Preparatory Study on

Eco-design of Boilers

Task 5 (FINAL)

Base Case

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1 INTRODUCTION

1.1 Introduction

The aim of Task 5 is the assessment of the “Base Case”, which represents the average new Central-Heating System currently sold in the EU. The definition of the Base Case entails

- Performance Characteristics
- Environmental Impacts and
- Life Cycle Costs

It will be the basis for establishing the saving potential, both environmentally and economically, of the Design Options in the Task 6 report and it will be one of the major inputs in the Scenario Analysis in Task 7 (Subtask 7.2).

Task 5 comprises the following subtasks, as defined by contract:

- 5.1. Retrieval of product-specific inputs
- 5.2. BaseCase Environmental Impact Assessment
- 5.3. BaseCase Life Cycle Costs assessment
- 5.4. Calculation of EU-Totals
- 5.5. EU-25 Total System Impact discussion

The inputs for **subtask 5.1** are given in the Task 1 to 4 reports:

- Bills of Materials (incl. product volume and weight) were given by the European Heating Industry (EHI) and checked against independent sources.
- Annual resources consumption is based on the Integrated Boiler Model, which in turn is based on
    - EN product test standards as well as standards relating to the Energy Performance of Buildings. (Task 1 report).
    - Market data regarding boiler typology (Task 2 report)
    - Building and dwelling characteristics (Task 3 report)
    - Energy consumption for the use phase (Task 4 report)

Emissions were assessed on the basis of international standards (Task 1 report) and technology research (Task 4 report). For the Base Case the EcoReport defaults were used.

For reasons outlined in Task 1 report –and in agreement with the European Commission—no direct distinction will be made between *Standard BaseCase*, i.e. based only on current steady-state testing, and the *Real-Life BaseCase*. Instead we will define a “BaseCase” which is based on the Integrated Boiler Model, i.e. which takes data from EN test standards but incorporates them in a wider model to obtain more realistic results.

For inputs where no specific data could be retrieved –e.g. the metal scrap recovery and EOL scenario— the default values from the “EuP Eco-report” were used.

The reports of Tasks 1 to 4 give ample explanation of the data and in Task 5 we will mainly focus on the results. Having said that, regarding the performance characteristics and specific we will give an overview in the following paragraph.

For **subtasks 5.2 to 5.4** we use all features of the EuP EcoReport tool that was developed in the MEEUP study (VHK, 2005). For the Use Phase we will make a split-up between electricity and fossil fuel resources used, although eventually they will all be expressed in terms of their environmental impact.

According to contract, a calculation of the total system impact –as opposed to what is now commonly referred to as the "boiler"— is required in **Subtask 5.5**. However, as was assessed in earlier task reports, the boiler's performance and environmental impact cannot be captured adequately without the system, we have already chosen a systems-approach from the outset. And thereby a separate assessment, i.e. subtask 5.5, is no longer necessary.

1.2 Task Report Structure

Chapter 2 introduces the Definitions of Performance, Environmental Impact and Life Cycle Costs as well as some fixed input values.

After that, this task report will largely follow the order of the subtasks. Chapter 3 gives the Specific Inputs for the Base Case. Chapter 4 and 5 give the outputs of the Environmental Impact and Life Cycle Assessment respectively. In Chapter 6 the EU-totals are presented.

2 DEFINITIONS

2.1 Definition of Performance

Currently, the most commonly used performance characteristic of a central heating system is its heating power (in kW). "Power" is then most often defined not as the heating output, but the fuel input, following EN standards.

However, although the *"power"* undoubtedly is an important factor, we do not believe this adequately represents the function of a central heating system. Not even if we use the output power (instead of the energy input) and not even –although this should be done-- if we consider all the inputs (latent heat, electricity, primary energy for power plants).

Instead, the performance of a central heating system can be defined as

"the capability of the system to reach and keep the indoor climate of an enclosed space (dwelling, building, etc.) at a desired level under normal and extreme circumstances, in as much as is possible through heating, using hydronic heat emitters".

This definition consists of three parts[1]:

- A general description of the aim for the indoor climate *("the capability…………. ……..circumstances")*
- A first restriction regarding the parameter of the indoor climate to be influenced *("in as much as is possible through heating").* This excludes e.g. cooling and ventilation.
- A second restriction regards the means to influence the parameter *("using hydronic heat emitters").* This excludes air-heating, local heaters and passive space heating measures .

We speak of *"indoor climate"* and not *"indoor temperature"*. This stresses the fact that the indoor climate comprises a range of parameters, such as air quality (CO, CO2, formaldehydes, etc.), air velocity ("drafts"), humidity ("dry throat", funghi), etc.. But perhaps more importantly it makes clear that there is no such thing as *"The indoor temperature"*. The heating comfort depends on the average air temperature, stratification (the air temperature gradient e.g. between floor and ceiling level), the radiation heat of the walls, etc.. The relevant EPB standards for buildings (e.g. EN 832) take this –explicitly or implicitly—into account.

The ECOBOILER Integrated Model, which was presented in Task 4, follows these EPB standards. The Model gives penalties for Stratification and whenever the Model speaks of *"indoor temperature"* it actually refers to what is called the *"operative temperature"*, which is (roughly) an average of the room air temperature and the temperature of the walls and ceiling.

[1] For the sake of our contract, we should also exclude solid fuels, but this is understood.

Linked to this is the definition of the "*desired level*" for the indoor climate. Of course -- in order to make the definition operational—we have to use one single reference temperature. Or better, a single reference temperature per zone. For a dwelling we use 19 degrees Celsius for the living room and kitchen, 18 degrees for the bedrooms and 21 degrees for the bathroom.

This *desired temperature* will depend on the performance of the heating system. For instance, stratification of room air will lead to a higher desired temperature, e.g. because people will otherwise suffer from cold feet ("hot head, cold feet"). This can lead to an up to 0,7°C higher desired temperature. Temperature fluctuations, e.g. between 19 and 21 degrees for the operative temperature, can lead to a 1°C higher desired temperature. As a consequence –and this is taken into account in the Integrated Model— the final "desired temperature" can be up to 2°C or more higher than the reference temperature.

Another aspect of the "*desired level*" is occupancy, i.e. when there is no-one there the desired level of indoor climate in a room is considerably lower. As much as thermal mass and internal heat transfer allow, there are heating systems with timer functions for the whole building or single rooms to anticipate that. The Integrated Model takes that (and the diminishing effect of thermal mass, etc.) into account.

On average, taking into account the effect of stratification, temperature fluctuations and night setback, the ECOBOILER Integrated Model finds an average desired temperature of 20,4°C for the whole house.

Then there is the definition of "*normal and extreme circumstances*". This implies well-defined contexts in which the heating system is evaluated. This relates not just to the climate (outdoor temperatures and solar irradiance over the season but also over a day) but also to the building (dimensions, insulation, thermal mass, ventilation, etc.). In the Integrated Model all these are defined not just for the "EU-25 average", which we take as a reference for the Base Case, but also for each single Member State (for the Sensitivity Analysis in Task 7). With the input data from JRC Ispra we thus create a basis for what is a "normal" circumstance, which is e.g. on average a temperature of around 7°C for the EU average heating season. But the Integrated Model calculates the heating output (i.e. the radiator capacity) on the basis of the "extreme" situation: an outdoor temperature that is on average minus 10 degrees Celsius in the EU.

Furthermore, per country and for the EU-average the Integrated Model distinguishes between "*apartment*", "*house*" and "*average dwelling*" but also between "*new*" and "*existing*".

Finally, we have to define what is intended by "*normal*" heat emitters and piping. The Task 2 report shows that >70-80% of the boilers sold end up in buildings with a radiator system. Convector heating or floor heating are niche markets. Therefore the Integrated Model assumes by default a radiator system, with a radiator constant of 1,3. The radiator capacity is based on the 'extreme' circumstance indicated above (e.g. -10°C) and a safety (oversizing) factor **Csafe** which, based on empirical studies, is set at 2,5.

The result is a radiator system that can be used both for high-temperature (HT) and low-temperature heating (LT) and thereby would cover the widest possible range of heating system solutions. The piping ('distribution losses' in the Integrated Model) is defined according to the standards.

This is as far as the "fixed" part of the Integrated Model goes. All the other components of the heating system like the heat generator (in the widest sense, e.g. including solar thermal and heat pumps), the temperature controllers (room or boiler thermostat, sensors, etc.) and the valve controllers (conventional valves or TRVs, PID or CPU controlled motor-valves, etc.) are all part of the "central heating system" that has to cope with the load-profile given by the "fixed part".

2.2 Definition of Load Profiles

As mentioned above, the definition of performance requires a definition of the "normal and extreme circumstances".

For various reasons (transparency for the consumer and the manufacturers), it would be wise to limit the number of load-profiles to a minimum. On the other hand it has to be recognized that a correct dimensioning of the load is very important for the environmental impact and costs, especially in the residential sector (the "lower" loads) where there is little technical assistance in dimensioning correctly (see Task 3 report). For that reason we propose, within the fixed values EU-average values mentioned above, to vary at least the load profile according to the type of dwelling. To characterize this load we use the classification that is most familiar to consumers (e.g. for clothes), ranging from extremely small (XXS) to very small (XS), small (S), medium (M), large (L), very large (XL) and extremely large (XXL). These are qualifications that are especially helpful for the consumer and small installer. At the very latest for the size "XXL", which is a collective boiler, there will be purchase decision makers that look beyond this simple classification and make a proper heat calculation and select the system performance on the basis of the technical fiche.

2.2.1 Climate

For 9 months (Sept.-May) every month-day is characterized by 5 periods (morning 7-9, midday 9-16, evening 16-21, late 21-23, night 23-7h) with each specific outdoor temperature and solar irradiance values.

The graph below gives the EU-25 average climate data that are used in the ECOBOILER Integrated Model. For the full table, see spreadsheet and Task 4 report.

