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Lot 25 **Non-Tertiary Coffee Machines**

Task 4: Technical analysis of existing products – Final version

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4. TASK 4 – TECHNICAL ANALYSIS OF EXISTING PRODUCTS

This task is a general technical analysis of current products on the EU market and provides general inputs for the definition of the Base-Cases (Task 5) as well as the identification of part of the improvement potential (Task 7), i.e. the part that relates to better-performing products that are already on the market. Bills of materials and resource consumption during all life-cycle stages are presented for several product types.

It should be underlined that the product cases have been chosen in order to represent the largest share of the market. Due to non-disclosure agreements with the data suppliers, it is not possible to give detailed information about each data set used.

4.1. PRODUCTS DESCRIPTION

4.1.1. MAIN COMPONENTS

The typical functional components constituting a non-tertiary coffee machine are detailed below for each coffee machine type addressed in this study. Note that combination machines are also in the scope and contain components of more than one of the machine types below.

■ Drip filter coffee machine:

- Housing
- Plate unit
- Electric network
- Water network



■ Pad filter coffee machine:

- Housing
- Percolation system
- Electric network and resistance
- Pump system



■ **Hard cap espresso coffee machine:**

- Housing
- Percolator capsule system
- Electric network and resistance system
- Pump system



■ **Semi-automatic espresso coffee machine:**

- Housing
- Percolation system
- Pump system
- Control system
- Resistance system
- Steam system
- Filter holder system



■ **Fully automatic coffee machine:**

- Housing
- Brewing module, including grinder
- Control system
- Pump system
- Steam system



All these components influence the raw material requirements and thus contribute to the environmental impacts caused by the production phase.

4.1.2. OPERATIONAL PRINCIPLE¹

Drip filter coffee machine: A flow-type heating system heats water from a storage tank. The boiling water is driven by steam power and flows through a tube to reach a

¹ Based on Nipkow, J., Josephy, B., Bush, E. and A. Pilone (forthcoming) *For a tasty but efficient coffee*, Paper for the 2011 Summer Study of the European Council for an Energy Efficient Economy, 6-11 June 2011, Belambra Presqu'île de Giens.

paper filter filled with ground coffee set on top of a jug. Drops of hot water fall on the ground coffee and slowly percolate down to the jug.

Pad filter coffee machine: Water is pumped at low pressure (<8 bars, often as low as 2.5 bars) through the heating unit (traditional boiler, thermoblock or flow-through heater). At a temperature of around 90°C, a set amount of water is forced through a pad, from where the brewing process sends coffee to a cup placed below the spout.

Hard cap espresso machine: Water is pumped, usually at high pressure (>8 bars) though for some types at low pressure, through a heating unit (traditional boiler, thermoblock or flow-through heater). At a temperature of around 90°C, a set amount of water is injected into the capsule, from where the brewing process sends coffee to a cup placed below the spout.

Semi-automatic espresso machine: A piston lever (portafilter) containing coffee grounds in a metal filter is manually placed in a support. A set amount of water is pumped at high pressure (>8 bars, usually 15 bars) through the heating unit (traditional boiler or thermoblock or flow-through heater). At a temperature of about 90°C, water is pressed through the piston, from where the brewing process sends coffee to a cup placed below the spout.

Fully automatic espresso machine: Similar to a semi-automatic machine but containing an electrically-driven brewing unit and a grinder. A set amount of coffee is ground from beans. The ground coffee is placed in the brewing unit and after brewing ejected. Water is pumped at high pressure (usually 15 bars) through the heating unit (traditional boiler, thermoblock or flow-through heater) and through the brewing unit at around 90°C to a cup.

4.2. PRODUCTION PHASE

The material composition of coffee machines is presented in the following Bills of Materials (BoMs) obtained by disassembling the machines.

4.2.1. TYPICAL BoM OF A DRIP FILTER COFFEE MACHINE

The typical BoM of a drip filter coffee machine is presented in Table 4-1 and Table 4-2.

Table 4-1: BoM of a drip filter coffee machine

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
1	HOUSING			
2	Coffee pot	287,7	2-TecPlastics	18-E-glass fibre
3	Coffee pot handle	42,2	1-BlkPlastics	4-PP
4	Screws coffee pot handle	1,0	3-Ferro	25-Stainless 18/8 coil
5	Tank coffee pot	18,4	1-BlkPlastics	4-PP

