Preparatory Study on

Eco-design of Water Heaters

Task 6   Design Options (Final)

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CONTENTS

page

LIST OF TABLES

page

1 INTRODUCTION

1.1 Introduction

The scope of Task 6 of the preparatory Eco-design study on Water Heaters is the identification of the short-term target design options, their monetary consequences in terms of Life Cycle Costs for the consumer, their environmental costs and benefits and pinpointing the solution with the least Life Cycle Costs (LLCC) and the Best Available Technology (BAT).

The assessment of monetary Life Cycle Costs is relevant to indicate whether design solutions might negatively or positively impact the total EU consumer's expenditure over the total product life (purchase, running costs, etc.). The distance between the LLCC and the BAT indicates – in a case a LLCC solution is set as a minimum target – the remaining space for product-differentiation (competition). The BAT indicates a medium-term target that would probably be more subject to promotion measures than restrictive actions. The BNAT (= Best Not yet Available Technologies (see subtask 6.5) indicates the long-term possibilities and helps to define the exact scope and nature of possible measures.

Please note that the underlying report is only a part of the deliverables under this task, specifically dealing with the documentation of inputs and especially costs. Furthermore it gives the main conclusions.

VHK has made all calculations based on the ECOHOTWATER model (and the ECOBOILER model for combined appliances - see also Lot 1 Ecodesign of Boilers study), which is added separately as an Excel file.

1.2 Approach

The Base-Case of New Water Heaters - as defined in Task 5 - will serve as the reference for the evaluation of the design options. These Base-cases define a water heating system (incl. distribution losses, waste heat recovery) in combination with the tapping patterns as defined in Task 5.

A specific problem of Water Heaters is that the Base Case is not a single water heater, but that in fact it has to be composed from the different technologies in the size classes, based on their relative market share. As opposed to boilers it is therefore not possible to link a Base Case performance to single technical parameters.

For each Design-option, the increase in consumer price (VAT included) will be estimated on the bases of:

- data that was gathered and presented in the Task 2 Report, chapter 4 and 5;
- data gathered for the Task 4 Report;
- hands-on experience with engineering and production in the heating industry;
- product list prices and prices collected from web-shops.

The energy savings related to each individual design option will be calculated using the Ecohotwater Model, version 4. The consequences of each design-option for environmental impact and Life-Cycle costs will be determined on the bases of the EuP EcoDesign Model (EcoReport version 5), where the input for the energy consumption in the use-phase is the output "CH Energy Total" from the Integrated HotWater/Boiler Model.

The parameters that are used for calculating the life-cycle running costs as defined in Task 5.

The base case and design options were calculated with the ECOHOTWATER model, which is added as a separate deliverable under this task in the form of an Excel file.

The ECOHOTWATER model contains 26 main variables and several derived parameters e.g. for appropriate tank volume, losses etc.. In total there are around 30 editable variables. On average there are around 4 or 5 plausible values for each parameter.

Theoretically, just counting the 26 main parameters and 4 possible values this means that there are 4^{26} (4 to the power 26) possible combinations. This comes down to 4,5 quadrillion design options (4,5 * 10^{15}). Even if we group these options and just assume the most popular values, the number of design options would be several thousands per size class (XXS-XXL).

In other words, it is impossible to analytically cover all possible options. The best we can do, is to pick out some characteristic design options –possibly as heterogeneous as possible—and give an overview of their energy and Life Cycle Costs results.

We will limit the possible amount of options to 9 per size class. Already, for 8 size classes, this means that we have to

- Define the technical parameters,
- Calculate the energy efficiency and consumption with the ECOHOTWATER model,
- Calculate the Life Cycle Costs and
- Calculate the environmental impact using the EcoReport.

for over 70 design options.

The result of this exercise, which involves still a significant manual data processing, is shown in this Task 6 report.

1.3 Design Options & Costs

As mentioned, most price and cost estimates come from previous task reports. In addition, the following table gives an overview of some cost-related parameters for renewable energy options.

Table 1.1: cost parameters for design options using renewables

	Solar			Electric Heat pump			Gas fired Heat pump		
	glazed	unglaz.	vacutube	br/water	water/w	air/water	br/water	water/w	air/water
	1	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
Streetprice EUR, VAT included									
SOLAR Material fixed costs	500	500	500						
SOLAR Material costs per m2	300	200	400						
SOLAR Installation fixed costs	350	350	350						
SOLAR Installation costs per m2	150	150	150						
HEAT PUMP Materials fixed costs				1000	1000	250	1000	1000	750
HEAT PUMP Materials costs per kW				1000	1000	500	1000	1000	600
HEAT PUMP Installation fixed costs				1000	1000	250	1000	1000	500
HEAT PUMP Installation costs/kW				600	600	250	500	500	300

Prices of solar systems and NON-air-source heat pumps are based upon list prices of manufacturers. The price of air-source heat pumps is based not on current market prices, but on cost projections resulting from volume production. VHK estimates that with the component costs at volume-production the prices could be around € 1250,- for a 2kW version (incl. VAT, excl. installation costs at € 750,-), making a COP 3 version an economical replacement product for standard ESWHs. Naturally, the ECOHOTWATER model takes into account that the volume of ventilation air intake does not exceed the ventilation requirements (e.g. <180 m3/h) to avoid “over-ventilation”.

2 DESIGN OPTIONS

2.1 Design options XXS & XS

The two smallest size categories have the same net load (in kWh hot water equivalent) but differ in tapping frequencies and tapping volume (see table below). They are both single point water heaters. The XXS-size is suitable for hand wash and small cleaning, whereas the XS-size should be capable of filling an 8-10 litre basin (dishwash, bucket) and is therefore suitable for dishwashing or a bathroom sink.

The XXS Base Case is a mix of small electric storage (10L) and electric instantaneous water heaters. The XS Base Case is a mix of small gas instantaneous (with pilot flame), electric storage (20L) and electric instantaneous water heaters (see Task 5)

The LLCC-point in the XXS and XS class is an electric instantaneous water heater (EIWH), whereby the LCC of the electronic and hydraulic version are about the same (2% difference for XXS), but the former has a better efficiency. This would put the LLCC-efficiency level at ca. 30-34% (see graphs) with the upper limit also being **BAT** level.

All in all, the analysis shows that it is possible to reach a **BAT –level of 34%** efficiency, but only when using an EIWH with electronic control. The power requirement for the EIWH (min. 6kW for XXS and 12kW for XS) might lead to extra installation costs related to the realisation of a dedicated 2- or 3-phase socket (especially for the 12kW units).

The next best option for XXS and XS is almost immediately a Base Case (average mix), with an efficiency of approximately **27%.** This is also a level that is still attainable for a smart and well-insulated electric storage water heater [1]. We propose to use this as an **LLCC target.**

Table 2.1. XXS and XS-size characteristics

Size	Load	[unit]	Examples of applications
XXS	Largest flow rate required (ΔT=45 K)	2 ltr./ min.	small sink tap (no dishwash) [1 c] single point only (semi-) public toilets (if hot water needed)
	Largest tapping required	2 ltr	
	24 h net hot water demand	2,1 kWh/ d	
	Nr. of cycles per 24 h	18	
XS	Largest flow rate required (ΔT=45 K)	4 ltr./ min.	average sink tap [1 b] single point with dishwash
	Largest tapping required	5 ltr	
	24 h net hot water demand	2,1 kWh/ d	
	Nr. of cycles per 24 h	16	

[1] The patented "drop stop" technology reduces standing losses by 15% (AEG Huz5 from 0.27 kWh/day to 0.23 kWh/day). Application of heat traps further reduces heat losses (eg. no heat loss through vented tap). Smart temp.control also reduces heat losses by varying storage temperature according demand. Overall efficiency could be raised from 23% for the standard electric storage to 26-27% for the improved version.