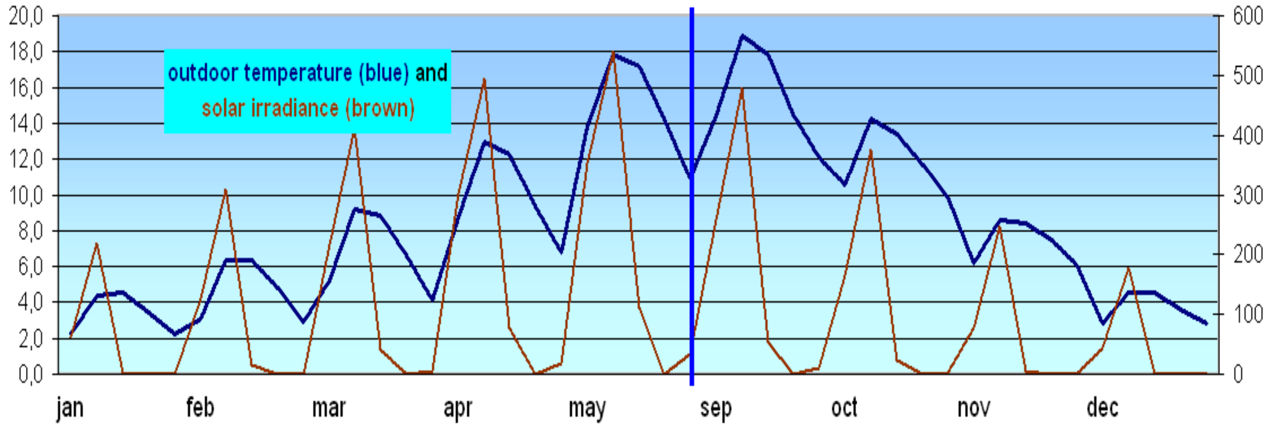

Figure 5-1. Average outdoor temperature and global solar irradiance for 9 average month-days Sept.-May in the average EU-25 climate, as used in the ECOBOILER integrated model (based on meteorological data from JRC Ispra database)

2.2.2 Dwelling Characteristics

The following tables describes the dwelling characteristics from which the 7 load profiles are derived. For more details, see spreadsheet and Task 4 report.

Table 2-1. Load-profiles and dwelling/ building characteristics

Cat.	Model	Heated volume (m^3) F	Heated floor area (m^2) F	Insulation value ($W/m^2.K$) U	infiltration losses (m^3/m^3) qinf	ventilation losses (m^3/m^3) qv	AV ratio AV	Nominal radiator capacity (kW) Pradnom
XXS	apartment new	232	78	0,53	0,12	0,47	0,40	6,4
XS	average new	288	101	0,53	0,14	0,47	0,51	9,3
S	apartment existing*	196	66	1,03	0,15	0,65	0,40	9,4
M	average existing	245	86	1,03	0,19	0,65	0,51	13,9
L	house existing	292	106	1,03	0,22	0,65	0,60	19,0
XL	new building (8 apartments)	1852	628	0,53	0,12	0,47	0,40	51,3
XXL	existing building (8 ap.)	1571	532	1,03	0,15	0,65	0,40	75,3
3XL	*High rise apt. building (20 exist apt.s)*	*4994*	*1693*	*0,86*	*0,14*	*0,59*	*0,4*	*205*
4XL	*3 high-rise apt. buildings (60 exist. apt.s)*	*14981*	*5078*	*0,86*	*0,14*	*0,59*	*0,4*	*616*

Notes:

*= similar to new house (5203 kWh/year net heat load)

ceiling height **h=** 2,85 m; Vent heat recovery **qrec**: 3-5% (exist-new); Internal transmission heat per m² **qinfi** (Aij: Uij): 0,60 W/m².K;

Internal infiltration per m³ Vi: **qinfi:** 0,10 m³/m³**;** Internal temperature correction **b:** 0,5**;** Solar gain factor **sgf**: 5%

At a last minute request of the Commission size-classes 3XL and 4XL were added; figures are indicative.

2.2.3 Extreme conditions

The table below presents the net heat load, the average power requirement during the heating season (Oct-Apr), the "normal" peak power output required on the coldest average day.

The last column of the table gives the peak power output that is required at a temperature of minus 10 degrees Celsius, which in most U-countries is used as the net design load of a CH-boiler.

Table 2-2. Load profiles: Net heat load, average power, peak output power required in normal and extreme circumstances

Cat.	Model	**Net heat load (kWh/a)** Qnet	**Average net power** [7 months] **(kW)** Pavg	**Normal peak power** [Jan. Morning] **(kW)** Phnorm	**Extreme peak power** [-10°C] **(kW)** Phextr.
XXS	apartment new	2.350	0,46	0,80	**2,60**
XS	average new	3.700	0,72	1,20	**3,70**
S	apartment existing*	4.850	0,95	1,40	**5,00**
M	average existing	7.480	1,47	2,20	**5,60**
L	house existing	10.515	2,06	3,10	**7,60**
XL	new building (8 apartments)	20.284	4,00	7,20	**22,20**
XXL	existing building (8 ap.)	42.195	8,00	13,20	**33,60**
3XL	*High rise apt. building (20 exist apt.s)*	*106.738*	*20,23*	*33,38*	*84,78*
4XL	*3 high-rise apt. buildings (60 exist. apt.s)*	*320.215*	*60,70*	*100,16*	*254,41*

At a last minute request of the Commission size-classes 3XL and 4XL were added; figures are indicative.

The *extreme peak power* above is calculated with the ECOBOILER Integrated Model, following EN 832 conventions, i.e. it incorporates transmission and ventilation losses.

According to EN 12831 (*Heating Systems in Buildings - Method for calculation of the design heat load, version 2003*) around 15-20% has to be added for heat-up, depending on thermal mass of the building construction and the degree of night-setback (1, 2 or 3 K).

Furthermore, there is a temperature correction factor that relates to the quality of the cold bridges in the construction. For external walls the default value is 1 (= no correction) with insulated cold bridges. If the cold bridges are not insulated –which is true for a part of the existing houses and buildings-- this value is 40% higher. We will assume a 15% temperature correction.

The total correction for heat-up (1,2) and temperature correction (1,15) thus becomes 1,38 (=1,2*1,15). This results in the Minimum Heat Output Required for the various load profiles, shown in the third column of the table below.

The fourth and last column in this table is for informative purposes and shows how the installer currently translates the design heat load into the boiler input power, taking into account efficiency and a safety factor (see Csafe above). In total this results in a factor 2,8 with respect of the design heat load, whereas in reality a factor of e.g. 1,4 (at 70% efficiency) would have been more than sufficient. We will use this last column as an input for the definition of the Base Case.

Table 2-3. Load: Minimum Required Output Power per BaseCase category

Cat.	Model	Extreme peak power [-10°C] Phextr.	Temperature & heat-up correction factor EN 12831 #	MINIMUM REQUIRED OUTPUT POWER kW	est. input power BaseCase (incl. eff + oversize) kW
XXS	apartment new	2,60	1,38	**3,6**	10
XS	average new	3,70	1,38	**5,1**	14
S	apartment existing*	5,00	1,38	**6,9**	19
M	average existing	5,60	1,38	**7,7**	22
L	house existing	7,60	1,38	**10,5**	29
XL	new building (8 apartments)	22,20	1,38	**30,6**	60
XXL	existing building (8 ap.)	33,60	1,38	**46,4**	115
3XL	*High rise apt. (20 exist apt.s)*	*84,78*	*1,38*	*117*	*250*
4XL	*3 high-rise apt. (60 exist. apt.s)*	*254,41*	*1,38*	*350*	*750*

At a last minute request of the Commission size-classes 3XL and 4XL were added; figures are indicative.

2.2.4 Net and Gross heat loads

The “Net heat loads” are defined in the ECOBOILER Integrated Boiler for the various load classes. They consist of the energy inputs that are necessary (at the requested indoor temperatures) to compensate for the outdoor climate and building conditions as given also in Table 2-2 for the average EU-25. In the ECOBOILER Integrated Model these energy losses are referred to as: Net heat load = $T_{set} + T_{mass} + T_{intrans}$.

All efficiency figures are related to this Net Heat Load. But also, as mentioned earlier, the piping and the radiator system are given as a fixed part of the load, because they are inherent to the fact that this is a hydronic central heating system. As such some losses are introduced, which can be deemed “unavoidable”, because it is not possible to operate the given system without at least some stratification losses, distribution losses, etc.. In other words, the system can never reach 100% energy efficiency with respect of its heating power output.

Therefore, as a secondary figure, the gross heat load is also calculated. This figure integrates all unavoidable losses. In that sense, the Gross Heat Load represents the lowest possible energy input that can be achieved with the given hydronic CH-system for a theoretical *"Ideal Boiler"* plus 100% efficient and effective controls. It can also be used as the yardstick for the System Efficiency .

The table below shows the Gross Heat Load and its components for the size-classes XXS to XXL:

Table 2-4. Load profiles: Gross Heat Load.

Gross Heat Load is the net heat load plus "unavoidable" losses that are inherent of the hydronic emitter system. The Gross Heat Load can be used as a secondary yardstick for the system efficiency.

		Net heat load (kWh/a)	unavoidable losses			Gross heat load (kWh/a)
			Stratification (kWh/a)	Distribution (kWh/a)	Other* (kWh/a)	
Cat.	**Model**	**Qnet**	**Qstrat**	**Qdistr**	**Qgen+**	**Qgross**
XXS	apartment new	2.354	175	428	370	**3.327**
XS	average new	3.699	277	517	370	**4.863**
S	apartment existing	4.850	295	532	370	**6.047**
M	average existing	7.480	435	594	370	**8.879**
L	house existing	10.515	592	635	370	**12.112**
XL	new building (8 apartments)	20.284	1.429	2.707	978	**25.398**
XXL	existing building (8 ap.)	42.195	2.409	3.231	1.618	**49.453**

*= Other relates to unavoidable generator losses (264 kWh/a), auxiliary electricity (88 kWh/s) and standby heat (18 kWh/a); For XL: 720+240+18,3=978,3; For XXL: 1200+400+18= 1618

2.3 Definition Environmental Impact

The assessment of the environmental impact should follow the MEEUP methodology and more specifically the EcoReport tool. The latter is a spreadsheet calculation tool that helps the user in performing the proper calculations with the Unit Indicators in Table 29 of the MEEUP Methodology Report (VHK, Nov. 2005).

The table on the following page presents a selection of Table 29 for Unit Indicators that are relevant for the CH-systems.

Unit Indicators nr. 68-73 represent the impact for gas-and oil-fired boilers per GJ heat output. The primary energy values and efficiencies are given in Net Calorific Value. For our purpose, i.e. the link with the ECOBOILER Integrated Model it is more convenient to

a. use Gross Calorific Values (divide by 111% for gas and 106% for oil)
b. recalculate –using the given efficiencies in the table—the values per unit of energy input, first in GJ (for gas and oil) then in kWh (for "fuel")
c. use an average "fuel" value with the relative shares of gas and oil (for new boilers 88/12%). [2]

This explains the conversions inserted in the table after Unit Indicators 68-73.