6	Metallic circle of coffee pot	9,0	4-Non-ferro	26-Al sheet/extrusion
7	Hinged filter carrier	146,2	1-BlkPlastics	4-PP
8	Hinged filter carrier coating	107,8	3-Ferro	25-Stainless 18/8 coil
9	Hinged filter	75,8	1-BlkPlastics	4-PP
10	Stop drop	1,2	1-BlkPlastics	4-PP
11	Stop drop spring	0,6	3-Ferro	21-St sheet galv.
12	Stop drop seal	0,1		
13	Water tank cover	35,8	1-BlkPlastics	4-PP
14	Nonslip rubber tip (x4)	1,8		
15	Base	135,5	1-BlkPlastics	4-PP
16	Base screws (x8)	4,8	3-Ferro	25-Stainless 18/8 coil
17	Bottom and high part retaining screws	2,6	3-Ferro	25-Stainless 18/8 coil
18	Bottom part housing	196,2	1-BlkPlastics	4-PP
19	High part housing	529,2	1-BlkPlastics	4-PP
20	High part housing coating	323,4	3-Ferro	25-Stainless 18/8 coil
21	Other	106,2	1-BlkPlastics	4-PP
22	Seal between Hot plate and housing	40,9	1-BlkPlastics	
23				
24	ELECTRIC CIRCUIT			
25	Line cord	30,9	1-BlkPlastics	8-PVC
26		30,9	4-Non-ferro	29-Cu wire
27	Line cord lip retaining	1,2	1-BlkPlastics	4-PP
28	Lip retaining screws (x2)	1,3	3-Ferro	25-Stainless 18/8 coil
29	Hot plate	74,8	3-Ferro	21-St sheet galv.
30	Hot plate screws (x2)	1,5	3-Ferro	25-Stainless 18/8 coil
31	Integrated circuit	34,4	6-Electronics	47-IC's avg., 1% Si
32	Button and LCD screen integrated circuit	17,9	6-Electronics	47-IC's avg., 1% Si
33	Button wires	4,1	4-Non-ferro	29-Cu wire
34	LCD screen	5,6	6-Electronics	42-LCD per m2 scrn
35	Buttons (x7)	1,3	1-BlkPlastics	4-PP
36	Button springs (x7)	0,2		
37	Button support	10,5	2-TecPlastics	12-PC
38	Button integrated circuit screws	0,8	3-Ferro	25-Stainless 18/8 coil
39	Button support coating	6,0	3-Ferro	25-Stainless 18/8 coil
40	Retaining bar resistance on hot plate	19,0	3-Ferro	21-St sheet galv.
41	Bar screws (x2)	2,1	3-Ferro	25-Stainless 18/8 coil
Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
42	Resistance	143,2	4-Non-ferro	27-Al diecast
43	Wire	8,0	4-Non-ferro	29-Cu wire
44	THERMOSTAT	4		
45	Fuse	0,7		
46	Thermostat ring	4,3	3-Ferro	21-St sheet galv.
47	Thermostat screws (x2)	2	3-Ferro	25-Stainless 18/8 coil

48	Fuse and wire sheath	3,5		
49				
50	WATER WAY			
51	Resistance pipe	18,4		
52	Tip	6,6	1-BlkPlastics	4-PP
53	Pipe ring (x4)	8,3	3-Ferro	21-St sheet galv.
54	Resistance to filter pipe	7,7	1-BlkPlastics	4-PP
55				

Table 4-2: BoM of a drip filter coffee machine in %

Items	Weight (g)	%
PP	1 303.5	51.80
PC	10.5	0.42
PPS	40.9	1.63
PVC	30.85	1.23
Glass fibbre	287.7	11.43
Non-ferrous	9	0.36
Ferrous	107.5	4.27
Stainless steel	453.3	18.01
Cu	30.85	1.23
Al	143.2	5.69
Rubber	20.5	0.81
Electronic	75.1	2.98
Miscellaneous	3.5	0.14

With this BoM, the manufacturing phase values in the EcoReport tool are calculated automatically as shown in Table 4-3.

Table 4-3: Manufacturing phase of a drip filter coffee machine

MANUFACTURING Description	Weight in g	Percentage Adjust
OEM Plastics Manufacturing (fixed)	1386	
Foundries Fe/Cu/Zn (fixed)	0	
Foundries Al/Mg (fixed)	143	
Sheetmetal Manufacturing (fixed)	569	
PWB Manufacturing (fixed)	9	
Other materials (Manufacturing already included)	120	
Sheetmetal Scrap (Please adjust percentage only)	28	5%

Only the sheet metal scrap value is adjustable. **5% will be considered for all base-cases.**

4.2.2. TYPICAL BoM OF A PAD FILTER COFFEE MACHINE

The typical BoM of a pad filter coffee machine is presented in Table 4-4 and Table 4-5.

Table 4-4: BoM of a pad filter coffee machine

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
1	Motor bloc			
2	pipe	6,0	1-BlkPlastics	
3	motor	38,0	3-Ferro	21-St sheet galv.
4		80,0	7-Misc.	
5	miscellaneous	12,0	3-Ferro	21-St sheet galv.
6				
7	Water heater			
8	shell	62,0	2-TecPlastics	11-PA 6
9	top	134,0	3-Ferro	25-Stainless 18/8 coil
10	elec. Protection	4,0	2-TecPlastics	12-PC
11	pipe	8,0	2-TecPlastics	11-PA 6
12	elec. Component	4,0	6-Electronics	
13				
14	Head			
15	water dispensing	10,0	2-TecPlastics	11-PA 6
16	spring	4,0	3-Ferro	22-St tube/profile
17	joint	12,0	2-TecPlastics	
18	filter holder	88,0	2-TecPlastics	11-PA 6
19	top	142,0	1-BlkPlastics	10-ABS
20		8,0	1-BlkPlastics	
21	pipe	6,0	2-TecPlastics	
22	opening	128,0	2-TecPlastics	11-PA 6
23	pod holder	4,0	1-BlkPlastics	4-PP
24		2,0	1-BlkPlastics	
25		32,0	3-Ferro	25-Stainless 18/8 coil
26	funnel	10,0	1-BlkPlastics	4-PP
27	cooffe dispensing	32,0	1-BlkPlastics	
28		34,0	3-Ferro	21-St sheet galv.
29		8,0	1-BlkPlastics	4-PP
30				
31	Drip tray			
32	drip tray	22,0	1-BlkPlastics	4-PP
33	grid	60,0	3-Ferro	21-St sheet galv.
34				
35	base			
36	pipe	10,0	2-TecPlastics	
37	plastic part 1	150,0	1-BlkPlastics	4-PP