Table 2.2: Design options XXS

Base case	XXS
Option 1	Base case (mix storage plus instant)
Option 2	ESWH 10 (for information only no improvement from energy or LCC perspective)
Option 3	ESWH smart (efficiency improved from 25% standard to 27%)
Option 4	EIWH hydraulic control
Option 5	EIWH electronic control
Option 6	n.a.
Option 7	n.a.
Option 8	n.a.
Option 9	n.a.

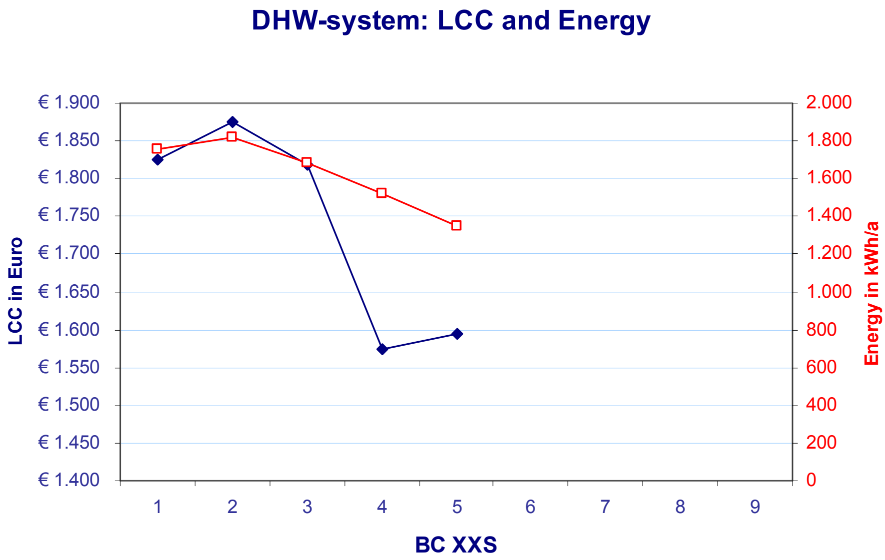

Table 2.3: Outcomes XXS

		BC XXS	ESWH 10	ESWH smart	EIWH H 8	EIWH E 8
MAIN ENERGY OUTPUTS (annual)						
WH sys. efficiency		**27%**	**25%**	**27%**	**30%**	**34%**
Primary energy consumption	kWh/a	**1757**	**1819**	**1681**	**1516**	**1349**
-of which fuel (primary kWh GCV)	kWh/a	**0**	**0**	**0**	**0**	**0**
-of which electricity (primary kWh)	kWh/a	**1.757**	**1.819**	**1.681**	**1.516**	**1.349**
MAIN LCC OUTPUTS (over product life)						
Price		**€ 122**	**€ 123**	**€ 185**	**€ 81**	**€ 245**
Installation		**€ 50**	**€ 50**	**€ 50**	**€ 50**	**€ 50**
Fuel (gas)		**€ 0**	**€ 0**	**€ 0**	**€ 0**	**€ 0**
Electricity		**€ 1.507**	**€ 1.560**	**€ 1.441**	**€ 1.300**	**€ 1.157**
Maintenance & Repairs		**€ 144**	**€ 143**	**€ 143**	**€ 143**	**€ 143**
TOTAL Life Cycle Costs LCC		**€ 1.824**	**€ 1.876**	**€ 1.819**	**€ 1.574**	**€ 1.595**

Table 2.4: Design options XS

Base Case	XS
Option 1	Base case (mix storage plus instant)
Option 2	ESWH smart (efficiency improved from 25% standard to 27%)
Option 3	EIWH hydraulic control
Option 4	EIWH electronic control
Option 5	GIWH self.ign./ room sealed
Option 6	n.a.
Option 7	n.a.
Option 8	n.a.
Option 9	n.a.

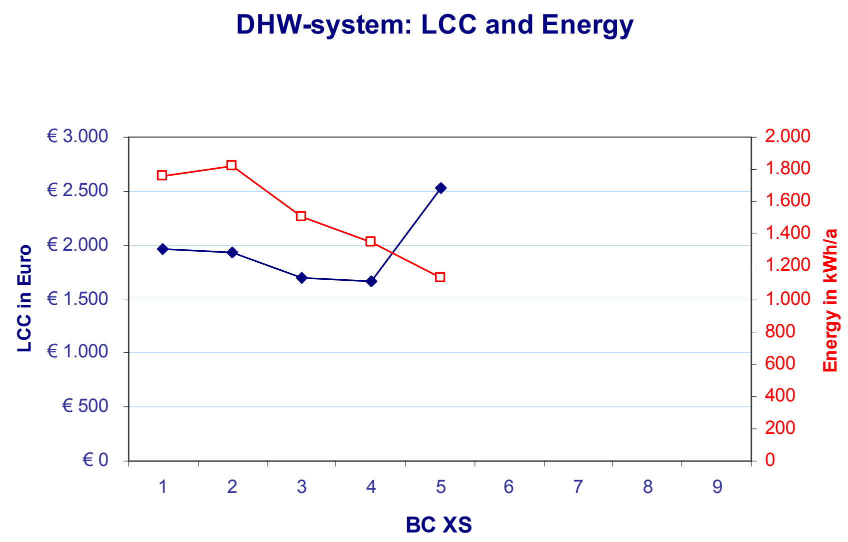

Table 2.5: Outcomes XS

		BC XS	*ESWH 20 smart*	*EIWH H 8*	*EIWH E 8*	*GIWH 9.4 self.ign.*
MAIN ENERGY OUTPUTS (annual)						
WH sys. efficiency		**27%**	**25%**	**30%**	**34%**	**40.7%**
Primary energy consumption	kWh/a	**1762**	**1817**	**1513**	**1348**	**1133**
-of which fuel (primary kWh GCV)	kWh/a	**235**	**0**	**0**	**0**	**1132**
-of which electricity (primary kWh)	kWh/a	**1.527**	**1.817**	**1.513**	**1.348**	**1**
MAIN LCC OUTPUTS (over product life)						
Price		**€ 187**	**€ 185**	**€ 199**	**€ 318**	**€ 480**
Installation		**€ 56**	**€ 50**	**€ 50**	**€ 50**	**€ 144**
Fuel (gas)		**€ 224**	**€ 0**	**€ 0**	**€ 0**	**€ 1.078**
Electricity		**€ 1.309**	**€ 1.558**	**€ 1.297**	**€ 1.156**	**€ 1**
Maintenance & Repairs		**€ 185**	**€ 143**	**€ 143**	**€ 143**	**€ 829**
TOTAL Life Cycle Costs LCC		**€ 1.961**	**€ 1.936**	**€ 1.689**	**€ 1.667**	**€ 2.532**

2.2 Design option S

The S-size category has the same net load (in kWh hot water equivalent) as the XXS and XS class, but should be capable of delivering a tapping of 9 litres at 55-60 °C. This equals around 16 litres of 40 °C or some 3-5 minutes of showering, depending on the showerhead. With this performance it could function as the smallest multi-point water heater, e.g. in a 1 person household (e.g. student flat, holiday home) .