Note that the emission values during the use phase are based on the MEEUP report, as is requested in the contract. MEEUP data are based on GEMIS 4.2. Eurofuel points out that newer data are available from the GEMIS 4.3 database. These can be found in Annex E of the Task 3 report.

[2] In Task 7.2 (scenario analysis) the share in the stock is 78/22% for gas/oil fired boilers

Table 2-5 . Selection of relevant Unit Indicators from EcoReport/ MEEUP Methodology Table 29

Row	Mat/process		energy			water		waste		GWP	AD	VOC	POP	Hma	PAH	PM	HMw	EP
nr			tot	el	fd	proc	cool	no	haz	CO2	SOx		i-Teq	Ni	Ni		Hg/20	PO4
		recyc	MJ	MJ	MJ	ltr	ltr	g	g	kg	g	g	ng	mg	mg	g	mg	g
4	PP	0%	73	7	53	5	40	4	28	1,97	6	0,02	0	0	0	1	0	165
5	PS	0%	87	4	48	5	177	1	22	2,79	17	0,00	0	0	121	2	0	55
10	ABS	0%	95	7	46	9	165	10	92	3,32	18	0,00	0	0	2	3	2	630
15	Rigid PUR	0%	104	17	39	60	301	20	427	4,17	31	0,00	0	0	20	7	43	3186
21	St sheet galv.	5%	34	2	0	0		0	1722	2,83	7	0,14	26	4	0	3	4	65
23	Cast iron	85%	10	0	0	1	4	0	315	1,06	3	0,12	6	2	0	14	1	26
25	Stainless 18/8 coil	63%	62	10	4	76	8	0	1000	6,21	56	0,14	8	148	0	8	86	2328
27	Al diecast	85%	55	0	0	0		0	750	3,55	16	0,07	33	1	18	4	6	1
30	Cu tube/sheet	60%	51	0	0	0		0	8014	2,73	63	0,00	10	33	5	1	38	62
31	CuZn38 cast	85%	38	0	0	0		0	3043	1,81	35	0,01	25	57	3	1	9	15
98	avg. controller board		781	579	3	523	106	652	1680	51,53	437	6,45	6	73	60	22	333	4702
54	glass/ mineral		16	13	0	8			14	0,83	3							
34	foundries Fe/Cu/Zn		2	1	0	0	1	0	7	0,12	1	0,00	0	0	0	0	0	1
35	foundries Al		7	4	0	0	2	0	20	0,36	2	0,00	0	0	0	0	0	4
36	sheetmetal plant		15	9	1	0	4	0	47	0,84	4	0,00	0	0	0	1	0	6
37	sheetmetal scrap		12	5	0	0	0	0	180	0,80	4	0,09	11	25	0	1	0	0
53	PWB assembly		128	3	5	12	36	4	107	8,52	49	3,10	0	1	3	15	0	709
60	per m³ appliances		798	3	0	0	0	6	277	46,67	150	15,73	2	14	36	3204	0	7
61	per product		52	0	0	0	0	1	51	4,52	12	0,05	0	3	3	0	0	1
63	per m³ installed product		312	0	0	0	0	4	177	18,60	50	4,91	1	9	8	214	0	5
65	Electricity <u>**per MWh**</u>		10500	10500	0	700	28000	242	12174	458,21	2704	3,95	69	180	21	58	68	323
68	Gas, η 86%, atmospheric		1163	0	0	0	0	0	0	64,29	19	0,85	0	0	0	0	0	0
69	Gas, η 90%, atmosph.		1111	0	0	0	0	0	0	61,43	18	0,81	0	0	0	0	0	0
70	Gas, η 101%, condens.		990	0	0	-14	0	0	0	54,74	16	0,72	0	0	0	0	0	0
71	Gas, η 103%, condens.		971	0	0	-20	0	0	0	53,68	16	0,71	0	0	0	0	0	0
72	Oil, η 85%, atmosph.		1176	0	0	0	0	0	0	87,76	110	1,52	0	0	0	1,857	0	0
73	Oil, η 95%, condens.		1053	0	0	-14	0	0	0	78,52	98	1,36	0	0	0	1,662	0	0
78	Extra for fossil fuel extraction & transport: **Gas +7%** (row 68-73)**, Oil +10%** (row 72-73)																	
conversion per GJ gas/oil input on GCV																		
	Gas		964	0	0	*	0	0	0	53,30	15	0,66	0	0	0,024	0,252	0	0
	Oil		1038	0	0	*	0	0	0	77,41	97	1,34	0	0	0,028	1,638	0	0
conversion per kWh avg. fuel input on GCV -→						gas	88%	oil	12%									
	Fuel		3,50	0	0	NA	0	0	0	0,20	0,09	0,00	0	0	0,000	0,002	0	0
86	Mini-van diesel		2	0	0	0	0	0	0	0,19	0	0,04	0	1	1	9	0	0
88	Landfill		68	0	0	0	0	0	1226	5,10	10	0,28	8	20	0	89	6	325
90	HFC refrigerants & R744		**GWP values: R134a=1300, R404a=3260, R410a=1730, R152a=140, R744= CO2=1**															
91	Incinerated		67	0	0	0	0	1000	0	5,02	10	0,14	0	18	0	85	5,7	325
92	Plastics, re-use, recyc.		7	0	0	0	0	0	3	0,44	2	0,13	0	1	0	30	0,0	0

93 Metals, **WEEE recycling credits already incorporated in production** (e.g. 85% recycling rate instead of 60-65% for cast metal products)

94 Plastics, Thermal recycling: **credit is 75% of feedstock energy & GWP of plastics used** (displaces oil)

95 Plastics, Re-use/ closed loop recycling: **credit is 75% of all production impact of plastics used**

96 Plastics, Recycling: **credit is 27 MJ** (displaces wood) **+ 50% of feedstock energy & GWP of plastics (less chance heat recovery)**

97 Electronics: if designed for easy separate shreddering **credit is 20% of production impact components and materials**

Some Comments on Interpretation of the Data

Despite the recalculation towards kWh input, it may still be difficult to interpret the emission values that are given.
For instance, although the data is there, it is not self-evident that for gas-fired boilers the emissions of NOx are equivalent to 42 ppm NOx. For this you need to know that the 0,052 g SOx equivalent/kWh equals 0,074 g NOx (conversion factor 0,7 from *MEEUP Methodology Report, VHK 2005*) and that 74 mg NOx/kWh equals 42 ppm/kWh input (1,76 mg NOx/kWh per ppm, from *Handbuch Feuerungstechnik 2006, Linke W. et al.*).

This value of 42 ppm/ khW input which originally came from the GEMIS 4.2 database of the Öko-Institut is the official value that is used in legislation and it follows EN standards, which are all based on measurement of the NOx-content in the flue gases.

But actually it is not the value that is the most relevant for policy goals and treaties like the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP), also known as “Gothenburg protocol”, which was then translated into the European NEC directive (National Emission Ceilings for SO2, NOx and NH3) . The latter sets targets in terms of absolute emissions (kg). In other words, it would be more appropriate to know the mg NOx/kWh output of a boiler.

2.4 Definition and fixed inputs Life Cycle Costs

Annex II of the EuP-Directive provides guidance regarding the definition of Life Cycle Costs (LCC). The LCC analysis method *‘uses a real discount rate on the basis of data provided from the European Central Bank and a realistic lifetime for the EuP; it is based on the sum of the variation in purchase price (resulting from variations in industrial costs) and in operating expenses, which result from the different levels of technical improvement options, discounted over the lifetime of the representative EuP. The operating expenses cover primarily energy consumption an additional expenses in other resources (such as water or detergent).’*

The relevant equation is

$$LCC = PP + PWF * OE$$

where LCC is Life Cycle Costs, PP is the purchase price (incl. installation costs) and OE is the operating expense.

The PWF (Present Worth Factor) is defined as

$$PWF= N * 1/(1+ r)^{N}$$

in which N is the product life and r is the discount (interest-inflation) rate.

In the Task 2 Report, chapter 4 we found an interest rate of 4% and an inflation rate of 2% resulting in a discount rate of 2%. For maintenance costs and electricity with 1,5% per year long-term price increase this is appropriate.

However, also in the same chapter we found a (long-term) annual price increase of 5,6% for gas and 8,2% for heating oil. This is much higher than inflation and for those two components we have to use Present Worth Factors based on a discount rate of -1,6% (gas) and – 4,2% (oil) instead of +2%.

All fixed inputs for the LCC-calculation are give in Chapters 4 and 5 of the Task 2 Report, for the EU-25 average and –whenever possible—per EU Member State.

The table below gives a summary of the running cost parameters that will be used for the Base Case (average EU-25):

Table 2-6. Running costs fixed parameters for LCC (EU avg)

Product Life (years) Rlife	17	years
Discount rate Rdis	2%	
Electricity rate per kWhe Rel	0,15	€/ kWhe
Fuel rate per kWh Rgas	0,047	€/ kWh
Oil rate per kWh Roil	0,061	€/ kWh
Avg. Fuel per kWh Rfuel	0,049	€/ kWh
present worth factor (in yrs)-->		PWF (yrs)
Electr.rate increase/ yr. Relinc	1,5%	14,3
Gas rate increase/ yr. Rgasinc	5,6%	19,7
Oil rate increase/ yr. Roilinc	8,2%	25,6
Fuel rate increase/yr Rfuelinc	5,9%	20,3
Repair & maint./ yr. Rmaint	€ 180	14,3

The prices of the products and installation costs will be based on the data in Chapters 4 and 5 of the Task 2 report, but they are direct <u>variables</u> for the design options (Task 6) and will therefore be discussed in the next chapter.

3 SPECIFIC INPUTS

3.1 Materials (BOMs)

The bills of materials (BOMs) are constructed on the basis of the data supplied by the European Heating Industry Association (EHI) and adjusted by VHK.[3]

For the individual boilers the basis is the EHI-BOM for a "gas wall-hung non condensing boiler", which was used directly for the Medium-size boiler.

For the smaller categories (S, XS, XXS) the bill of materials was derived by reducing the material weight for copper, steel and aluminium with 30% and making some minor adjustments. For the Large (L) category the material weight of copper, steel and aluminium components was increased by 15%.