38	plastic part 2	110,0	1-BlkPlastics	10-ABS
39	2 knobs "1 cup" "2 cups"	4,0	1-BlkPlastics	4-PP
40	power switch	2,0	1-BlkPlastics	10-ABS
41				
Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
42	Elec			
43	2 ribbon cable	6,0	6-Electronics	
44	sonde	0		
45	electric cables	24	4-Non-ferro	29-Cu wire
46	electronic card 1	0	6-Electronics	51-PWB 6 lay 2 kg/m2
47	electronic card 2	2	6-Electronics	51-PWB 6 lay 2 kg/m2
48	electronic card 3	26	6-Electronics	49-PWB 1/2 lay 3.75kg/m2
49	aluminium part	30	4-Non-ferro	26-Al sheet/extrusion
50				
51	Screwing			
52	screw	6	3-Ferro	22-St tube/profile
53	plastic clips	2	1-BlkPlastics	
54				
55				
56	Miscellaneous			
57	Water tank	188	1-BlkPlastics	4-PP
58	back part housing	80	1-BlkPlastics	4-PP
59	elec. Protection	6	1-BlkPlastics	4-PP
60	housing	142	1-BlkPlastics	4-PP
61	power cord	100	4-Non-ferro	29-Cu wire
62	water inflow	4	1-BlkPlastics	4-PP
63				

Table 4-5: BoM of a pad filter coffee machine

Item	Weight (g)	%
ABS	254	13.87
Steel	154	8.41
Aluminium	30	1.64
Cable	130	7.10
Electronic	28	1.53
Stainless steel	166	9.07
PA - GF30	170	9.28
PA - GF50	64	3.50
PA6 - GF40	62	3.39
PC	4	0.22
Plastics misc.	26	1.42

Item	Weight (g)	%
POM	42	2.29
PP	621	33.92
Motor	80	4,37

4.2.3. TYPICAL BOM OF A HARD CAP ESPRESSO MACHINE

The BoM of a hard cap espresso machine is presented in Table 4-6 and Table 4-7.

Table 4-6: BoM of a hard cap espresso machine

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
1	HOUSING			
2	Removable water tank	200,0	1-BlkPlastics	9-SAN
3	Water tank stop drop	0,6	1-BlkPlastics	
4	Stop drop spring	0,5	3-Ferro	
5	Stop drop seal	0,2		
6	Drip grid	45,8	3-Ferro	
7	Drip tray and capsule container	127,1	1-BlkPlastics	10-ABS
8	Capsule container	29,2	1-BlkPlastics	4-PP
9	Side housing (x2)	126,9	1-BlkPlastics	10-ABS
10	Base	137,0	1-BlkPlastics	10-ABS
11	Base screws (x8)	4,5	3-Ferro	21-St sheet galv.
12	Bottom housing percolator	101,5	1-BlkPlastics	10-ABS
13	Bottom housing percolator screws	2,2	3-Ferro	21-St sheet galv.
14	Main housing	298,5	1-BlkPlastics	10-ABS
15				
16	PERCOLATOR AND CAPSULE SYSTEM			
17	Lever	193,0	4-Non-ferro	32-ZnAl4 cast
18	Lever screws (x2)	5,0	3-Ferro	21-St sheet galv.
19	Spout	26,0	1-BlkPlastics	10-ABS
20	Spout ring	8,0	1-BlkPlastics	10-ABS
21	Capsule system housing	125,1	2-TecPlastics	11-PA 6
22	Capsule system housing screws (x4)	2,9	3-Ferro	21-St sheet galv.
23	Rotation lever rod	46,7	3-Ferro	
24	Stop rotation lever rod	1,8	3-Ferro	
25	Retaining ring lever (x3)	2,3	3-Ferro	
26	Clamping capsule system ferrous	62,0	3-Ferro	
27	Rotation-Translation piece	17,1	2-TecPlastics	11-PA 6
28	Capsule holder piece	32,4	2-TecPlastics	11-PA 6
29	Tip	0,7	1-BlkPlastics	
30	Seal	1,8		
31				

32	ELECTRIC CIRCUIT			
33	Line cord	63,6	1-BlkPlastics	8-PVC
34		63,6	4-Non-ferro	28-Cu winding wire
35	Line cord screws (x2)	1,4	3-Ferro	21-St sheet galv.
36	Line cord lip retaining	0,3	1-BlkPlastics	
37	Integrated circuit	31,8	6-Electronics	47-IC's avg., 1% Si
38	Heat sink	36,0	4-Non-ferro	27-Al diecast
39	Integrated circuit box	37,4	2-TecPlastics	11-PA 6
40	Integrated circuit box screws	1,5	3-Ferro	21-St sheet galv.
41	Button On/Off connector	3,3	4-Non-ferro	
Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
42	Button On/Off spring (x2)	0,3	3-Ferro	
43	Button On/Off	6,5	1-BlkPlastics	
44	Button On/Off support	7	2-TecPlastics	11-PA 6
45	Button On/Off support screws	0,7	3-Ferro	21-St sheet galv.
46	Wire	27,2	4-Non-ferro	29-Cu wire
47	Wire lip	11,7	1-BlkPlastics	
48	Wire strap	6,5	2-TecPlastics	11-PA 6
49	Ground screw	1,6	3-Ferro	21-St sheet galv.
50	Coffee button (x2)	4,6		
51	Coffee button integrated circuit (x2)	2,8	6-Electronics	47-IC's avg., 1% Si
52	Wire connector	1,8	6-Electronics	
53	Pump fuse	0,7	6-Electronics	
54	Resistance fuse (x2)	1,8	6-Electronics	
55	Fuse sheath resistance (x2)	2,2	1-BlkPlastics	
56	Fuse resistance screws (x2)	3,2	3-Ferro	21-St sheet galv.
57	Water transducer resistance	4,1	6-Electronics	
58	Fuse resistance ring (x2)	1,4	3-Ferro	
59	Coffee button diode (x2)	0,1	6-Electronics	
60				
61	RESISTANCE SYSTEM			
62	Plate holder resistance	39,3	2-TecPlastics	11-PA 6
63	Isolate between plate and resistance	3,7		
64	Plate screws (x4)	5,1	3-Ferro	21-St sheet galv.
65	Ring	1,4		
66	Pipe	16,1	1-BlkPlastics	
67	Pipe tip	2,3	4-Non-ferro	
68	Pipe tip seal	0,1		
69	Pipe retaining ring	0,5	3-Ferro	
70	Elbow pipe	3	2-TecPlastics	11-PA 6
71	Wire protection	2,2		
72	Resistance	458,7	4-Non-ferro	32-ZnAl4 cast
73				