The S Base Case is a mix of small gas instantaneous (with pilot flame), electric storage and electric instantaneous water heaters (see Task 5). The electric instantaneous water heaters are more efficient than the Base Case and would therefore qualify as a design option. A gas-fired instantaneous water heater (GIWH) would also qualify, provided it does not have a pilot flame.

A sophisticated electronic GIWH with self-ignition (eg. water powered) proves itself as **BAT**-point in the S class with 36% efficiency, but it has to be considered that the installation costs apply to a replacement like-for-like and not for the installation of a new flue duct. In that case, the smart ESWH or electronic EIWH at efficiency levels of 34-35% will probably be more attractive.

As a conclusion, we propose a **LLCC-level of 30-33%**. The **BAT** level will be somewhere in the range of **36-40%** efficiency.

Table 2.6: S-size characteristics

Size	Load	[unit]	Examples of applications
S	Largest flow rate required (ΔT=45 K)	5 ltr./ min.	large sink tap/ small shower tap [1]
	Largest tapping required	9 ltr	1 person household
	24 h net hot water demand	2,1 kWh/ d	student flat holiday home
	Nr. of cycles per 24 h	11	single point or small multi-point

Table 2.7: Design options S

Base case	S
Option 1	ESWh (just for information, not better than Base Case)
Option 2	Base case (mix storage plus instant)
Option 3	EIWH hydraulic control 18kW
Option 4	EIWH electronic control 18kW
Option 5	GIWH self.ignition, steady state eff. 85% 19.4kW
Option 6	n.a.
Option 7	n.a.
Option 8	n.a.
Option 9	n.a.

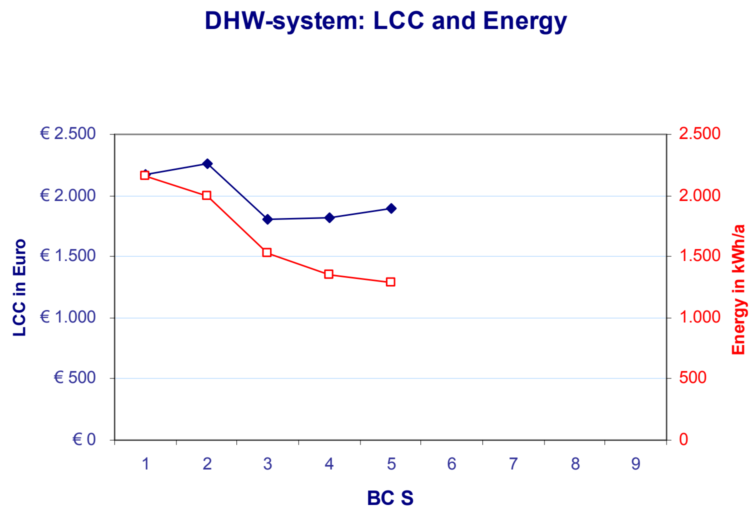

Table 2.8: Outcomes S

		ESWH 30	*BC S*	*EIWH 18 H*	*EIWH 18 E*	*GIWH 18 E*
MAIN ENERGY OUTPUTS (annual)						
WH sys. efficiency		**21%**	**23%**	**30%**	**34%**	**36%**
Primary energy consumption	kWh/a	**2159**	**1997**	**1530**	**1350**	**1293**
-of which fuel (primary kWh GCV)	kWh/a	**0**	**338**	**0**	**0**	**1292**
-of which electricity (primary kWh)	kWh/a	**2.159**	**1.659**	**1.530**	**1.350**	**3**
MAIN LCC OUTPUTS (over product life)						
Price		**€ 123**	**€ 171**	**€ 245**	**€ 420**	**€ 450**
Installation		**€ 50**	**€ 74**	**€ 100**	**€ 100**	**€ 210**
Fuel (gas)		**€ 0**	**€ 322**	**€ 0**	**€ 0**	**€ 1.231**
Electricity		**€ 1.851**	**€ 1.422**	**€ 1.312**	**€ 1.158**	**€ 2**
Maintenance & Repairs		**€ 143**	**€ 271**	**€ 143**	**€ 143**	**€ 0**
TOTAL Life Cycle Costs LCC		**€ 2.167**	**€ 2.261**	**€ 1.800**	**€ 1.821**	**€ 1.893**

2.3 Design option M

The M-size category has almost three times the net heat load as the XXS, XS and S class. The efficiency is derived from test pattern nr. 2 (100 litres @ 60 °C/day) and its LCC/energy are calculated on the basis of a load of 60 litres @ 60 °C/ day.

The M-size represents the average residential water heater for a small family (2,5 persons). The dwelling could be an apartment (social housing), a small terraced house, a larger holiday home, etc., but it also very much depends on habits and comfort level that is required. The M-size water heater is typically suited as a multi-point for kitchen plus bathroom with shower. It is not suitable –unless for patient users-- for filling bathtubs on a daily basis.

The M Base Case is a mix of all sorts of gas/electric and instantaneous/storage types with a large quantity of gas combi's (see Task 5). The graph on the next page shows that –for the average EU—the use of solar thermal installations with an electric storage back-up (option 2) is still somewhat problematic for the M-size.

The design options at LLCC level of around 38-43% represent a small "M-size" LT-instantaneous combi (option 6) and a electronically controlled electric instantaneous water heater (option 5). The efficiency of option 5 is possibly somewhat higher in reality since many gas combi's are condensing (if calculated with the model a condensing gas instant_combi results in 46% efficiency).

The condensing 80L storage combi (option 3) and air source heat pump produce comparable efficiencies but are higher in LCC compared to the dedicated instantaneous water heaters (mostly because of continuous storage losses).

The gas-fired condensing combi_storage with solar panels (option 8) and a ground-source electric heat pump (option 7) represent a BAT level at 45% or higher.

Of course the BAT can be extended to beyond 100% given a large enough solar system or higher COP, but the LCC also increases drastically. In this context it must be mentioned that the COP of the air-based heat pump (option 4) is set at 2,5. Several manufacturers mention a COP of 3 or 3.5 which would lift the BAT level to around 50-60% (at COP 3 efficiency is 47%, at COP 3.5 efficiency is 62%)

Table 2.9: M-size characteristics

Size	Load	[unit]	Examples of applications
M	Largest flow rate required (ΔT=45 K)	6 ltr./min.	average shower tap [2]
	Largest tapping required	24 ltr.	2-3 person household, showers multi-point
	24 h net hot water demand	5,85 kWh/ d	larger holiday home
	Nr. of cycles per 24 h	23	

Table 2.10: Design options M

Option 1	Base case (EU25-mix of storage plus instant)
Option 2	ESWH 80L + 3.6m^2 SOLAR
Option 3	COMBI storage 80L condensing
Option 4	ASHP 2kW/COP2.5
Option 5	EIWH-electronic 23kW
Option 6	COMBI instant LT
Option 7	GSHP water/water 2kW/COP 3.8
Option 8	COMBI instant condensing + SOLAR 3.6m^2
Option 9	EIWH-electronic + SOLAR 3.6M^2