The bill of materials for the XXL category was derived from the EHI-BOMS for "Gas Floor Standing & Gas Jet Burner" and "Oil Jet Burner" boilers, by doubling the weight of the heat exchanger (cast iron and steel). The weight of all other materials increases by 20%. The total weight is checked with weights of similar products on the market. The XL category is mainly an average between the L and XXL category.

For the 3XL and 4XL category the weight are derived through an up scaling of the XXL class to the requested total weight of these boilers (based on product now on the market).

Table 3-1 Bills of Materials for Base Case (avg. new boiler) categories

Row nr	Mat/process	unit	1 XXS	2 XS	3 S	4 M	5 L	6 XL	7 XXL	8 *3XL*	9 *4XL*
4	PP (Plastics)	g	3.650	3.650	3.650	3.650	3.650	3.200	3.564	*10.463*	*32.195*
5	PS (Misc.)	g	350	350	350	350	350	100	84	*247*	*760*
10	ABS (Plastics ABS)	g	0	0	0	0	0	0	0	*0*	*0*
15	Rigid PUR	g	800	800	800	800	800	800	2.844	*8.350*	*25.693*
21	St sheet galv.	g	19.726	19.726	19.726	28.180	32.407	50.754	69.100	*202.868*	*624.224*
23	Cast iron	g	1.170	1.170	1.170	1.170	1.170	71.465	141.760	*416.188*	*1.280.579*
25	Stainless 18/8 coil	g	1.862	1.862	1.862	2.660	3.059	1.728	1.728	*5.073*	*15.610*
27	Al diecast	g	1.379	1.379	1.379	1.970	2.265	0	0	*0*	*0*
30	Cu tube/sheet	g	2.982	2.982	2.982	4.260	4.899	700	888	*2.607*	*8.022*
31	CuZn38 cast	g	1.650	1.650	1.650	1.650	1.650	500	564	*1.656*	*5.096*
98	avg. controller board	g	690	690	690	690	690	750	876	*1.752*	*5.256*
54	glass	9	0	0	0	0	0	0	0	*0*	*0*
		kg	**34,3**	**34,3**	**34,3**	**45,4**	**50,9**	**123.0**	**221,4**	*650,0*	*2000,0*

At a last minute request of The Commission size-classes 3XL and 4XL were added; figures are indicative.

The materials include spare parts (1%).

[3] See MEEUP Product Cases Report, VHK for European Commission 2005.

3.2 Manufacturing phase

The inputs required to assess the environmental impacts for the manufacturing phase are generated automatically by the EcoReport. As metal scrap percentage we use the default 25%. Please note that for plastics the manufacturing impacts are included in the materials.

Table 3-2 gives the required inputs.

Table 3-2. Manufacturing inputs for BaseCases

Row	Mat/process		1	2	3	4	5	6	7	8	9
nr		unit	XXS	XS	S	M	L	XL	XXL	*3XL*	*4XL*
34	foundries Fe/Cu/Zn	g	2820	2820	2820	2820	2820	71965	142324	*417844*	*1285675*
35	foundries Al	g	1379	1379	1379	1970	2265	0	0	*0*	*0*
36	sheetmetal plant	g	19726	19726	19726	28180	32407	50754	69100	*202868*	*624224*
37	sheetmetal scrap	g	4932	4932	4932	7045	8102	12688	17275	*50717*	*156056*
53	PWB assembly	g	690	690	690	690	690	750	876	*1.752*	*5.256*

At a last minute request size-classes 3XL and 4XL were added; figures are indicative.

3.3 Distribution phase

The EcoReport requires the product volume as an input for transportation and warehouse. Other than that, there are two fixed impacts (multiplier=1) . See Table 3-3.

Table 3-3. Distribution inputs for BaseCases

Row	Mat/process		1	2	3	4	5	6	7	8	9
nr		unit	XXS	XS	S	M	L	XL	XXL	*3XL*	*4XL*
60	per m³ appliances	m³	0,08	0,1	0,12	0,15	0,15	0,5	1	*2*	*6*
61	per product	#	1	1	1	1	1	1	1	*1*	*1*
63	per m³ installed product	m³	0,08	0,1	0,12	0,15	0,15	0,5	1	*2*	*6*

At a last minute request size-classes 3XL and 4XL were added; figures are indicative.

3.4 Use Phase

The use phase consists of the energy consumption and the maintenance/repairs. For the latter we assume a total distance of 100 km for 17 years of maintenance. The spare parts were already included in the materials production.

But the most important is of course the energy consumption of the CH-boiler, based on a series of technical design features. The basis for the design features is the ECOBOILER Integrated Model, where we have defined design-settings for each category/ load profile that come as close as possible to the technical market segmentation as found in Chapter 3 of the Task 2 report.

An overview of these settings for XXS to 4XL boiler categories is given in Table 3-4 on the next page [4] [5].

The outcome of these settings for the annual energy consumption is given in Table 3-5.

Finally, in Table 3-6 the inputs for the EcoReport are summarized.

[4] MTS reports that in their opinion fuel/air ratio controls used in Basecase appliances (= new LT wall hung boilers) are not pneumatic but atmospheric. Pneumatic devices are mainly used for condensing boilers and eventually for higher power LT boilers (>70 Kw) but they're not largely used.

[5] In table 3-4 standby heat loss of 1% is given for all load profiles. DTI remarks that relatively speaking the standby losses could be lower for larger boilers.

Table 3-4. Design Inputs BaseCases

DESIGN INPUT BASECASE	1	2	3	4	5	6	7	8	9
INPUTS CH									
CH-power class	1 -XXS (XX Small)	2 -XS (Xtra Small)	3 -S (Small)	4 -M (Medium)	5 -L (Large)	6 -XL (Xtra Large)	7 -XXL (XX Large)	8 -3XL	9 -4XL
	6 -apartment new	2 -average new	5 -apartment existing	1 -average existing	3 -house existing	8 -new building (8 ap)	7 -exist. building (8 ap)	9 -high-rise avg. (20 ap)	10 -block avg. (60 ap)
boiler characteristics									
power input in kW*	10 kW	14 kW	19 kW	22 kW	29 kW	60 kW	115 kW	250 kW	750 kW
turndown ratio	33%	33%	33%	33%	33%	33%	33%	33%	33%
standby heat loss (% of Pnom)	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%
steady st. efficiency %	5 -80/80/80/80	5 -80/80/80/80	5 -80/80/80/80	5 -80/80/80/80	5 -80/80/80/80	5 -80/80/80/80	5 -80/80/80/80	5 -80/80/80/80	5 -80/80/80/80
fuel (dewpoint)	1-gas	1-gas	1-gas	1-gas	1-gas	1-gas	1-gas	1-gas	1-gas
air-fuel mix control	2 -pneumatic	2 -pneumatic	2 -pneumatic	2 -pneumatic	2 -pneumatic	2 -pneumatic	2 -pneumatic	2 -pneumatic	2 -pneumatic
circ. pump power	5 -65W	5 -65W	6 -95W	6 -95W	6 -95W	7 -200W	7 -200W	8 -600W	9 -1800W
fan power	2 -P=6..30W	2 -P=6..30W	3 -P=9..40W	3 -P=9..40W	3 -P=9..40W	5 -P=60W	6 -P=90W	7 -P=150W	8 -P=400W
CPU power sb/on	3 -P=6/8W	4 -P=10/12W	4 -P=10/12W	4 -P=10/12W	4 -P=10/12W	7 -P=28/30W	8 -P=56/60W	9 -P=72/80W	10 -P=220/250W
controls power sb/on	1 -P=0/10W	1 -P=0/10W	1 -P=0/10W	1 -P=0/10W	1 -P=0/10W	3 -P=0/18W	3 -P=0/18W	4 -P=0/36W	5 -P=0/72W
comb. air intake	1 -room sealed	1 -room sealed	1 -room sealed	1 -room sealed	1 -room sealed	1 -room sealed	1 -room sealed	1 -room sealed	1 -room sealed
boiler mass (empty), kg	34 kg	34 kg	34 kg	45 kg	51 kg	110 kg	221 kg	650 kg	2000 kg
water content in kg	1,5 kg	1,5 kg	1,5 kg	4,0 kg	6,0 kg	12,0 kg	20,0 kg	60,0 kg	200,0 kg
envelope volume in m3	0,08 m3	0,10 m3	0,12 m3	0,15 m3	0,17 m3	1,00 m3	1,00 m3	2,00 m3	6,00 m3
noise level in dB-A	43 dB-A	43 dB-A	43 dB-A	43 dB-A	43 dB-A	50 dB-A	50 dB-A	50 dB-A	50 dB-A
controllers									
auto-timer control	yes	yes	yes	yes	yes				
valve control	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K
boiler temp control	6 -on/off RT	6 -on/off RT	6 -on/off RT	6 -on/off RT	6 -on/off RT	4 -fixed BT	4 -fixed BT	4 -fixed BT	4 -fixed BT
electronic optimiser	no	no	no	no	no	no	no	no	no
autoset weather control	N/A	N/A	no	N/A	N/A	N/A	no	no	no
solar (for combi only)									
collector type	N/A	1 -glazed	3 -vacutube	3 -vacutube	3 -vacutube	3 -vacutube	3 -vacutube	3 -vacutube	3 -vacutube
collector surface m2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
tank position	N/A	1 -indoors	1 -indoors	1 -indoors	1 -indoors	1 -indoors	1 -indoors	1 -indoors	1 -indoors
CH-fraction served	0%	100%	0%	0%	0%	0%	0%	0%	100%
El. back-up heater CH?	no	no	no	no	no	no	no	no	no
heat pump (HP)									
Reference type	1 -El. brine/ water 0/50	3 -El. air/ water 7/50	3 -El. air/ water 7/50	3 -El. air/ water 7/50	3 -El. air/ water 7/50	3 -El. air/ water 7/50	2 -El. water/ water 10/5	2 -El. water/ water 10/50	2 -El. water/ water 10/5
Power nominal in kW	0,0 kW	0,0 kW	0,0 kW	0,0 kW	0,0 kW	0,0 kW	0,0 kW	0,0 kW	0,0 kW
COP nominal 0/50	0,00	0,00	0,00	2,50	0,00	3,50	3,70	3,70	3,70
Ratio CH : DHW	100%	80%	80%	80%	80%	80%	80%	80%	80%
CH-fraction served	100%	0%	100%	100%	100%	50%	100%	100%	0%
El. back-up heater CH?	no	no	no	no	no	no	no	no	no