74	PUMP SYSTEM			
75	Water tank tip	4,7	1-BlkPlastics	10-ABS
76	Water tank tip seal	0,7		
77	Water tank tip retaining ring	0,3	3-Ferro	
78	Water tank tip grid	0,2	3-Ferro	
79	Up counter	17,1	2-TecPlastics	11-PA 6
80	Up counter blade	1,7	1-BlkPlastics	
81	Up counter connector	2,1	6-Electronics	
82	Pipe	13,2	1-BlkPlastics	
83	Pipe retaining ring	0,6	3-Ferro	
84	Pipe elbow	5,4	2-TecPlastics	11-PA 6
85	Rubber holder pump	23,8		
86	Rubber holder pump strap	2,4	1-BlkPlastics	
87	Pump ring	123,1	3-Ferro	
88	Pump ring screws (x2)	3	3-Ferro	21-St sheet galv.

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
89	Pump	226		
90	Pump Shaft	22	1-BlkPlastics	
91	Pump shaft ring (x2)	47	3-Ferro	
92	Pump shaft ring	1,1	1-BlkPlastics	
93	Pump shaft seal	1,3		
94	Pump spring	4,6	3-Ferro	
95	Pump tip	20,7	3-Ferro	
96				
97				

Table 4-7: BoM of a hard cap espresso machine

Items	Weight (g)	%
Acrylonitrile butadiene styrene (ABS)	829.7	27.89
Rubber	16	0.54
Polyamide	131.3	4.41
Polybutylene terephthalate (PBT)	159.3	5.36
Polypropylene	29.2	0.98
PVC	63.55	2.14
Styrene acrylonitrile (SAN)	200	6.72
Nitrile rubber (NBR)	23.8	0.80
Plastic	66.3	2.23
Cu	63.55	2.14
Al	36	1.21

Items	Weight (g)	%
ZnAl	651.7	21.91
Steel, galvanised	32.1	1.08
Ferrous	367.7	12.36
Non-ferrous	5.6	0.19
Electronic	72.4	2.43
Miscellaneous	226.2	7.60

4.2.4. TYPICAL BOM OF A SEMI-AUTOMATIC ESPRESSO MACHINE

The typical BoM of a semi-automatic espresso machine is presented in Table 4-8 and Table 4-9.

Table 4-8: BoM of a semi-automatic espresso machine

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
1	HOUSING			
2	Removable water tank	201,2	1-BlkPlastics	10-ABS
3	Water tank handle	10,1	1-BlkPlastics	
4	Water tank stop drop	0,6	3-Ferro	21-St sheet galv.
5	Stop drop spring	0,6		
6	Stop drop seal	0,2	1-BlkPlastics	10-ABS
7	Water compartment lip	142,8	1-BlkPlastics	10-ABS
8	Measuring spoon	25,9	4-Non-ferro	27-Al diecast
9	Drip tray grid	83,0	1-BlkPlastics	10-ABS
10	Drip tray grid coating	117,0	4-Non-ferro	27-Al diecast
11	Level indicator	4,1	1-BlkPlastics	4-PP
12	Drip tray	131,3	1-BlkPlastics	10-ABS
13				
14	Drip tray screws (x2)	1,0	3-Ferro	25-Stainless 18/8 coil
15	Water tank support	326,9	1-BlkPlastics	10-ABS
16	Cup tray	113,4	3-Ferro	21-St sheet galv.
17	Cup tray handles (x2)	38,8	3-Ferro	21-St sheet galv.
18	Handles screws	2,0	3-Ferro	25-Stainless 18/8 coil
19	Water tank holder screws (x4)	2,5	3-Ferro	25-Stainless 18/8 coil
20	Isolator plate	7,8		
21	Base	117,5	1-BlkPlastics	10-ABS
22	Base screws (x6)	3,8	3-Ferro	21-St sheet galv.
23	Nonslip rubber tip (x4)	4,4		
24	Back part housing	182,6	1-BlkPlastics	10-ABS
25	Back part housing screws (x6)	2,9	3-Ferro	25-Stainless 18/8 coil
26	Bottom pat housing	409,9	1-BlkPlastics	10-ABS
27	Bottom part housing coating	67,3	3-Ferro	25-Stainless 18/8 coil