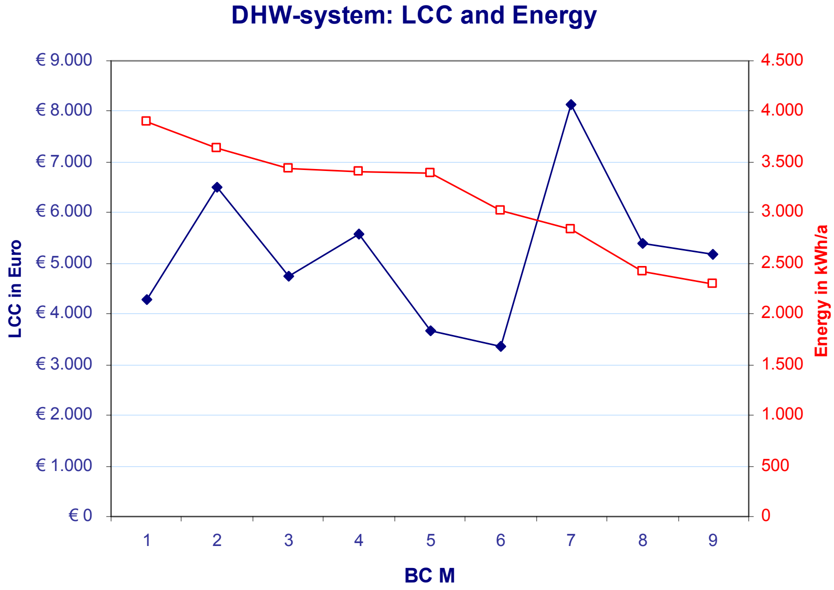

Table 2.11: Outcomes M

		1	2	3	4	5	6	7	8	9
		BC M	*ESWHSOL 3.6m2*	*COMBI 80L/cond*	*ASHP 2kW/2,5*	*EIWH-e 23kW*	*COMBI LT/instant*	*GSHP 2kW/3,8*	*COMBISOL 3.6m2/instant/cond*	*EIWHSOL 3.6m2/23kW*
MAIN ENERGY OUTPUTS (annual)										
WH sys. efficiency		**35%**	**35%**	**37%**	**38%**	**38%**	**43%**	**45%**	**53%**	**56%**
Primary energy consumption	kWh/a	**3906**	**3637**	**3442**	**3411**	**3398**	**3015**	**2830**	**2427**	**2289**
-of which fuel (primary kWh GCV)	kWh/a	**1113**	**0**	**3297**	**0**	**0**	**2870**	**0**	**2090**	**0**
-of which electricity (primary kWh)	kWh/a	**2.793**	**3.637**	**145**	**3.411**	**3.398**	**145**	**2.830**	**338**	**2.289**
MAIN LCC OUTPUTS (over product life)										
Price		**€ 262**	**€ 1.833**	**€ 687**	**€ 1.250**	**€ 448**	**€ 160**	**€ 3.000**	**€ 1.740**	**€ 2.028**
Installation		**€ 170**	**€ 980**	**€ 243**	**€ 750**	**€ 100**	**€ 160**	**€ 2.200**	**€ 1.050**	**€ 990**
Fuel (gas)		**€ 1.060**	**€ 0**	**€ 3.141**	**€ 0**	**€ 0**	**€ 2.734**	**€ 0**	**€ 1.990**	**€ 0**
Electricity		**€ 2.395**	**€ 3.119**	**€ 124**	**€ 2.925**	**€ 2.914**	**€ 124**	**€ 2.427**	**€ 289**	**€ 1.963**
Maintenance & Repairs		**€ 392**	**€ 515**	**€ 357**	**€ 515**	**€ 214**	**€ 214**	**€ 515**	**€ 357**	**€ 214**
TOTAL Life Cycle Costs LCC		**€ 4.279**	**€ 6.446**	**€ 4.552**	**€ 5.439**	**€ 3.676**	**€ 3.392**	**€ 8.141**	**€ 5.427**	**€ 5.195**

2.4 Design option L

The L-size category has almost twice the net heat load as the M class. The efficiency is derived from test pattern nr. 3 (199 litres @ 60 °C/day) and its LCC/energy are calculated on the basis of a load of 120 litres @ 60 °C/ day.

The L-size represents the residential water heater for a larger family (4-5 persons). The dwelling is typically a house or a large apartment. The L-size water heater is suitable for multiple showers and regular small baths. In the tertiary sector this type of heater could be used in small restaurants or small barber shops.

The L Base Case is again a mix of all sorts of gas/electric and instantaneous/storage types (see Annexes) with 37% overall efficiency. Not an option are electric storage and gas water heaters with pilot flame with system efficiencies below Base Case. Also the solar assisted (3m2) electric storage (34% efficiency) does (option 2) not exceed base-case efficiency.

Gas-fired design options nr. 3 and 4 represent the LLCC level of around 50%. Design Option 3 represents an "L-size" dedicated gas-fired instantaneous water heater with 49% efficiency. Option 4 is the gas combined storage achieving 51% if condensing. Also attractive from LCC point is design option 6, the electric (ventilation) air-based heat pump that reaches –at a nominal COP of 3.0—an efficiency level of 53% .

BAT level starts at around 60% and is reached by GSWH of either high efficiency (condensing, option 8) or use of solar systems (option 9). With a better COP we estimate that 60-100% efficiency would be possible for ASHP or other options with larger solar systems.

Table 2.12: L-size characteristics

Size	Load	[unit	Applications
L	Largest flow rate required (ΔT=45 K)	10 ltr./ min.	bath tap [3]
	Largest tapping required	62 ltr	4-5 person household with showers
	24 h net hot water demand	11,7 kWh/ d	and occasional bath
	Nr. of cycles per 24 h	24	small restaurants

Table 2.13: Design options L

Option 1	Base case (mix storage plus instant)
Option 2	ESWHSOL - electric storage plus 3.6m^2 solar (does not exceed BC in efficiency and LCC)
Option 3	Gas Instantaneous Water Heater 40kW/average efficiency (80%gcv)/electronic ignition
Option 4	Combi boiler 120L storage / condensing (efficiency 95%gcv)
Option 5	Ground Source Heat Pump 3kW/COP 3.8
Option 6	Air Source Heat pump 3kW/COP 3.0
Option 7	Combi boiler 120L storage / condensing + 3.6m^2 solar
Option 8	Gas Storage Water Heater condensing efficiency 95%gcv (product price: 3*standard, installation costs: 1.5*standard)
Option 9	GIWH 40kW average efficiency (80%gcv), electronic ignition + 3.6m^2 solar