Table 3-5. Annual Energy Consumption BaseCases

DESIGN INPUT BASECASE		1		2		3		4		5		6		7		8		9	
INPUTS CH																			
CH-power class		**1 -XXS (XX Small)**		**2 -XS (Xtra Small)**		**3 -S (Small)**		**4 -M (Medium)**		**5 -L (Large)**		**6 -XL (Xtra Large)**		**7 -XXL (XX Large)**		**8 -3XL**		**9 -4XL**	
		6 -apartment new		*2 -average new*		*5 -apartment existing*		*1 -average existing*		*3 -house existing*		*8 -new building (8 ap)*		*7 -exist. building (8 ap)*		*9 -high-rise avg. (20 ap)*		*10 -block avg. (60 ap)*	
MAIN ENERGY OUTPUTS																			
Net heating efficiency		53%		54%		52%		54%		55%		44%		45%		43%		43%	
Primary energy consumption		4422 kWh/a		6873 kWh/a		9368 kWh/a		13827 kWh/a		19095 kWh/a		45965 kWh/a		93407 kWh/a		246159 kWh/a		739894 kWh/a	
-of which fuel (primary kWh GCV)		4100 kWh/a		6470 kWh/a		8814 kWh/a		13247 kWh/a		18490 kWh/a		43118 kWh/a		89492 kWh/a		236126 kWh/a		710017 kWh/a	
-of which electricity (primary kWh)		322 kWh/a		403 kWh/a		555 kWh/a		580 kWh/a		605 kWh/a		2.848 kWh/a		3.915 kWh/a		10.033 kWh/a		29.877 kWh/a	
ANNUAL SPACE HEAT ENERGY breakdown																			
TOTAL	kWh/a	4422	100%	6873	100%	9368	100%	13827	100%	19095	100%	45965	100%	93407	100%	246159	100%	739894	100%
Tset	kWh/a	1653	37%	2680	39%	3799	41%	6056	44%	8660	45%	19949	43%	41924	45%	105759	43%	317277	43%
Tmass	kWh/a	423	10%	681	10%	788	8%	1106	8%	1454	8%	335	1%	271	0%	979	0%	2938	0%
Tintrans	kWh/a	277	6%	339	5%	263	3%	318	2%	401	2%	0	0%	0	0%	0	0%	0	0%
Tfluct (cntrl)	kWh/a	383	9%	604	9%	642	7%	992	7%	1359	7%	3109	7%	5262	6%	13968	6%	41905	6%
Tstrat(emit)	kWh/a	241	5%	367	5%	415	4%	629	5%	918	5%	2507	5%	3888	4%	10188	4%	30565	4%
Distr. loss	kWh/a	394	9%	601	9%	846	9%	1131	8%	1474	8%	6514	14%	14289	15%	43148	18%	129442	17%
Steady st.	kWh/a	628	14%	1009	15%	1752	19%	2633	19%	3674	19%	8450	18%	17584	19%	46393	19%	139556	19%
Start/stop	kWh/a	21	0%	32	0%	43	0%	44	0%	51	0%	216	0%	604	1%	1512	1%	4543	1%
Stby heat	kWh/a	79	2%	157	2%	265	3%	338	2%	499	3%	2037	4%	5669	6%	14179	6%	43791	6%
Electric	kWh/a	322	7%	403	6%	555	6%	580	4%	605	3%	2848	6%	3915	4%	10033	4%	29877	4%
Credit solar	kWh/a	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Credit HP	kWh/a	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Net heating efficiency	%	53%		54%		52%		54%		55%		44%		45%		43%		43%	
gross heat load	kWh/a	2.965		4.508		6.052		8.929		12.292		23.766		48.638		124.389		371.657	
net heat load	kWh/a	2.354		3.699		4.850		7.480		10.515		20.284		42.195		106.738		320.215	
net load per unit floor area	kWh/m2	56		68		141		160		180		73		175		145		146	
CH syst. Efficiency	%	61%		62%		60%		62%		63%		51%		52%		50%		50%	

Table 3-6. Summary Use Phase inputs

Row nr	Mat/process	unit	1 XXS	2 XS	3 S	4 M	5 L	6 XL	7 XXL	8 3XL	9 4XL
65	Electricity	kWhe/a	129	161	222	232	242	1.139	1.566	4.013	11.950
	Fuel	kWh/a	4.422	6.873	9.368	13.827	19.095	45.965	93.407	246.159	739.894
86	Mini-van diesel	km	100	100	100	100	100	100	100	100	100

Please note that the Base Case assessment relates to **new** boilers. For an impact analysis of the **existing** EU boiler stock see the Task 7.2 report.

The variation of design features is limited between the categories, which is fairly close to real-life. Basically, the differences can be found between typical individual boilers (XXS to L) on one hand and collective/commercial boilers (XL, XXL) on the other hand. We therefore anticipate that in Task 6 we will concentrate on just two categories --M and XXL—and extrapolate these results for the other categories.

The M and XXL Base Cases use the following settings:

- Inputs power as indicated. On average 22 kW for individual boilers (M), 100 kW for the collective boiler (XXL),
- Combustion air intake is room-sealed (type C)
- Turndown ratio: 33% (smallest power as a fraction of nominal)
- Steady State Efficiencies on Gross Calorific Value: 80/80/80/80% for 60/80°C regime at full power, 30/50 regime at full power, 60/80 regime at minimum power, 30/50 regime at mininum power. The collective boiler starts from 76% steady state efficiency.
- Standby heat energy losses: 1% of Pnom.
- No pilot flame (electronic ignition)
- Pump 45 W, fan 9-40 W each, CPU power 10/12 W for standby/"on", power of gas valve etc. 10/10 W for standby/"on". No night setback for pump. Pump stops 10 minutes after "burner-off". Prepurge time 25 seconds.
- Consequently the electricity consumption in standby (in W electric) is 20 W, at maximum (nominal) load 112 W and at minimum load 110 W. The primary energy factor for power plant losses and distribution is 2,5 (1 kWh electric= 2,5 kWh primary).
- On/off room thermostat for individual boilers, with timer-control (regime 19/18/21 for Zone 1/2/3) but without electronic optimiser (reheat power 100%). Fixed boiler thermostat (70°C average) for collective boilers.
- For individual boilers: Valve controllers: TRVs 2K (thermostatic radiator valves with a 2K bandwidth and a 20 minute delay) in bed- and bathroom. No valves in reference room (living room and kitchen), because this is controlled by the room thermostat. The system is not hydraulically not optimised and has a bypass-mix of 30% (mix between return and feed flows).
- For collective boilers: TRVs 2K in all rooms.
- Pump set at fixed flow 1000 ltrs./h.
- The air-fuel mixer of the heat generator is pneumatic with an air factor of 1,4 . Consequently, the fuel loss factor is set at 1,5% (at 14.000 cycles equivalent) and the corrected dewpoint for the default fuel (gas) is set at 50°C.
- The boiler mass, water content, envelope volume will be indicated per BaseCase. An average value is 60 kg boiler mass and an average water content of 4 ltr. for an

individual boiler. The envelope will then be smaller than 0,15 m³. The default noise level is 45 dBA.

3.5 End-of-Life phase (EOL)

For the End-of-Life we assume the EcoReport default scenario:

Table 3-7. Default EOL scenario

Landfill (not recovered)	5% of total weight * [row 89]
Incinerated	(plastics & PWB fraction -(re-used + recycled)) * [row 91]
Cost of plastics recycling	(re-used + recycled fraction) * [row 92]
Plastics: Re-used (closed loop)	1% of plastics fraction
Plastics: Materials recycling	9% of plastics fraction
Plastics: Thermal recycling	90% of plastics fraction
Electronics easy to assembly	YES: electronics fraction & manuf. [=row 98] * 20%
Metals & Misc.	95% recycled (value already incorporated)

As a consequence, the following inputs will be used for the EOL:

Table 3-8. EOL Inputs Base Cases

Row nr	**Mat/process**	unit	1 XXS	2 XS	3 S	4 M	5 L	6 XL	7 XXL	8 *3XL*	9 *4XL*
93	Metals recycled	g	27331	27331	27331	37896	43178	118889	203338	*596972*	*1836854*
94	Plastics, Thermal recycling: **credit is 75% of feedstock energy & GWP of plastics used** (displaces oil)										
95	Re-used plastics credits										
4	PP	g	35	35	35	35	35	30	34	*100*	*309*
5	PS	g	3	3	3	3	3	1	1	*2*	*7*
15	PUR	g	8	8	8	8	8	8	27	*80*	*246*
96	Plastics, Recycling: **credit is 27 MJ** (displaces wood) **+ 50% of feedstock energy & GWP of plastics (less chance heat recovery)**										
4	PP	g	312	312	312	312	312	274	305	*894*	*2753*
5	PS	g	30	30	30	30	30	9	7	*21*	*65*
15	PUR	g	68	68	68	68	68	68	243	*714*	*2197*
97	Electronics: if designed for easy separate shreddering **credit is 20% of production impact components and materials**										
98		**g**	131	131	131	131	131	143	166	*332*	*998*
	Default EOL scenario		Materials balance EOL								
	disposal	g	6145	6145	6145	6701	6979	10362	17037	*50885*	*156571*
	recyc/re-use	g	27918	27918	27918	38483	43765	119421	204121	*599115*	*1843429*
	total	g	34062	34062	34062	45183	50743	129783	221158	*650000*	*2000000*

At a last minute request size-classes 3XL and 4XL were added; figures are indicative.

Please note that the last 4 rows of Table 3-8 --together with the BOMs- give the materials balance.

3.6 LCC Inputs: Prices and installation costs

The prices of the BaseCases are derived from Chapters 4 and 5 of the Task 2 Report.

The results are given in Table 3-10 on the next page.

3.7 EU Totals: Markets by Category

For the calculation of the EU Totals an estimate of the relative share and absolute sales numbers per category is needed. For this estimate we have used the data in Chapter 3 of the Task 2 report. The main source table is given below as a reminder (originally Table 3-11 in Chapter 3, Task 2 report).