28	Inside support	365,4	3-Ferro	21-St sheet galv.
29	Inside support screws (x9)	6,6	3-Ferro	25-Stainless 18/8 coil
30	Low part housing	296,3	1-BlkPlastics	10-ABS
31	Control panel	106,7	3-Ferro	25-Stainless 18/8 coil
32	Control panel screws (x2)	1,9	3-Ferro	25-Stainless 18/8 coil
33	Drip tray coating	48,0	4-Non-ferro	27-Al diecast
34				
35	FILTER HOLDER SYSTEM			
36	Filter holder main part	125,0	3-Ferro	21-St sheet galv.
37	Spout	14,3	2-TecPlastics	12-PC
38	Spout coating	6,2	3-Ferro	25-Stainless 18/8 coil
39	Grounds ejection button	2,1	1-BlkPlastics	
40	Grounds ejection spring	0,9	3-Ferro	21-St sheet galv.
41	Fixed ring	29,5	3-Ferro	21-St sheet galv.
Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
42	Fixed ring seal	0,3		
43	Screws ring (x3)	1,2	3-Ferro	21-St sheet galv.
44	Moving part filter holder	18	2-TecPlastics	11-PA 6
45	Outflow moving part seal	0,2		
46	Moving part seal	2,3		
47	Filter plate	2	3-Ferro	21-St sheet galv.
48	Filter plate screw	0,4	3-Ferro	25-Stainless 18/8 coil
49	Handle	50,1	1-BlkPlastics	
50	Handle weight	86,3	3-Ferro	21-St sheet galv.
51	Handle weight screw	0,6	3-Ferro	25-Stainless 18/8 coil
52	Gradual coffee tamping system	9,4	1-BlkPlastics	
53	Gradual coffee tamping system spring	1,6	3-Ferro	21-St sheet galv.
54	Rack tamping system tip	2,2	3-Ferro	21-St sheet galv.
55	Rack tamping system tip screw	0,4	3-Ferro	25-Stainless 18/8 coil
56	Gradual coffee tamping system screw	0,4	3-Ferro	25-Stainless 18/8 coil
57				
58	STEAM NOZZLE SYSTEM			
59	Steam production wheel	13,7	1-BlkPlastics	4-PP
60	Steam nozzle tip	1,2	1-BlkPlastics	
61	Steam nozzle tip seal	0,1		
62	steam nozzle ball joint	9,6	1-BlkPlastics	
63	Ball joint seal	0,1		
64	Steam nozzle main body	29,6	3-Ferro	21-St sheet galv.
65	Ball joint ring	4,1	1-BlkPlastics	
66	Ball joint ring seal	0,3		
67	Ball joint ring screws (x3)	2,1	3-Ferro	25-Stainless 18/8 coil
68	Wheel support	7,4	1-BlkPlastics	
69	Limit stop wheel support screw	0,2	3-Ferro	25-Stainless 18/8 coil

70	Wheel support seal	0,3		
71	Pipe support	11,6	1-BlkPlastics	
72	Pipe support screw	1,2	3-Ferro	25-Stainless 18/8 coil
73	Pipe	21,4		
74	Pipe ring	4,1	3-Ferro	21-St sheet galv.
75	Sensor	1,7	6-Electronics	
76	Sensor screws (x2)	0,4	3-Ferro	25-Stainless 18/8 coil
77	Wires	10,5	4-Non-ferro	29-Cu wire
78	Steam nozzle accessory main body	9,2	1-BlkPlastics	
79	Steam nozzle accessory coating	4,1	3-Ferro	25-Stainless 18/8 coil
80	Steam nozzle accessory stem	1,9	3-Ferro	21-St sheet galv.
81	Steam nozzle accessory tip	1,5	1-BlkPlastics	
82	Steam nozzle accessory auto-cappuccino main body	14,3	1-BlkPlastics	
83	Steam nozzle accessory auto-cappuccino coating	5,6	3-Ferro	25-Stainless 18/8 coil
84	Accessory auto-cappuccino tip	2	1-BlkPlastics	
85	Accessory auto-cappuccino pipe	6,9		
86				
87				
88				

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
89	ELECTRIC CIRCUIT			
90	Integrated circuit	52	6-Electronics	47-IC's avg., 1% Si
91	Integrated circuit screws (x4)	2	3-Ferro	25-Stainless 18/8 coil
92	Integrated circuit support	22,5	1-BlkPlastics	4-PP
93	Integrated circuit support screws (x4)	1,9	3-Ferro	25-Stainless 18/8 coil
94	Line cord	60,15	1-BlkPlastics	8-PVC
95		60,15	4-Non-ferro	28-Cu winding wire
96	Line cord lip retaining	0,6	1-BlkPlastics	
97	Line cord lip retaining screws (x2)	1,4	3-Ferro	25-Stainless 18/8 coil
98	Wires	27,7	4-Non-ferro	29-Cu wire
99	Slit fitting	6	6-Electronics	
100	Wire tip sheath	1	1-BlkPlastics	
101	Fuses (x2)	1,8	6-Electronics	
102	Fuse ring	1,5	3-Ferro	21-St sheet galv.
103	Fuse ring screws	0,4	3-Ferro	25-Stainless 18/8 coil
104	Fuse sheath	1,9		
105	Ground screw	1,7	3-Ferro	25-Stainless 18/8 coil
106	Solenoid valve water way	84,1	4-Non-ferro	31-CuZn38 cast
107	Solenoid valve electric circuit	52,7	6-Electronics	
108	Solenoid valve (x4)	2,6	3-Ferro	25-Stainless 18/8 coil
109	Solenoid valve support	16,6	3-Ferro	21-St sheet galv.
110	Solenoid valve support screws	0,8	3-Ferro	25-Stainless 18/8 coil