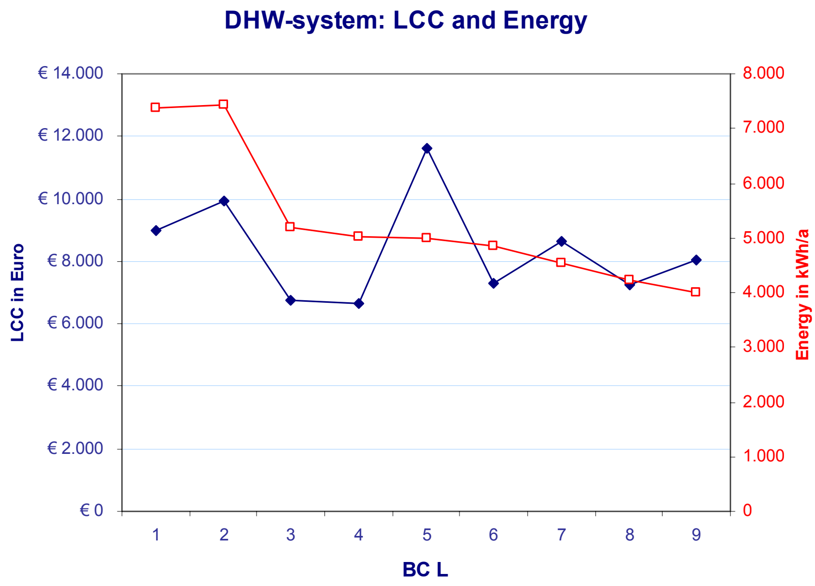

Table 2.14: Outcomes L

option	1	2	3	4	5	6	7	8	9
	BaseCase	*ESWHSOL 3.6m2*	*GIWH 40kW/80 %GCV*	*COMBI 120L/cond*	*GSHP 3kW/3,8*	*ASHP 3kW/3,0 COP*	*COMBISOL 3.6m2/120L /cond*	*GSWH condensing/ 120L/no pilot*	*GIWHSOL 40kW/3.6m2/ 80%GCV*
MAIN ENERGY OUTPUTS (annual)									
WH sys. efficiency	**37%**	**34%**	**49%**	**51%**	**51%**	**53%**	**56%**	**61%**	**64%**
Primary energy consumption	**7375**	**7440**	**5186**	**5032**	**5004**	**4850**	**4549**	**4214**	**4014**
-of which fuel (primary kWh GCV)	**3640**	**0**	**5184**	**4945**	**0**	**0**	**4220**	**4212**	**3700**
-of which electricity (primary kWh)	**3.735**	**7.440**	**2**	**87**	**5.004**	**4.850**	**329**	**3**	**314**
MAIN LCC OUTPUTS (over product life)									
Price	**€ 1.189**	**€ 1.926**	**€ 600**	**€ 937**	**€ 4.000**	**€ 1.750**	**€ 2.517**	**€ 1.800**	**€ 2.180**
Installation	**€ 671**	**€ 1.010**	**€ 360**	**€ 262**	**€ 2.800**	**€ 1.000**	**€ 1.152**	**€ 540**	**€ 1.250**
Fuel (gas)	**€ 3.467**	**€ 0**	**€ 4.938**	**€ 4.710**	**€ 0**	**€ 0**	**€ 4.020**	**€ 4.012**	**€ 3.524**
Electricity	**€ 3.203**	**€ 6.380**	**€ 2**	**€ 75**	**€ 4.291**	**€ 4.159**	**€ 282**	**€ 2**	**€ 269**
Maintenance & Repairs	**€ 471**	**€ 515**	**€ 829**	**€ 357**	**€ 515**	**€ 515**	**€ 357**	**€ 915**	**€ 829**
TOTAL Life Cycle Costs LCC	**€ 9.001**	**€ 9.830**	**€ 6.729**	**€ 6.341**	**€ 11.605**	**€ 7.423**	**€ 8.328**	**€ 7.268**	**€ 8.053**

2.5 Design Options XL

The XL-size category is intended for families that enjoy a few baths or a jacuzzi every day. The efficiency is derived from test pattern nr. 4 at 300 litres @ 60 °C/day and its LCC/energy are calculated on the basis of a load of 180 litres @ 60 °C/ day.

In the tertiary sector this type of heater could be used in medium-sized restaurants or barber shops.

The XL Base Case is currently the domain of the storage types, both gas-fired and electric (see Task 5). Due to the presence of electric storage even a gas storage with pilot flame exceeds the base case efficiency, as does the ESWH with a solar system (option 2).

A serieus reduction in energy consumption is achieved by the ground source heat pump (option 3) but the high product prices exclude this option from the LLCC range.

At LLCC we find the gas instantaneous water heaters (GIWH, design option 4) and the condensing combi-boiler + 150 litre cylinder (design option 5) which can be considered typical for low threshold LLCC.

Also at LLCC level (but possibly more difficult to implement) is the air-based heat pump (combination of ventilation and outside air) with a nominal COP of 3 and a system efficiency of 57%. With higher COPs e.g. 3,5 efficiencies close to 74% can be reached.

A condensing GSWH (design option 8) reaches BAT levels at around 70% (LLCC based upon product price fourfold of standard GSWH and installation 1.5 times standard), which can also be reached through a more conventional efficiency (80% gcv) GSWH with a 3.6 m2 solar system (design option 9).

Table 2.15. XL-size characteristics

Size	Load	[unit]	Applications
XL	Largest flow rate required (ΔT=45 K)	10 ltr./ min.	large bath [4] 4-5 person household + daily bath medium restaurants barber shop
	Largest tapping required	76 ltr	
	24 h net hot water demand	19,1 kWh/ d	
	Nr. of cycles per 24 h	30	

Table 2.16: Design options XL

Option 1	Base case (mix storage plus instant)
Option 2	ESWH with 3.6m^2 solar system
Option 3	GSHP 3kW/COP 3.8
Option 4	GIWH 40kW / conventional eff. 80%
Option 5	Combi storage boiler 150L / condensing
Option 6	Air Source Heat pump 3kW/COP 3
Option 7	Combi storage boiler 150L condensing plus 3.6m^2 solar system
Option 8	GSWH condensing efficiency 95% (product price 4*standard, installation 1.5*standard)
Option 9	GSWH conventional efficiency 80% with 3.6m^2 solar system

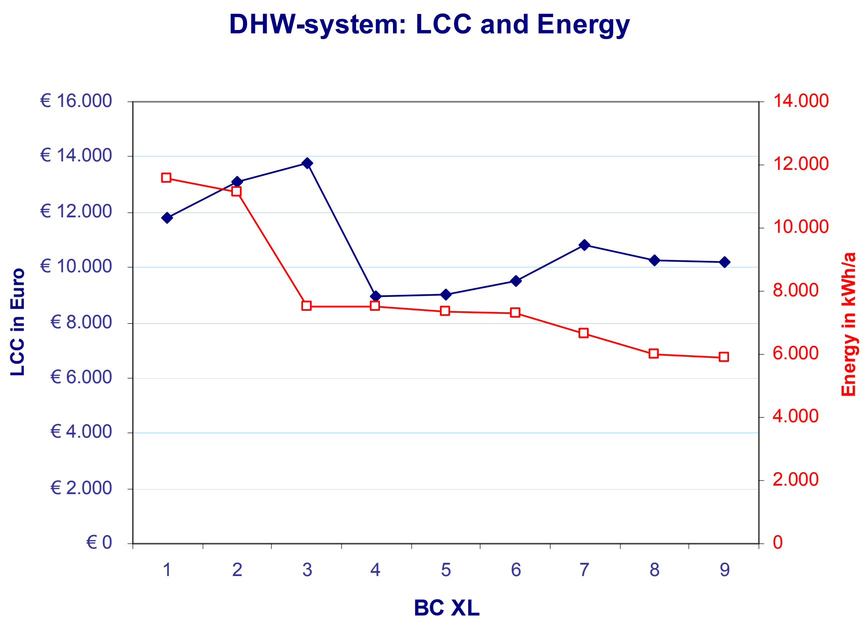

Table 2.17: Outcomes XL

	1 BaseCase	2 ESWHSOL 3.6m2	3 GSHP 3kW/3,8	4 GIWH 40kW/conv.	5 COMBISTOR condensing	6 ASHP 3kW/3,0 COP	7 COMBISTOR SOL 3.6m2/cond	8 GSWH cond	9 GSWHSOL 3.6m2/conv.
MAIN ENERGY OUTPUTS (annual)									
WH sys. efficiency	37%	38%	56%	56%	57%	57%	63%	70%	71%
Primary energy consumption	11566	11146	7526	7526	7334	7298	6625	5974	5903
-of which fuel (primary kWh GCV)	4273	0	0	7504	7200	0	6249	5965	5582
-of which electricity (primary kWh)	7.293	11.146	7.526	23	134	7.298	376	9	321
MAIN LCC OUTPUTS (over product life)									
Price	€ 665	€ 1.926	€ 4.000	€ 600	€ 1.037	€ 1.750	€ 2.617	€ 3.000	€ 2.330
Installation	€ 358	€ 1.010	€ 2.800	€ 360	€ 269	€ 1.000	€ 1.159	€ 675	€ 1.340
Fuel (gas)	€ 4.070	€ 0	€ 0	€ 7.147	€ 6.858	€ 0	€ 5.952	€ 5.682	€ 5.317
Electricity	€ 6.254	€ 9.558	€ 6.454	€ 19	€ 115	€ 6.258	€ 322	€ 8	€ 275
Maintenance & Repairs	€ 439	€ 515	€ 515	€ 829	€ 357	€ 515	€ 357	€ 915	€ 915
TOTAL Life Cycle Costs LCC	€ 11.786	€ 13.008	€ 13.768	€ 8.956	€ 8.636	€ 9.523	€ 10.408	€ 10.279	€ 10.177