Table 3-9 . EU 2004 Boiler Market, segmented by sector, application, boiler type and capacity
(VHK analysis on the basis of BRGC data 2006)

SECTOR	**RESIDENTIAL (incl. boilers shared with small non-residential)**											**NON-RESIDENTIAL**			**TOTAL**
APPLICATION	INDIVIDUAL							COLLECTIVE			TOTAL			TOTAL	
TYPE	**gas wh**				**gas fs**	**oil jet**	**total Indiv.**	**gas fs**	**oil jet**	**total Coll.**		**gas fs**	**oil jet**		
Output in kW	8-15	16-25	26+	tot wh	< 35	< 30		> 35	> 30			> 35	>.30		
Austria	*4*	*23*	*17*	44	4	9	**57**	1	2	**3**	**59**	1	2	**8**	67
Belgium	*8*	*61*	*36*	105	17	22	**144**	4	9	**13**	**157**	5	11	**13**	170
CzechRep.	*12*	*12*	*61*	85	8	0	**93**	2	0	**2**	**95**	2	1	**1**	96
Denmark	*17*	*2*	*2*	21	0	5	**25**	0	0	**1**	**26**	0	0	**0**	26
Estonia	–	–	–	2	0	1	**3**	0	0	**0**	**3**	0	0	**0**	3
Finland	–	–	–			12	**12**	0	0	**0**	**12**	0	0	**9**	21
France	–	*430*	*107*	537	64	153	**754**	7	16	**23**	**777**	9	19	**38**	815
Germany	*72*	*359*	*64*	495	46	117	**658**	16	38	**54**	**711**	19	47	**47**	758
Greece	*0*	*8*	*3*	12	1	27	**39**	0	18	**18**	**57**	0	22	**29**	86
Hungary	*9*	*69*	*8*	86	8	1	**95**	5	0	**5**	**101**	6	0	**0**	101
Ireland	*20*	*35*	*3*	58	2	35	**96**	0	5	**5**	**101**	0	6	**10**	111
Italy	*1*	*1084*	*145*	1230	59	21	**1310**	3	12	**14**	**1324**	3	14	**14**	1338
Latvia	–	–	–	6	1	1	**7**	0	0	**0**	**7**	0	0	**0**	7
Lithuania	–	–	–	8	3	1	**12**	0	0	**0**	**12**	0	0	**3**	15
Netherlands	*210*	*153*	*44*	408	2	0	**410**	3	0	**3**	**413**	3	0	**6**	419
Poland	*2*	*114*	*11*	126	8	7	**141**	4	5	**9**	**150**	5	6	**6**	157
Portugal	–	*30*	*3*	33	0	4	**37**	0	5	**6**	**43**	1	7	**10**	53
Slovakia	*2*	*6*	*18*	26	13	0	**39**	2	0	**2**	**42**	3	0	**0**	42
Slovenia	*1*	*6*	*1*	8	1	10	**18**	0	0	**0**	**18**	0	0	**4**	22
Spain	*3*	*371*	*64*	438	1	24	**463**	3	34	**37**	**500**	4	42	**42**	542
Sweden	*0*	*1*	–	1	0	0	**1**	0	1	**1**	**3**	0	1	**6**	9
UK (>44 kW)	*203*	*1044*	*318*	1565	59	92	**1715**	4	6	**10**	**1726**	5	8	**75**	1801
EU	*564*	*3810*	*904*	**5295**	**296**	**541**	**6132**	**51**	**152**	**203**	**6335**	**67**	**186**	**253**	**6588**
avg. kW	*12*	*22*	*29*	22,1	22	22	**22,1**	120	93	**100**	**25**	120	93	**100**	**27**
mln. kW	*6,8*	*83,8*	*26,2*	116,8	6,5	11,9	**135,2**	6,1	14,2	**20,2**	**155**	8,0	17,3	**25,3**	**181**

Table 3-10. Prices and Installation Costs BaseCases PER UNIT

BASECASES	1	2	3	4	5	6	7	8	9
	1 -XXS (XX Small)	2 -XS (Xtra Small)	3 -S (Small)	4 -M (Medium)	5 -L (Large)	6 -XL (Xtra Large)	7 -XXL (XX Large)	8 -3XL	9 -4XL
PRODUCT PRICE break down									
OEM Subass. Costs (Task 2, Ch. 5)	Euro/ system	Euro/ system	Euro/ system	Euro/ system	Euro/ system	Euro/ system	Euro/ system	Euro/ system	Euro/ system
Heat exchanger group	55	65	77	90	104	180	270	540	1.620
El. controls group	50	50	50	50	50	63	78	156	563
Burner group	12	14	17	20	23	29	36	72	216
Fuel controls group	35	35	35	35	35	44	55	109	328
CH-return group	40	40	40	40	40	80	100	200	600
CH-supply group	10	10	10	10	10	13	16	31	94
Fan group	30	35	30	30	30	60	75	150	450
Casing	18	22	26	30	35	60	90	180	540
Condensate collect	8	8	8	8	8	10	13	25	90
Hot water group	21	21	21	21	21	21	21	21	21
Packaging etc.	6	7	9	10	12	20	30	60	180
Extra oil-fired (*0,11)	54	58	61	65	69	486	658	1.298	3.949
Subtotal OEM	340	365	382	409	436	1.064	1.440	2.842	8.650
Labour	102	110	115	123	131	319	432	853	2.595
Overhead	238	256	268	286	305	745	1.008	1.990	6.055
total MSP	680	731	765	818	872	2.129	2.881	5.685	17.300
Ex wholesale	885	950	994	1.063	1.133	2.768	3.745	7.390	22.490
Ex installer excl. VAT	1.055	1.133	1.185	1.268	1.351	3.300	4.466	8.811	26.815
BOILER consumer street price incl. VAT	1.255	1.348	1.410	1.509	1.608	3.927	5.314	10.485	31.909
CONTROLLERS incl. VAT	0	0	0	0	0	0	0	0	0
INSTALLATION (Labour, materials, VAT)	972	1.033	1.094	1.215	1.337	2.572	3.857	5.143	9.001
subtotal Boiler (all in)	2.227	2.381	2.504	2.724	2.945	6.498	9.171	15.629	40.910
SOLAR materials incl. VAT	0	0	0	0	0	0	0	0	0
SOLAR installation incl. VAT	0	0	0	0	0	0	0	0	0
HEAT PUMP materials incl. VAT	0	0	0	0	0	0	0	0	0
HEAT PUMP installation incl. VAT	0	0	0	0	0	0	0	0	0
TOTAL PURCHASE	2.227	2.381	2.504	2.724	2.945	6.498	9.171	15.629	40.910

In the Table 3-9 we have split the small "gas fs" and "oil jet" boilers over the "gas wh" categories proportionally. This gives us a subdivision of individual boilers in 3 categories: 8-15 kW, 16-25 kW, 26+ kW. The first category covers XXS (10 kW) and XS-size (14 kW). From the RT2000 database (Table 3-5 of Chapter 3, Task 2) we know that the XXS-size is a small segment. We will set this category at around 2% of the market (130.000 units per year). The remainder will be XS, which comes down to 450.000 units.

The subdivision of the 16-25 kW we will estimate that the S-size (19 kW=16-20 kW) constitutes around 25% or 1 million units. This leaves 3 million units for the M-size (22 kW= range 20-25 kW).

For the 26+ kW wall-hung gas category, the RT2000 database shows that 65% of units is in the size <33 kW, which would qualify for the L category (29 kW= range 26-32 kW) and represents a segment of 650.000 units annual sales.

This leaves 350.000 wall-hung gas-fired units for the category range 33-70 kW (roughly XL= 86 kW). As is shown in Table 3-10 of Chapter 3/Task 2, there are also around 67.000 gas-fired floor standing units and 233.000 oil jet burners in that category. With that, the XL category is as large as the L category: 650.000 units.

The category of 70 to 120-150 kW (XXL=130 kW) the data show around 100.000 wall hung units (probably mostly 80-100 kW) plus another 17.000 gas floor standing units and 55.000 oil jet burners. In total this is around 177.000 units (± 20%).

The remainder, not covered by the categorisation, are boilers with a heat input over 120-150 kW. These are around 27.000 gas-fired floor standing units and some 50.000 oil-fired boilers, totalling 77.000 units. If the subdivision of floor standing gas boilers applies, around 55% (40.000 units) are between 120 and 350 kW. Around 37.000 boilers are in the range >350 kW.

Table 3-11. Estimated market segmentation of BaseCases

	indicative range heat input (kW)	Unit sales * 1000	Share of total	oil units * 1000	oil share
XXS	<10 kW	**150**	2,3%	13	8,8%
XS	10-15 kW	**500**	7,6%	44	8,8%
S	16-20 kW	**1000**	15,2%	88	8,8%
M	21-25 kW	**3400**	51,5%	300	8,8%
L	26-32 kW	**650**	9,9%	57	8,8%
XL	33-70 kW	**650**	9,9%	267	41,0%
XXL	70-150 kW	**170**	2,6%	51	30,0%
150-350 kW	150-350 kW	**40**	0,6%	26	65,0%
350+ kW	>350 kW	**37**	0,6%	24	65,0%
Total		**6597**	100,0%	871	13,2%

The XXS-XXL categories cover over 98% of unit sales and around 88% of installed capacity (in total kW).

In the categories XXS-L we estimate the share of oil-fired boilers at 8,8%. In the categories XL the share is 41% and with XXL 30%. In the largest categories above 150 kW input the share of oil fired boilers is around 65% according to the data in the Task 2 Report.

4 ENVIRONMENTAL IMPACT

Annex A gives an example of the EcoReport for a Medium sized boiler.

The table on the next page gives the outcome for all Base Cases.

Main findings are that, depending on the BaseCase size class, emissions to air primarily occur in the use phase according following table:

- 98 to 99,9% of all CO2 emissions relate to the use phase;
- 92 to 99% of all SOx emissions relate to the use phase;
- all VOC emissions relate to the use phase;
- 20 – 35% of POP (persistent organic pollutants) relate to the use phase;
- 30 – 90% of heavy metal emission relate to use phase;
- 30 – 85% of all PAH’s relate to the use phase;
- around 50% of all PM emissions relate to the use phase.