111	Solenoid valve wire	6,2	4-Non-ferro	29-Cu wire
112	Solenoid valve wire tip sheath	1,1		
113				
114	RESISTANCE SYSTEM			
115	Resistance	495,2	4-Non-ferro	32-ZnAl4 cast
116	thermocouple probe	8	6-Electronics	
117	thermocouple probe ring retaining	1	3-Ferro	25-Stainless 18/8 coil
118	Thermocouple probe ring retaining screws	0	3-Ferro	25-Stainless 18/8 coil
119	Resistance screws (x3)	5	3-Ferro	25-Stainless 18/8 coil
120	Isolator plate	6		
121	Resistance wire	11	6-Electronics	
122	Resistance wire tip sheath	1		
123				
124	PUMP SYSTEM			
125	Meter	15		
126	Meter seal	0		
127	Meter wire	4	4-Non-ferro	29-Cu wire
128	Meter screws	1	3-Ferro	25-Stainless 18/8 coil
129	Pump	378		
130	Pump sensor and wire	9		
131	Pump wire tip sheath	2		
132	Pump support	9	1-BlkPlastics	4-PP
133	Pump support screws (x4)	2	3-Ferro	25-Stainless 18/8 coil
134	Pump rubber (x2)	34		
135	Pump pipe out	17		
Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
136	Meter pipe (x2)	14		
137	Meter pipe spring (x2)	2	3-Ferro	21-St sheet galv.
138	Pump pipe ring	2	3-Ferro	25-Stainless 18/8 coil
139	pump tip out	6		
140	Water tank tip out	6	1-BlkPlastics	4-PP
141	Tank tip seal	3		
142	Tank tip screws (x2)	1	3-Ferro	25-Stainless 18/8 coil
143	Tank tip drilled plate	1	3-Ferro	21-St sheet galv.
144				
145	CONTROL SYSTEM			
146	Support	18	1-BlkPlastics	4-PP
147	Support screws	2	3-Ferro	25-Stainless 18/8 coil
148	integrated circuit	15	6-Electronics	47-IC's avg., 1% Si
149	Integrated circuit screws (x5)	2	3-Ferro	25-Stainless 18/8 coil
150	Button (x4)	9		
151	Wire	12	4-Non-ferro	29-Cu wire
152				

153	STEAM SYSTEM			
154	Pipe	20		
155	Pipe ring	2	3-Ferro	25-Stainless 18/8 coil
156	Tank	92	1-BlkPlastics	4-PP
157	Tank screws	4	3-Ferro	25-Stainless 18/8 coil
158				
159	PERCOLATOR SYSTEM			
160	Feed channel pipe	14		
161	Percolator pipe ring	1	3-Ferro	25-Stainless 18/8 coil
162	percolator housing screw	2	3-Ferro	25-Stainless 18/8 coil
163	Rack	196	4-Non-ferro	27-Al diecast
164	percolator housing	34	2-TecPlastics	11-PA 6
165	Percolator inside	51	2-TecPlastics	11-PA 6
166	Percolator housing, percolator inside, rack screws (x8)	9	3-Ferro	25-Stainless 18/8 coil
167	Filter plate	5	3-Ferro	21-St sheet galv.
168	Filter plate percolator screw	0	3-Ferro	25-Stainless 18/8 coil
169	Filter plate support	14	2-TecPlastics	11-PA 6
170	Filter plate support seal	4		
171	Filter plate support spring	1	3-Ferro	21-St sheet galv.
172	Spring tip	0		
173	support plate screws (x3)	4	3-Ferro	25-Stainless 18/8 coil
174				

Table 4-9: BoM of a semi-automatic espresso machine

Items	Weight (g)	%
Acrylonitrile butadiene styrene (ABS)	1 700	32.12
Acrylonitrile styrene (AS)	201	3.80
Rubber	143	2.70
Nylon 6-6 (PA66)	117	2.20
Polycarbonate (PC)	14	0.27
Polyoxymethylene (POM)	15	0.28
Polypropylene	165	3.11
PVC	60	1.14
Plastic	141	2.66
Cu	60	1.14
Stainless steel	245	4.64
Brass	84	1.59
Ferrous	851	16.07
Non-ferrous	387	7.31
Electronic	596	11.25
Miscellaneous	515	9.73

4.2.5. TYPICAL BoM OF A FULLY AUTOMATIC ESPRESSO MACHINE

The typical BoM of a fully automatic espresso machine is presented in Table 4-10 and in Table 4-11.

Table 4-10: BoM of a fully automatic espresso machine

Pos nr	MATERIALS Extraction & Production Description of component	Weight (g)	Category	Material or Process
1	WATER TANK			
2	front part	107,0	1-BlkPlastics	10-ABS
3	tank	219,0	1-BlkPlastics	9-SAN
4	filter	2,0	1-BlkPlastics	4-PP
5	plastic parts	3,0	1-BlkPlastics	10-ABS
6	spring	0,0	3-Ferro	22-St tube/profile
7	joint	0,0	2-TecPlastics	
8				
9	Drip tray			
10	grid	197,0	3-Ferro	21-St sheet galv.
11	"full" indicator	2,0	1-BlkPlastics	4-PP
12	drip tray	212,0	1-BlkPlastics	10-ABS
13				
14	Coffee lid			
15	lid	63,0	1-BlkPlastics	5-PS
16	coffee bean hopper lid	149,0	1-BlkPlastics	5-PS
17	joint	23,0	2-TecPlastics	
18				
19	Top			
20	pre-ground bypass doser	5,0	1-BlkPlastics	5-PS
21	screw	2,0	3-Ferro	22-St tube/profile
22	screw protection	2,0	4-Non-ferro	31-CuZn38 cast
23	plastic disc	7,0	1-BlkPlastics	10-ABS
24	lid screw (x3)	3,0	3-Ferro	22-St tube/profile
25	grinder adjustment knob	3,0	1-BlkPlastics	10-ABS
26	transparent lid	146,0	1-BlkPlastics	5-PS
27				
28				
29	Brew group			
30	plastic part	579,0	1-BlkPlastics	
31	screw	9,0	3-Ferro	22-St tube/profile
32	spring	2,0	3-Ferro	22-St tube/profile
33	joint	1,0	2-TecPlastics	
34	coffee filter	3,0	3-Ferro	21-St sheet galv.
35				
36	Screws	55,0	3-Ferro	22-St tube/profile