2.6 Design options XXL

The XXL-size category is used, either as stand-alone or in cascade, for collective residential applications (e.g. apartment buildings) or in tertiary applications such as small sauna, larger restaurants, etc. The efficiency is derived from test pattern nr. 5 at around 400 litres @ 60 °C/day and its LCC/energy are calculated on the basis of a load of 250 litres @ 60 °C/ day.

Again the XXL Base Case is currently the domain of the storage types, both gas-fired and electric (see Annexes). Design Option 2 is an electric storage boiler with a 5.4m2 solar system.

Attractive from LCC point are a gas fired storage water heater with conventional efficiency (option 4), the condensing combi boiler with storage (option 5) and the air source heat pump (option 3). The ground source heat pump is similar in efficiency but with much higher LCC. The system efficiency at LLCC range lies around 60%.Note that price information on the heat pump options are less secure, as is the influence of certain parameters like pump power.

An improved (condensing) gas storage water heater (option 7) is in the BAT range, as is the “XXL-size” condensing combi_storage plus solar system (option 8) or a conventional gas water heater with solar system (option 9).

The BAT-level results in an efficiency of over 70% and can, depending on size of solar system or COP, extend to 100%.

Table 2.18. XXL-size characteristics

Size	Load	[unit]	Applications
XXL	market share		simultaneous bath+shower [5]
	Largest flow rate required (ΔT=45 K)	16 ltr./ min.	>4-5 person household, frequent bath 2-family household
	Largest tapping required	107 ltr	barber shop, large restaurants
	24 h net hot water demand	24,5 kWh/ d	small public sauna or spa
	Nr. of cycles per 24 h	30	

Table 2.19: Design options XXL

Option 1	Base case (mix storage plus instant)
Option 2	ESWHSOL with 5.4m^2 solar system
Option 3	Air Source Heat pump 4kW/COP 3.0
Option 4	Gas Storage Water Heater / conventional efficiency 80%gcv
Option 5	Combi storage boiler 250L / condensing
Option 6	Ground Source Heat Pump 4kW/COP 4.0
Option 7	Gas Storage Water Heater 250L / condensing efficiency 85%gcv (product price 4*standard, installation 1.5*standard)
Option 8	Combi storage boiler 250L / condensing / plus 5.4m^2 solar system
Option 8	Gas Storage Water Heater 250L / conv. eff. 80%gcv / plus 5.4m^2 solar system

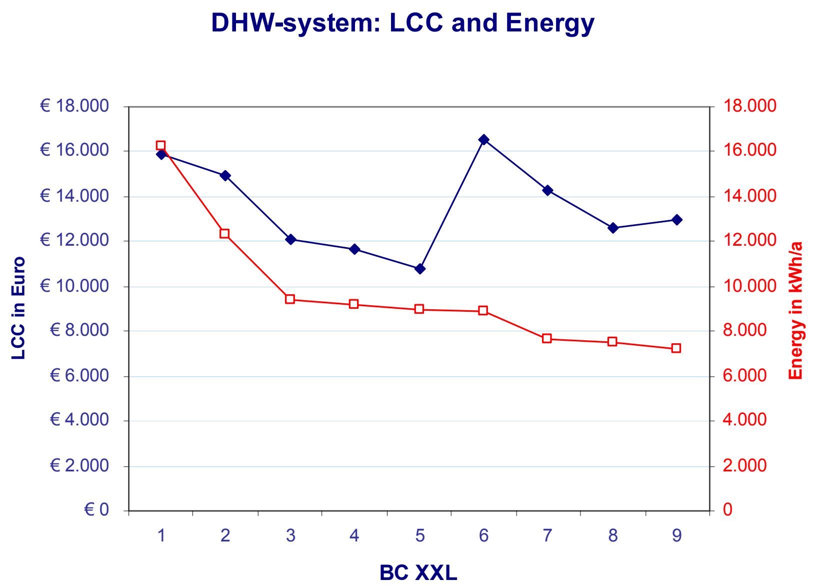

Table 2.20: Outcome XXL

	1 BaseCase XXL	2 ESWHSOL 5.4m2	3 ASHP 4kW/3,0 COP	4 GSWH conventional	5 COMBISTOR condensing	6 GSHP 34W/4.0	7 GSWH cond	8 COMBISTOR SOL 5,4m2/cond	9 GSWHSOL 5,4m2/conv .
MAIN ENERGY OUTPUTS (annual)									
WH sys. efficiency	**34%**	**44%**	**57%**	**59%**	**60%**	**60%**	**71%**	**72%**	**75%**
Primary energy consumption	**16277**	**12311**	**9434**	**9212**	**8949**	**8916**	**7628**	**7498**	**7182**
-of which fuel (primary kWh GCV)	**2387**	**0**	**0**	**9192**	**8637**	**0**	**7608**	**6581**	**6382**
-of which electricity (primary kWh)	**13.890**	**12.311**	**9.434**	**20**	**313**	**8.916**	**20**	**918**	**800**
MAIN LCC OUTPUTS (over product life)									
Price	**€ 824**	**€ 2.466**	**€ 2.250**	**€ 1.250**	**€ 1.187**	**€ 5.000**	**€ 5.000**	**€ 3.307**	**€ 3.370**
Installation	**€ 394**	**€ 1.280**	**€ 1.250**	**€ 750**	**€ 254**	**€ 3.400**	**€ 1.125**	**€ 1.414**	**€ 1.910**
Fuel (gas)	**€ 2.274**	**€ 0**	**€ 0**	**€ 8.756**	**€ 8.227**	**€ 0**	**€ 7.247**	**€ 6.268**	**€ 6.079**
Electricity	**€ 11.911**	**€ 10.557**	**€ 8.090**	**€ 17**	**€ 268**	**€ 7.646**	**€ 17**	**€ 787**	**€ 686**
Maintenance & Repairs	**€ 499**	**€ 515**	**€ 515**	**€ 915**	**€ 357**	**€ 515**	**€ 915**	**€ 357**	**€ 915**
TOTAL Life Cycle Costs LCC	**€ 15.901**	**€ 14.817**	**€ 12.104**	**€ 11.688**	**€ 10.293**	**€ 16.560**	**€ 14.304**	**€ 12.133**	**€ 12.960**

2.7 Design Options 3XL and 4XL

During the last expert meeting the Commission indicated its interest in also the very large water heating systems, i.e. with limited production series. To accommodate this wish we have defined size-classes 3XL and 4XL for water heating functions. Typically this would be systems for large apartment buildings (collective), sports facilities, hospitals, car washes, etc. So far, we have assumed that these very large installations would fall under the "XXL" category and are cascades of XXL water heaters. As such they were taken into account in the EU-totals in Task 5. The addition of the 3/4XL appliances here would therefore not change.