Table 4-1. Environmental impacts BaseCases

BASECASES		1		2		3		4		5		6		7		8		9	
		1 -XXS (XX Small)		2 -XS (Xtra Small)		3 -S (Small)		4 -M (Medium)		5 -L (Large)		6 -XL (Xtra Large)		7 -XXL (XX Large)		8 -3XL		9 -4XL	
ENVIRONMENTAL IMPACT PER UNIT OVER LIFE																			
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**34,1**		**34,1**		**34,1**		**45,2**		**50,7**		**129,8**		**221,2**		**649,4**		**1997,9**	
of which																			
Disposal	kg	**6,1**		**6,1**		**6,1**		**6,7**		**7,0**		**10,4**		**17,0**		**49,6**		**152,6**	
Recycled	kg	**27,9**		**27,9**		**27,9**		**38,5**		**43,8**		**119,4**		**204,1**		**599,8**		**1845,3**	
OTHER RESOURCES																			
Total Energy (GER)	GJ	**269,4**	266,7	**416,0**	413,3	**566,0**	563,3	**831,8**	828,4	**1145,3**	1141,6	**2832,8**	2827,2	**5689,3**	5680,7	**14843,3**	14819,8	**46177,2**	46105,5
of which, electric(in primary)	GJ	**23,6**	23,0	**29,4**	28,8	**40,2**	39,6	**42,2**	41,4	**44,0**	43,2	**204,5**	203,3	**281,1**	279,5	**720,5**	716,3	**2145,8**	2133,2
Water (process)	m3	**2,0**	1,5	**2,4**	1,9	**3,1**	2,6	**3,3**	2,8	**3,4**	2,9	**14,1**	13,6	**19,4**	18,6	**49,5**	47,8	**147,6**	142,2
Water (cooling)	m3	**61,7**	61,3	**77,1**	76,7	**106,0**	105,6	**110,9**	110,4	**115,7**	115,2	**543,0**	542,2	**746,6**	745,5	**1913,6**	1910,3	**5698,9**	5688,6
Waste, non-haz./ landfill	kg	**5,3**	0,5	**5,5**	0,7	**5,7**	0,9	**5,8**	1,0	**5,8**	1,0	**9,0**	4,7	**12,9**	6,4	**34,6**	16,5	**104,8**	49,2
Waste, hazardous/ incineratec	kg	**98,0**	26,7	**104,7**	33,3	**117,3**	45,9	**146,9**	48,0	**162,7**	50,1	**369,1**	235,8	**521,2**	324,1	**1407,6**	830,6	**4248,3**	2473,3
EMISSIONS TO AIR																			
GHG in GWP100	tCO2	**15,1**	14,9	**23,4**	23,2	**31,8**	31,6	**47,0**	46,8	**64,9**	64,6	**176,0**	175,6	**344,4**	343,7	**859,7**	857,9	**3095,7**	3090,2
AP Acidification	kgSOx	**12,4**	11,4	**17,1**	16,0	**23,0**	22,0	**29,6**	28,3	**37,2**	35,8	**181,4**	179,9	**289,2**	286,9	**593,3**	587,2	**3527,8**	3508,9
VOC Volatile Organic Comp.	kg	**0,2**	0,2	**0,3**	0,3	**0,4**	0,4	**0,6**	0,6	**0,8**	0,8	**2,6**	2,6	**4,9**	4,8	**11,5**	11,4	**49,1**	48,6
POP Persist.Organic Poll.	mg i-Teq	**0,9**	0,2	**0,9**	0,2	**1,0**	0,3	**1,3**	0,3	**1,4**	0,3	**3,3**	1,3	**4,8**	1,8	**13,4**	4,7	**40,8**	14,0
HMa Heavy Metals	mg Ni	**1,3**	0,4	**1,4**	0,5	**1,6**	0,7	**1,8**	0,8	**2,0**	0,8	**4,7**	3,5	**6,5**	4,8	**17,2**	12,3	**51,6**	36,6
PAHs	mg	**0,2**	0,1	**0,3**	0,1	**0,3**	0,1	**0,3**	0,2	**0,3**	0,2	**0,6**	0,5	**0,9**	0,7	**2,1**	1,8	**6,2**	5,4
PM Particulate Matter	kg	**2,1**	1,1	**2,2**	1,2	**2,4**	1,3	**2,7**	1,4	**2,9**	1,5	**8,0**	4,2	**13,3**	6,1	**29,6**	11,7	**117,3**	62,7
EMISSIONS TO WATER																			
HMw Heavy Metals	g Hg/20	**0,7**	0,1	**0,8**	0,2	**0,8**	0,3	**1,0**	0,3	**1,1**	0,3	**2,0**	1,3	**2,7**	1,8	**7,0**	4,6	**21,1**	13,8
EP Eutrophication	g PO4	**12,4**	0,7	**12,6**	0,9	**12,9**	1,2	**15,7**	1,3	**17,1**	1,3	**23,2**	6,3	**31,5**	8,6	**85,5**	22,0	**260,3**	65,6

5 LIFE CYCLE COSTS

An overview of the lifecycle costs is given in Table 5-1

The energy costs over life vary from 47% of total LLC costs for a basecase XXS boiler to 97% for a basecase 4XL boiler.

Table 5-1. Life Cycle Costs and Annual Expenditure PER UNIT

BASECASES	1	2	3	4	5	6	7	8	9
	1 -XXS (XX Small)	2 -XS (Xtra Small)	3 -S (Small)	4 -M (Medium)	5 -L (Large)	6 -XL (Xtra Large)	7 -XXL (XX Large)	8 -3XL	9 -4XL
LCC break down									
Product Price	€ 1.255	€ 1.348	€ 1.410	€ 1.509	€ 1.608	€ 3.927	€ 5.314	€ 10.485	€ 31.909
Installation	€ 972	€ 1.033	€ 1.094	€ 1.215	€ 1.337	€ 2.572	€ 3.857	€ 5.143	€ 9.001
Fuel energy (gas, oil)	€ 4.009	€ 6.328	€ 8.620	€ 12.956	€ 18.083	€ 42.169	€ 87.522	€ 230.929	€ 694.390
Electricity	€ 276	€ 345	€ 476	€ 497	€ 519	€ 2.442	€ 3.357	€ 8.603	€ 25.620
Repair & Maintenance	€ 2.573	€ 2.573	€ 2.573	€ 2.573	€ 2.573	€ 3.859	€ 5.145	€ 6.431	€ 7.718
TOTAL LCC	€ 9.085	€ 11.627	€ 14.172	€ 18.750	€ 24.119	€ 54.968	€ 105.196	€ 261.592	€ 768.637
Annual expenditure									
Product Price	€ 74	€ 79	€ 83	€ 89	€ 95	€ 231	€ 313	€ 617	€ 1.877
Installation	€ 57	€ 61	€ 64	€ 71	€ 79	€ 151	€ 227	€ 303	€ 529
Fuel energy (gas, oil)	€ 213	€ 331	€ 451	€ 666	€ 919	€ 2.213	€ 4.496	€ 11.850	€ 35.617
Electricity	€ 19	€ 24	€ 33	€ 35	€ 36	€ 171	€ 235	€ 602	€ 1.793
Repair & Maintenance	€ 180	€ 180	€ 180	€ 180	€ 180	€ 270	€ 360	€ 450	€ 540
TOTAL expenditure/a	€ 543	€ 675	€ 812	€ 1.041	€ 1.309	€ 3.036	€ 5.631	€ 13.821	€ 40.356

6 EU TOTALS

The table 6.1 on the next page shows the total environmental impact of the products sold in 2005 over their lifetime, i.e. the period between 2005 and 2022. One could also say that it is the total environmental impact caused by the buyers in 2005 (c.p.).

In that sense, the categories XXS-4XL will consume almost 9.500 PJ primary energy per year and emit 570 MtCO2 equivalent, 479 kt SOx equivalent, etc. over their life.

Table 6.2 shows the total life cycle costs that these buyers in 2005 have caused. In fact, these 6,9 mln. buyers have "signed a check" to spend 193 billion (193.000 million) Euro over the next 17 years (figures in NPV[6]). Of this sum, only about 23 billion (12%) are costs for the purchase and installation. The rest are running costs, of which almost 151 billion Euro energy costs.

Annually –in current money units and including the write-offs— they will spend over 10 billion Euro, of which around 8 billion Euro in energy costs.

When looking at costs and impacts per size, it is not surprising that the category with the highest unit sales (Medium-size, 3,4 mln.= 50% of sales) is responsible for most impact (ca. 30%). It is perhaps more surprising that the second in row is the 4XL-category (0,037 mln. units = 0,5% of sales) with around 18% of the total impact.

This calculation of totals is a first step towards the scenario analysis, which will take place in Task 7.2.

---

[6] Net Present Value

Table 6.1. Environmental Impact BaseCases sold in 2005 over their product life (17 years)

		1 -XXS (XX Small)		2 -XS (Xtra Small)		3 -S (Small)		4 -M (Medium)		5 -L (Large)		6 -XL (Xtra Large)		7 -XXL (XX Large)		8 -3XL		9 -4XL		NEW TOTAL EU	
Units sales/a * 1000:																					
Total 6597		**150**		**500**		**1000**		**3400**		**650**		**650**		**170**		**40**		**37**			
IMPACT CATEGORY																					
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kt	**5**		**17**		**34**		**154**		**33**		**84**		**38**		**26**		**74**		**465**	
of which																					
Disposal	kt	**1**		**3**		**6**		**23**		**5**		**7**		**3**		**2**		**6**		**55**	
Recycled	kt	**4**		**14**		**28**		**131**		**28**		**78**		**35**		**24**		**68**		**410**	
OTHER RESOURCES																					
Total Energy (GER)	PJ	**40**	40	**208**	207	**566**	563	**2828**	2817	**744**	742	**1841**	1838	**967**	966	**594**	593	**1709**	1706	**9498**	9471
of which, electric(in primary)	PJ	**4**	3	**15**	14	**40**	40	**143**	141	**29**	28	**133**	132	**48**	48	**29**	29	**79**	79	**519**	514
Water (process) * mln.	m3	**0**	0	**1**	1	**3**	3	**11**	9	**2**	2	**9**	9	**3**	3	**2**	2	**5**	5	**38**	34
Water (cooling) * mln	m3	**9**	9	**39**	38	**106**	106	**377**	375	**75**	75	**353**	352	**127**	127	**77**	76	**211**	210	**1373**	1370
Waste, non-haz./ landfill	kt	**1**	0	**3**	0	**6**	1	**20**	3	**4**	1	**6**	3	**2**	1	**1**	1	**4**	2	**46**	12
Waste, hazardous/ incinerated	kt	**15**	4	**52**	17	**117**	46	**499**	163	**106**	33	**240**	153	**89**	55	**56**	33	**157**	92	**1331**	595
EMISSIONS TO AIR																					
GHG in GWP100	MtCO2	**2**	2	**12**	12	**32**	32	**160**	159	**42**	42	**114**	114	**59**	58	**34**	34	**115**	114	**570**	568
AP Acidification	ktSOx	**2**	2	**9**	8	**23**	22	**101**	96	**24**	23	**118**	117	**49**	49	**24**	23	**131**	130	**479**	470
VOC Volatile Organic Comp.	kt	**0**	0	**0**	0	**0**	0	**2**	2	**1**	1	**2**	2	**1**	1	**0**	0	**2**	2	**8**	8
POP Persist.Organic Poll.	g i-Teq	**0**	0	**0**	0	**1**	0	**4**	1	**1**	0	**2**	1	**1**	0	**1**	0	**2**	1	**12**	3
HMa Heavy Metals	t Ni	**0**	0	**1**	0	**2**	1	**6**	3	**1**	1	**3**	2	**1**	1	**1**	0	**2**	1	**17**	9
PAHs	t Ni	**0**	0	**0**	0	**0**	0	**1**	1	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**3**	2
PM Particulate Matter	kt	**0**	0	**1**	1	**2**	1	**9**	5	**2**	1	**5**	3	**2**	1	**1**	0	**4**	2	**28**	14
EMISSIONS WATER																					
HMw Heavy Metals	t Hg/20	**0**	0	**0**	0	**1**	0	**3**	1	**1**	0	**1**	1	**0**	0	**0**	0	**1**	1	**8**	3
EP Eutrophication	t PO4	**2**	0	**6**	0	**13**	1	**53**	4	**11**	1	**15**	4	**5**	1	**3**	1	**10**	2	**119**	16