37				
38	Steam wand			
39	protection	14,0	4-Non-ferro	
40	joint	12,0	2-TecPlastics	
41				
Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
42	Housing			
43	right door	175,0	1-BlkPlastics	10-ABS
44	feet (x4)	7	2-TecPlastics	
45	right door hinge	83	1-BlkPlastics	10-ABS
46	back part housing	236	1-BlkPlastics	10-ABS
47	top part housing	334	1-BlkPlastics	10-ABS
48	left door	200	1-BlkPlastics	10-ABS
49	front part housing	500	3-Ferro	21-St sheet galv.
50	top	470	1-BlkPlastics	4-PP
51	bottom	351	1-BlkPlastics	10-ABS
52				
53	Miscellaneous			
54	dreg drawer	242	1-BlkPlastics	10-ABS
55	hot water wand	14		
56	power cord	150	4-Non-ferro	29-Cu wire
57	plastic wheels (x2)	62	1-BlkPlastics	
58	black pipe	4	2-TecPlastics	
59	transparent pipe	5	1-BlkPlastics	
60	power switch	8	6-Electronics	45-slots / ext. ports
61	outlet	9	6-Electronics	45-slots / ext. ports
62	rubber (x2)	27	2-TecPlastics	
63	knob (x2)	14	1-BlkPlastics	
64	motor KFC545S-16205 38/09	157	7-Misc.	
65				
66	Brewing bloc			
67	spring	3	3-Ferro	22-St tube/profile
68	joint	10	2-TecPlastics	
69	electronic card (1*2 cm)		6-Electronics	51-PWB 6 lay 2 kg/m2
70	plastic parts	13	1-BlkPlastics	10-ABS
71	motor bloc	387	7-Misc.	
72	wheel	14	1-BlkPlastics	4-PP
73	brewing screw	20	3-Ferro	25-Stainless 18/8 coil
74	screw	12	3-Ferro	22-St tube/profile
75	plastic bloc	170	1-BlkPlastics	
76				
77	front part			
78	various parts (control panel)	92	1-BlkPlastics	10-ABS

79	steam dial	70	3-Ferro	25-Stainless 18/8 coil
80	dispensing head	156	1-BlkPlastics	10-ABS
81	screw	2	3-Ferro	22-St tube/profile
82	buttons	13	2-TecPlastics	
Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category	Material or Process
89	Steam distribution			
90	wand	28	3-Ferro	25-Stainless 18/8 coil
91	wheel	6	1-BlkPlastics	
92	various part	36	1-BlkPlastics	
93	protection	36	2-TecPlastics	11-PA 6
94	screw	3	3-Ferro	22-St tube/profile
95	Klixon® (x2)	8	7-Misc.	
96	bloc KANETA 4509 230V/1300W	387	7-Misc.	
97	pipe clips	6	3-Ferro	22-St tube/profile
98	pipes	31	2-TecPlastics	
99				
100	Water distribution			
101	pipes	41	2-TecPlastics	
102	component 932-952 1-B	21	1-BlkPlastics	
103	plastic part	26	1-BlkPlastics	
104	various parts	70	3-Ferro	22-St tube/profile
105	spring	4	3-Ferro	25-Stainless 18/8 coil
106	ULKA model E	364	7-Misc.	
107				
108				
109	Interior plastic housing			
110	part 1	533	1-BlkPlastics	4-PP
111	part 2	423	1-BlkPlastics	4-PP
112	part 3	36	1-BlkPlastics	10-ABS
113	part 4 (electronic protection)	63	1-BlkPlastics	4-PP
114				
115	Electronic			
116	card 1 (5*10 cm)	18	6-Electronics	49-PWB 1/2 lay 3.75kg/m2
117	card 2 (2,5*7 cm)	6	6-Electronics	49-PWB 1/2 lay 3.75kg/m2
118	card 3 (2*3,5 cm)	3	6-Electronics	50-PWB 6 lay 4.5 kg/m2
119	card 4 (14*14 cm)	229	6-Electronics	50-PWB 6 lay 4.5 kg/m2
120	ribbon cable (43 cm)	13	6-Electronics	
121	various part	7	1-BlkPlastics	
122	wires (+ connectors)	104	4-Non-ferro	29-Cu wire

Table 4-11: BoM of a fully automatic espresso machine

Items	Weight (g)	%
ABS	2 170	26.04
Steel	975	11.70
Rubber	80	0.96
Electronic	256	3.07
Stainless steel	114	1.37
Non ferrous	16	0.19
PA66	36	0.43
PBT	93	1.12
PEI	17	0.20
Plastic misc.	545	6.54
POM	670	8.04
PP	1 426	17.11
PPE+PS	63	0.76
SAN	219	2.63
SEBS	149	1.79
Silicone	20	0.24
Misc. (cables+motors)	1 483	17.80

4.3. DISTRIBUTION PHASE

The coffee machine is placed in a box, most of the time in cardboard. An example of such a box is provided in Figure 4-1.



Figure 4-1: Photo of empty packaging

The average volumes of packaging have been assumed as follows for the Base-Cases of this study based on measurements of some models.

