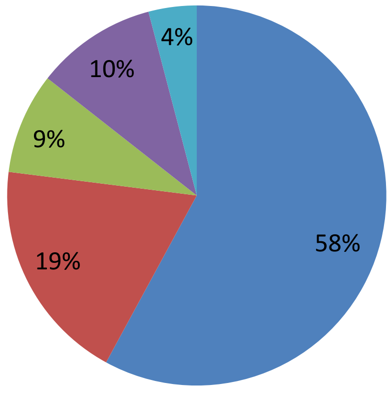
Particulate Matter (PM, dust)



Greenhouse Gases in GWP100



Acidification, emissions



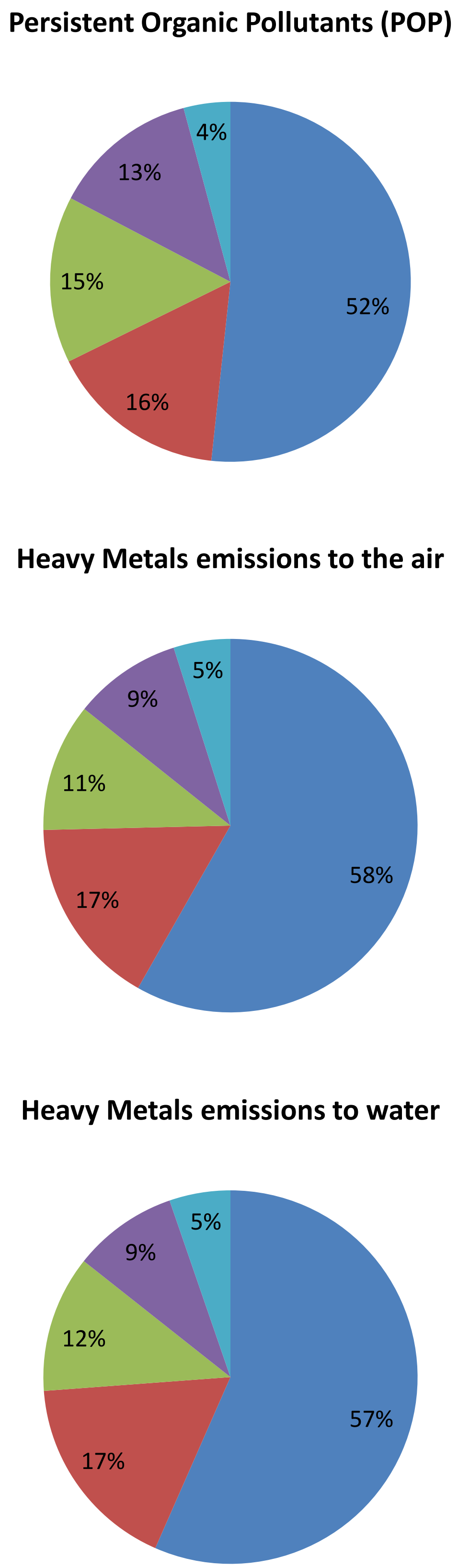


Figure 5-13: Base-Cases' share of the environmental impacts of the 2010 stock

Drip filter coffee machines contribute to the biggest share in all the indicators calculated by EcoReport as they represented 52.1% of the total stock of electric coffee machines in 2010.

5.4.2. Life Cycle Costs

Regarding the total consumer expenditure in 2010 related to coffee machines, about 89% of the total costs are due to the price of coffee. This percentage is lower for fully-automatic espresso machine (71%) due to the price of this product. Details on consumer expenditure are provided in Table 5-15. These results come from the EcoReport tool which take into account the various costs per machine and then extrapolate them for the year 2010 by using the sales and stock data.

Table 5-15: Total annual consumer expenditure in EU-27, 2010

	Base-case 1	Base-case 2	Base-case 3	Base-case 4	Base-case 5	Total
EU-27 sales (mln units)	9,24	3,53	3,01	1,16	0,81	**17,75**
Share of the EU-27 sales	*52.1%*	*19.9%*	*17.0%*	*6.5%*	*4.6%*	
Product Price (mln €)	323	286	470	119	482	**1 680**
Energy costs (mln €)	1 654	547	229	292	104	**2 826**
Coffee costs (mln €)	21 899	13 350	15 045	3 315	2 042	**55 651**
Other costs (water, filter, …) (mln €)	1 384	14	8	6	4	**1 416**
Repair and maintenance costs (mln €)	0	244	137	108	133	**622**
Total (mln €)	25 260	14 441	15 889	3 840	2 765	**62 195**
Share of Total Annual Consumer Expenditure	*40.6%*	*23.2%*	*25.5%*	*6.2%*	*4.4%*	

5.5. CONCLUSIONS

The environmental impact assessments carried out with the EcoReport tool shows that there are some common observations to all domestic Base-Cases: the use phase is by far the most impacting stage of the life cycle in terms of energy consumption and waste, non-hazardous/landfill. The production phase has a significant contribution to the following impacts: generation of non-hazardous waste, heavy metals emissions to air and water, acidification emissions and eutrophication. Finally, the end-of-life phase is dominating only one category: Waste, hazardous/ incinerated.

The analysis of the improvement potential in Task 7 will focus on technologies that reduce the energy consumption, and also on alternative material reducing environmental impacts. Task 6 will examine the improvement options of coffee machines considered as best available technologies, in an attempt to improve upon the Base-Cases.