Table 6.2. Life Cycle Costs and Annual Expenditure for BaseCase units sold in 2005 over their product life (17 years)

		1 -XXS (XX Small)	2 -XS (Xtra Small)	3 -S (Small)	4 -M (Medium)	5 -L (Large)	6 -XL (Xtra Large)	7 -XXL (XX Large)	8 -3XL	9 -4XL	TOTAL
Units sales/a * 1000: **Total 6597**		150	500	1000	3400	650	650	170	40	37	
LCC break down											
Product Price	M€	188	674	1.410	5.130	1.045	2.552	903	419	1.181	13503
Installation	M€	146	517	1.094	4.132	869	1.672	656	206	333	9624
Fuel energy (gas, oil)	M€	601	3.164	8.620	44.049	11.754	27.410	14.879	9.237	25.692	145405
Electricity	M€	41	173	476	1.691	337	1.587	571	344	948	6168
Repair & Maintenance	M€	386	1.286	2.573	8.747	1.672	2.508	875	257	286	18589
TOTAL LCC	M€	1.363	5.813	14.172	63.749	15.677	35.729	17.883	10.464	28.440	193290
Annual expenditure											
Product Price	M€	11	40	83	302	61	150	53	25	69	794
Installation	M€	9	30	64	243	51	98	39	12	20	566
Fuel energy (gas, oil)	M€	32	165	451	2.263	597	1.438	764	474	1.318	7503
Electricity	M€	3	12	33	118	24	111	40	24	66	432
Repair & Maintenance	M€	27	90	180	612	117	176	61	18	20	1301
											0
TOTAL expenditure/a	M€	81	338	812	3.538	851	1.973	957	553	1.493	10596

ANNEX A: ECOREPORT EXAMPLE

INPUTS: Medium- Sized Boiler

Version 5 VHK for European Commission 28 Nov. 2005

ECO-DESIGN OF ENERGY-USING PRODUCTS

EuP EcoReport: INPUTS

Nr	New Gas Wall Hung Non Condensing Combi "Medium"	apr-07	R. v. Holsteijn
	Products		**vhk**

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category Click &select	Material or Process select Category first !
1	Aluminium die cast	1970,0	4-Non-ferro	**27-Al diecast**
2	Stainless steel	2660,0	3-Ferro	**25-Stainless 18/8 coil**
3	Electronics	690,0	6-Electronics	**98-controller board**
4	Cast iron	1170,0	3-Ferro	**23-Cast iron**
5	Plastics	3650,0	1-BlkPlastics	**4-PP**
6	Plastics ABS		1-BlkPlastics	**10-ABS**
7	Copper	4260,0	4-Non-ferro	**30-Cu tube/sheet**
8	Brass	1650,0	4-Non-ferro	**31-CuZn38 cast**
9	Insulation	800,0	2-TecPlastics	**15-Rigid PUR**
10	Insulation Mineral Wool			
11	Steel	28180,0	3-Ferro	**21-St sheet galv.**
12	Others	350,0	1-BlkPlastics	**5-PS**
13				
	TOTAL	**45380**		

Pos nr	MANUFACTURING Description	Weight in g	Percentage Adjust	Category index (fixed)
201	**OEM Plastics Manufacturing** (fixed)	4800		20
202	**Foundries Fe/Cu/Zn** (fixed)	2820		34
203	**Foundries Al/Mg** (fixed)	1970		35
204	**Sheetmetal Manufacturing** (fixed)	35100		36
205	**PWB Manufacturing** (fixed)	0		53
206	**Other materials** (Manufacturing already included)	690		
207	**Sheetmetal Scrap (Please adjust percentage only)**	8775	**25%**	37

Pos nr	DISTRIBUTION (incl. Final Assembly) Description		Answer	Category index (fixed)	
208	**Is it an ICT or Consumer Electronics product <15 kg ?**		NO	59	0
209	**Is it an installed appliance (e.g. boiler)?**		YES	60	1
				62	0
210	**Volume of packaged final product in m³**	**in m³**	0,15	63	1

Pos nr	Description		unit	Subtotals
				64 0
Pos nr	**USE PHASE** Description		unit	Subtotals
211	Product Life in years	17	years	
	Electricity			
212	On-mode: Consumption per hour, cycle, setting, etc.	0	kWh	0
213	On-mode: No. Of hours, cycles, settings, etc. / year	0	#	
214	Standby-mode: Consumption per hour	0	kWh	0
215	Standby-mode: No. Of hours / year	0	#	
216	Off-mode: Consumption per hour	0	kWh	0
217	Off-mode: No. Of hours / year	0	#	
	TOTAL over Product Life	2,39	MWh (=000 kWh)	65
	Heat			
218	Avg. Heat Power Output	0	kW	
219	No. Of hours / year	0	hrs.	
220	Type and efficiency (Click & select)	89,5%		69-Gas, atmospheric 90
	TOTAL over Product Life	665,56	GJ	
	Consumables (excl, spare parts)			material
221	Water	0	m³/year	83-Water per m³
222	Auxilliary material 1 (Click & select)	0	kg/ year	85-None
223	Auxilliary material 2 (Click & select)	0	kg/ year	85-None
224	Auxilliary material 3 (Click & select)	0	kg/ year	85-None
	Maintenance, Repairs, Service			
225	No. of km over Product-Life	100	km / Product Life	86
226	Spare parts (fixed, 1% of product materials & manuf.)	454	g	
Pos nr	**DISPOSAL & RECYCLING** Description		unit	Subtotals
	Substances released during Product Life and Landfill			
227	Refrigerant in the product (Click & select)	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%		
	Disposal: Environmental Costs perkg final product			
231	Landfill (fraction products not recovered) in g en %	2269	5%	88-fixed
232	Incineration (plastics & PWB not re-used/recycled)	4320	g	91-fixed
233	Plastics: Re-use & Recycling ("cost"-side)	480	g	92-fixed
	Re-use, Recycling Benefit	in g	% of plastics fraction	
234	Plastics: Re-use, Closed Loop Recycling (please edit%)	48	1%	4
235	Plastics: Materials Recycling (please edit% only)	432	9%	4
236	Plastics: Thermal Recycling (please edit% only)	4320	90%	72
237	Electronics: PWB Easy to Disassemble ? (Click&select)	0	NO	98
238	Metals & TV Glass & Misc. (95% Recycling)	38551		fixed

RESULTS

Version 5 VHK for European Commission 28 Nov. 2005											
	ECO-DESIGN OF ENERGY-USING PRODUCTS					EuP EcoReport: Assessment of Environmental Impact					
Nr	Life cycle Impact per product:						apr-07		R. v. Holsteijn		
0	Products						0		vhk		
	Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Total	
	Materials	**unit**									
1	Bulk Plastics	g			**4000**			3600	400	**4000**	**0**
2	TecPlastics	g			**800**			720	80	**800**	**0**
3	Ferro	g			**32010**			1601	30410	**32010**	**0**
4	Non-ferro	g			**7880**			394	7486	**7880**	**0**
5	Coating	g			**0**			0	0	**0**	**0**
6	Electronics	g			**690**			690	0	**690**	**0**
7	Misc.	g			**0**			0	0	**0**	**0**
	Total weight	g			**45380**			7005	38376	**45380**	**0**
	Other Resources & Waste							debet	credit		
8	Total Energy (GER)	MJ	2442	851	**3293**	**218**	**820714**	449	254	**195**	**824421**
9	of which, electricity (in primary MJ)	MJ	532	492	**1024**	**0**	**25063**	0	2	**-2**	**26086**
10	Water (process)	ltr	631	7	**638**	**0**	**1677**	0	1	**-1**	**2313**
11	Water (cooling)	ltr	548	212	**760**	**0**	**66816**	0	10	**-10**	**67566**
12	Waste, non-haz./ landfill	g	93791	3919	**97709**	**119**	**30025**	2783	7	**2776**	**130630**
13	Waste, hazardous/ incinerated	g	483	1	**484**	**2**	**582**	4320	1	**4319**	**5387**
	Emissions (Air)										
14	Greenhouse Gases in GWP100	kg CO2 eq.	166	48	**215**	**14**	**45089**	33	18	**16**	**45334**
15	Ozone Depletion, emissions	mg R-11 eq.								negligible	
16	Acidification, emissions	g SO2 eq.	1072	210	**1281**	**42**	**19289**	67	23	**44**	**20657**
17	Volatile Organic Compounds (VOC)	g	9	1	**10**	**3**	**593**	1	0	**1**	**607**
18	Persistent Organic Pollutants (POP)	ng i-Teq	916	94	**1011**	**1**	**174**	19	0	**19**	**1205**
19	Heavy Metals	mg Ni eq.	784	221	**1006**	**6**	**492**	124	0	**124**	**1627**
	PAHs	mg Ni eq.	167	0	**167**	**9**	**125**	0	0	**0**	**301**
20	Particulate Matter (PM, dust)	g	155	32	**187**	**513**	**1244**	582	1	**582**	**2526**
	Emissions (Water)										
21	Heavy Metals	mg Hg/20	783	0	**783**	**0**	**169**	37	0	**37**	**990**
22	Eutrophication	g PO4	15	0	**15**	**0**	**1**	2	0	**2**	**18**
23	Persistent Organic Pollutants (POP)	ng i-Teq					negligible				