Table 4-12: Volumes of packaging

Type of coffee machine	Volume of packaged product (m ³)
Drip filter coffee machine	0.035

Pad filter coffee machine	0.032
Hard cap espresso machine	0.023
Semi-automatic espresso machine	0.030
Fully automatic espresso machine	0.06

4.4. USE PHASE

4.4.1. ENERGY CONSUMPTION

The power and electricity consumptions of the five Base-Cases are detailed in the table below. **The data come from information provided by stakeholders, including manufacturers, and are based on the draft measurement standards being developed by CENELEC TC59X/WG15** with the help of manufacturers and Euro-Topten/S.A.F.E. (see Task 3, section 3.1.1.2 for details on the use patterns and the definition of the coffee period).

Furthermore, the following assumptions are made for the Base-Cases (as a reminder, they are typical European products currently in stock (not sales)):

- No auto-power down functionality
- Power consumption in standby higher than for the maximum consumption for products sold since January 2010 following the entry into force of the Standby Regulation (1275/2008)
- Power consumption in off mode is assumed to be 0W

Table 4-13: Electricity consumption of the Base-Cases

	Electricity consumption during coffee period (Wh)	Yearly electricity consumption due to coffee periods (kWh)	Ready-to-use mode (W)	Yearly electricity consumption due to Ready mode (kWh)	Total yearly consumption (kWh)	Lifetime (years)	Lifetime electricity consumption (kWh)
Drip filter coffee machine	232	169	0.5	2.4	172	6	1 030
Pad filter coffee machine	93	102	15	60	162	7	1 134
Hard cap espresso machine	73	80	10	40	120	7	843
Semi-automatic espresso machine	83	91	26	104	195	7	1 367
Fully automatic espresso machine	62	68	11	45	113	10	1 133

4.4.2. GENERAL USE PHASE

Details on the general use phase are provided in this section, for each base-case coffee machine.

Table 4-14 : Consumables used per coffee period

	Water (ml coffee)	Coffee (g)
Drip filter coffee machine	850	50
Pad filter coffee machine	240 ²	4 pad filters
Hard cap espresso machine	240 ²	4 hard caps
Semi-automatic espresso machine	240 ²	28=4*7
Fully automatic espresso machine	240 ²	28=4*7

4.4.3. DECALCIFICATION

Regular decalcification of the appliance is a guarantee for its long life. The amount of scale depends on the hardness of the water but also on the level of use (see Table 4-15).

Table 4-15: Frequency of decalcification

Average number of coffees per week	Soft water (<19°th)	Hard water (<19-30°th)	Very hard water (>30°th)
Less than 7	Once a year	Every 8 months	Every 6 months
From 7 to 20	Every 4 months	Every 3 months	Every 2 months
Over 20	Every 4 months	Every 2 months	Every month

In this study, it will be assumed that the cup-by-cup coffee machines are decalcified every three months using a decalcifier and water. For drip filter coffee machines, water and vinegar can be used for this operation and will be considered for the base case.

² Four coffee cups are prepared during a coffee period: three cups of 40 ml and one cup of 120 ml.

4.5. END-OF-LIFE PHASE

The default end-of-life values are listed in Table 4-16. These values are assumed to correspond broadly with the most likely real end-of-life phase of coffee machines, although no specific data were provided by manufacturers. A majority of recycled plastics go to thermal recycling as do almost all parts of the casing.

In general, casing is easy to be removed. A high percentage of metal casing parts separated for steel recycling can be assumed. These assumptions will be used for all Base Cases.

Table 4-16: End-of-life scenario of a coffee machine

Pos nr	DISPOSAL & RECYCLING Description		unit	Subtotals
	<u>Substances released during Product Life and Landfill</u>			
227	Refrigerant in the product	0	g	1-none
228	Percentage of fugitive & dumped refrigerant	0%		
229	Mercury (Hg) in the product	0	g Hg	
230	Percentage of fugitive & dumped mercury	0%		
	<u>Disposal: Environmental Costs perkg final product</u>			
231	Landfill (fraction products not recovered) in g en %	126	5%	88-fixed
232	Incineration (plastics & PWB not re-used/recycled)	1506	g	91-fixed
233	Plastics: Re-use & Recycling ("cost"-side)	167	g	92-fixed
	<u>Re-use, Recycling Benefit</u>	in g	% of plastics fraction	
234	Plastics: Re-use, Closed Loop Recycling	17	1%	4
235	Plastics: Materials Recycling	151	9%	4
236	Plastics: Thermal Recycling	1506	90%	72
237	Electronics: PWB Easy to Disassemble ?	0	YES	98
238	Metals & TV Glass & Misc. (95% Recycling)	800		fixed

4.6. RECOMMENDATIONS ON MANDATES

As described in Task 1, the international standard related to the energy consumption of domestic coffee machines, EN 60661, does not reflect the market reality and this explains why stakeholders (namely FEA/CECED and Topten/S.A.F.E) have developed their own measurement methods.

The current development within the CENELEC TC 59X/WG15 might solve this issue as it is working on a new version of the standard for both pressure machines and filter coffee machines. A draft version is expected to be elaborated soon. This would allow possible Ecodesign requirements (e.g. energy label, Minimum Energy Performance Standard (MEPS)) to be based on this standard.

4.7. CONCLUSIONS

This task presented a general technical analysis of the existing products on the EU market. It gave a description of the different materials used in various types of coffee machines as well as information on other life cycle stages. Regarding the use phase, average electricity consumption has been defined based on both measurements and assumptions in line with the draft standards proposed within CENELEC for cup-by-cup coffee machines and drip filter coffee machines.

Further, the use of consumables (water, filter, drip filter, cap, coffee, and decalcifier) has been specified. The information gathered in this report will serve as input for defining base-cases in Task 5 and allowing the environmental and economic assessment of them.