In the table below we show some possible definitions of the very large installations, assuming a tapping pattern of 8 times the M-size tapping volumes, frequency and flow rates for the 3XL category. Likewise, we assume 16 times the M-size tapping volumes, frequency and flow rates for the 4XL category. The base cases are modelled as if all are separate cylinders.

As far as design options are concerned we have very little information. We can only assume that –at the given tapping volumes—the efficiency would be fairly close to the steady state efficiency (e.g. water heaters in circulation loop, keeping temperature constant). This means that for instance the efficiency values of Japan (**83% on GCV**) or possibly China (expected 88%) might be a good indication of what is feasible at **LLCC level**. This is supported by our calculations showing that indeed a system efficiency of 95% results in lower life cycle costs than the Base Case, by using air-source heat pumps or ground(water-to-water) source heat pumps.

The **BAT** level heavily depends on what one assumes as system characteristics: Calculations have shown that for the 3XL class systems with a 5.5kW heat pump with COP 5.2 or systems with a seperate cylindersystem and a 75m2 solar system results in an efficiency index over 100%. All in all we conclude that system efficiencies of 150% to 185% or higher are possible.

Table 2.21. 3XL and 4XL size characteristics

Size	Load	[unit]	**Applications**
3XL	market share	<1%	multi-family (8 * M-class)
	Largest flow rate required (ΔT=45 K)	48 ltr./ min.	small hotels & campings
	Largest tapping required	215 ltr	small collective shower facility
	24 h net hot water demand	46,8 kWh/ d	also in cascades
	Nr. of cycles per 24 h	23	
4XL	market share	<1%	collective hot water (16 * M-class)
	Largest flow rate required (ΔT=45 K)	96 ltr./ min.	larger multi-family, homes for elderly
	Largest tapping required	430 ltr	swimming pool showers, hospitals, military, prisons
	24 h net hot water demand	93,6 kWh/ a	hotels, car wash
	Nr. of cycles per 24 h	23	collective shower facilities (gym), also in cascades

Table 2.22: Design options 3XL

Base case	3XL
Option1	BC - (separate cylinder 750L)
Option 2	ASHP 5.5/3.25; Air source heat pump with Pnom 5.5kW and COP 3.25
Option 3	GSHP 5kW/COP4.6: water-to-water heat pump with Pnom 5kW and COP 4.6
Option 4	Solar system 24m2 with solar storage 500L (and 750L DHW storage with BC heat generator)

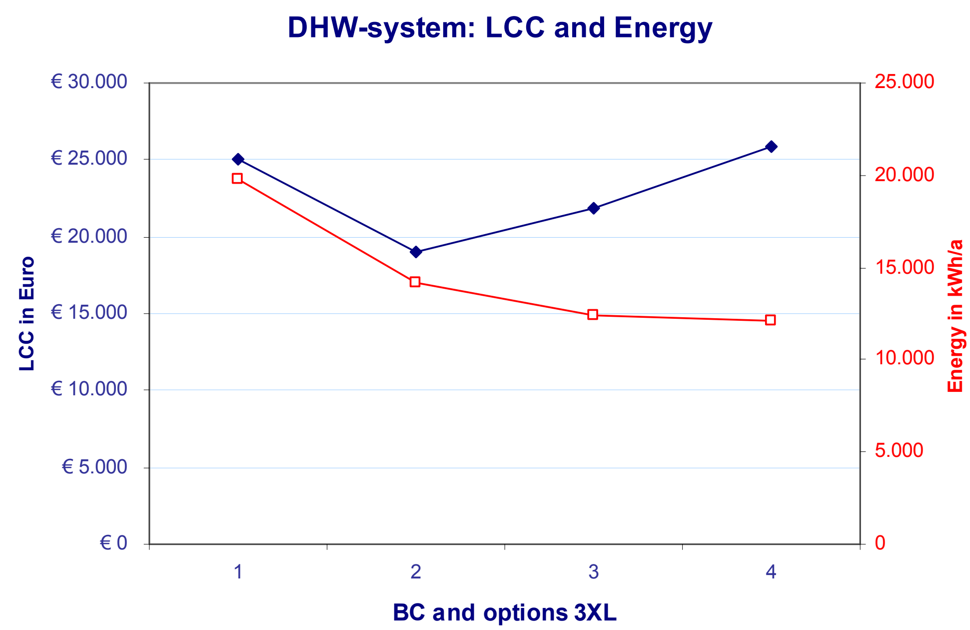

Table 2.23: Outcomes 3XL design options

		BCI 3XL 750L	*ASHP 5.5kW/3.25COP*	*GSHP 5kW/COP4.3*	*Solar 24M2/500L*
MAIN ENERGY OUTPUTS (annual)					
WH sys. efficiency		**52%**	**72%**	**83%**	**85%**
Primary energy consumption	kWh/a	**19746**	**14175**	**12383**	**12076**
-of which fuel (primary kWh GCV)	kWh/a	**19014**	**0**	**0**	**10866**
-of which electricity (primary kWh)	kWh/a	**733**	**14.175**	**12.383**	**1.210**
MAIN LCC OUTPUTS (over product life)					
Price		**€ 4.000**	**€ 3.030**	**€ 5.000**	**€ 7.700**
Installation		**€ 860**	**€ 1.640**	**€ 3.400**	**€ 3.950**
Fuel (gas)		**€ 18.111**	**€ 0**	**€ 0**	**€ 10.350**
Electricity		**€ 628**	**€ 12.155**	**€ 10.619**	**€ 1.038**
Maintenance & Repairs		**€ 1.429**	**€ 2.144**	**€ 2.858**	**€ 2.858**
TOTAL Life Cycle Costs LCC		**€ 25.028**	**€ 18.969**	**€ 21.877**	**€ 25.896**

Table 2.24:Design options 4XL

Base case	4XL
Option1	BC - (separate cylinder 1500L)
Option 2	ASHP 7.5/3.65; Air source heat pump with Pnom 7.5kWand COP 3.65
Option 3	GSHP 7.5/4.75: ground source heat pump with Pnom 7.5kW and COP 4.75
Option 4	Solar system 46m^2 with solar storage 1000L (and 1500L DHW storage with BC heat generator)

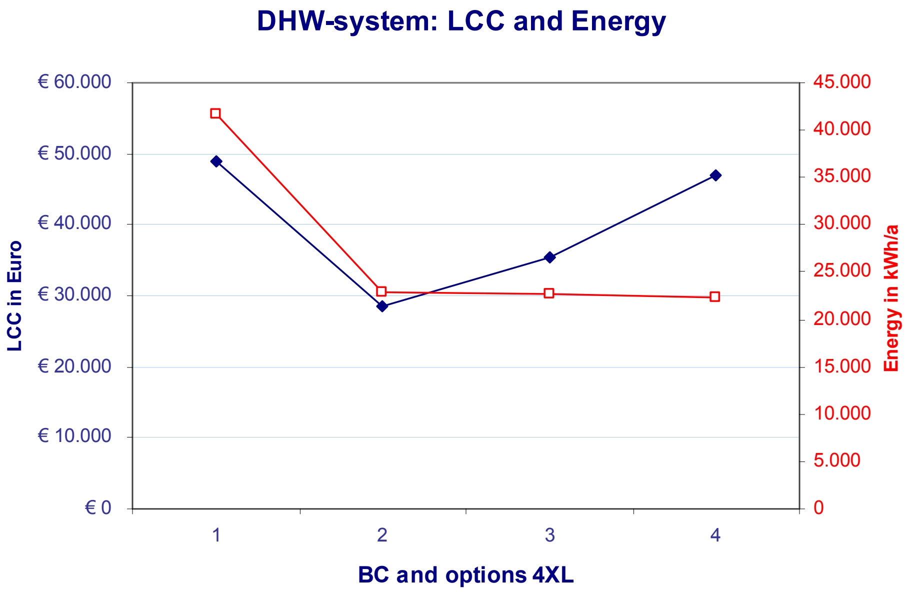

Table 2.25: Outcomes 4XL design options

		BC 4XL 1500L	ASHP 7.5kW/COP3.65	GSHP 7.5kW/COP4.75	Solar 46M^2/1000L
MAIN ENERGY OUTPUTS (annual)					
WH sys. efficiency		**49%**	**90%**	**91%**	**92%**
Primary energy consumption	kWh/a	**41668**	**22839**	**22661**	**22327**
-of which fuel (primary kWh GCV)	kWh/a	**40816**	**0**	**0**	**20087**
-of which electricity (primary kWh)	kWh/a	**853**	**22.839**	**22.661**	**2.240**
MAIN LCC OUTPUTS (over product life)					
Price		**€ 6.000**	**€ 3.990**	**€ 7.000**	**€ 14.300**
Installation		**€ 1.290**	**€ 2.120**	**€ 4.600**	**€ 7.250**
Fuel (gas)		**€ 38.878**	**€ 0**	**€ 0**	**€ 19.134**
Electricity		**€ 731**	**€ 19.585**	**€ 19.432**	**€ 1.921**
Maintenance & Repairs		**€ 2.144**	**€ 2.858**	**€ 4.288**	**€ 4.288**
TOTAL Life Cycle Costs LCC		**€ 49.043**	**€ 28.553**	**€ 35.320**	**€ 46.892**

3 SUMMARY TABLES

3.1 Performance characteristics

Table 3.1. Overview of performance classes (Base Case classes)

Size		Requirements from Standards	Examples of applications
XXS	Market share	7%	small sink tap (no dishwash) [1 c]
	Largest flow rate required (ΔT=45 K)	2 ltr./ min.	single point only
	Largest tapping required	2 ltr	(semi-) public toilets (if hot water needed)
	24 h net hot water demand	2,1 kWh/ d	
	Nr. of cycles per 24 h	18	
XS	Market share	12.5%	average sink tap [1 b]
	Largest flow rate required (ΔT=45 K)	4 ltr./ min.	single point only
	Largest tapping required	5 ltr	
	24 h net hot water demand	2,1 kWh/ d	
	Nr. of cycles per 24 h	16	
S	Market share	4%	large sink tap/ small shower tap [1]
	Largest flow rate required (ΔT=45 K)	5 ltr./ min.	1 person household
	Largest tapping required	9 ltr	student flat
	24 h net hot water demand	2,1 kWh/ d	holiday home
	Nr. of cycles per 24 h	11	single point or small multi-point
M	Market share	52.7%	average shower tap [2]
	Largest flow rate required (ΔT=45 K)	6 ltr./min.	2-3 person household, showers
	Largest tapping required	24 ltr.	multi-point
	24 h net hot water demand	5,85 kWh/ d	larger holiday home
	Nr. of cycles per 24 h	23	
L	Market share	9%	bath tap [3]
	Largest flow rate required (ΔT=45 K)	10 ltr./ min.	4-5 person household with showers
	Largest tapping required	62 ltr	and occasional bath
	24 h net hot water demand	11,7 kWh/ d	small restaurants
	Nr. of cycles per 24 h	24	
XL	Market share	5.5%	large bath [4]
	Largest flow rate required (ΔT=45 K)	10 ltr./ min.	4-5 person household + daily bath
	Largest tapping required	76 ltr	medium restaurants
	24 h net hot water demand	19,1 kWh/ d	barber shop
	Nr. of cycles per 24 h	30	
XXL	Market share	8.8%	simultaneous bath+shower [5]
	Largest flow rate required (ΔT=45 K)	16 ltr./ min.	>4-5 person household, frequent bath
	Largest tapping required	107 ltr	2-family household
	24 h net hot water demand	24,5 kWh/ d	barber shop, large restaurants
	Nr. of cycles per 24 h	30	small public sauna or spa
3XL	Market share	<1%	multi-family (8 * M-class)
	Largest flow rate required (ΔT=45 K)	48 ltr./ min.	small hotels & campings
	Largest tapping required	215 ltr	small collective shower facility
	24 h net hot water demand	46,8 kWh/ d	also in cascades
	Nr. of cycles per 24 h	23	
4XL	Market share	<1%	collective hot water (16 * M-class)
	Largest flow rate required (ΔT=45 K)	96 ltr./ min.	larger multi-family, homes for elderly
	Largest tapping required	430 ltr	swimming pool showers, hospitals, military, prisons
	24 h net hot water demand	93,6 kWh/ a	hotels, car wash
	Nr. of cycles per 24 h	23	collective shower facilities (gym), also in cascades

3.2 Energy/ LCC at Base Case, LLCC and BAT levels

These tables provide a summarised overview of the main outcomes of the tables shown in the preceding sections.

Table 3.2. Efficiencies

	Base Case	LLCC	BAT
XXS	27%	25-30%	34%
XS	27%	25-30%	34%
S	23%	30-33%	36-40%
M	35%	38-45%	>45-50%
L	37%	50-55%	>60 %
XL	37%	55-60%	>70%
XXL	34%	60%	>75%
3XL	52%?	72%	> 75% (here arbitrarily chosen at 83% - solar option)
4XL	49%?	90%	> 90% (here arbitrarily chosen at 91% - solar option)

Table 3.3. Annual Energy Consumption

Energy in kWh/a					Savings vs. Base Case in kWh/a and %			
	Base Case	LLCC	% syst.eff.	BAT	LLCC	%	BAT	%
XXS	1757	1681	27%	1349	76	4%	408	23%
XS	1762	1513	30%	1133	249	14%	629	36%
S	2159	1530	30%	1293	629	29%	866	40%
M	3906	3015	43%	2289	891	23%	1617	41%
L	7375	5032	51%	4014	2343	32%	3361	46%
XL	11566	7334	57%	5903	4232	37%	5663	49%
XXL	16277	8949	60%	7182	7328	45%	9095	56%
3XL	19746	14175	72%	12076	5571	28%	7670	39%
4XL	41668	22839	90%	22327	18829	45%	19341	46%

Estimated overall energy saving at LLCC level: ca. 30-40% (between M and L). Estimated overall energy saving at BAT level: ca. 60% (between M and L)

Table 3.4. Life Cycle Costs

Life Cycle Costs in Euro				Savings vs. Base Case in Euro and %			
	Base Case	LLCC	BAT	LLCC	%	BAT	%
XXS	1824	1819	1595	5	0,3%	229	13%
XS	1961	1689	2532	272	13,9%		
S	2167	1800	1893	367	16,9%	274	13%
M	4274	3392	5195	882	20,6%		
L	9001	6341	8053	2660	29,6%	948	11%
XL	11786	8636	10177	3450	26,7%	1609	14%
XXL	15901	10293	12960	5608	35,3%	2941	18%
3XL	25028	18969	25896	6059	24,2%		
4XL	49043	28553	46892	20490	41,8%	2151	4%

ANNEX A

BASE CASE: composed BOMs

XXS

Row nr	Mat/process	unit	XXS	XXS	XXS	XXS
			ESWH 10	**EIWH H 8**	**EIWH E 8**	**BC XXS**
1	LDPE	g	1700	0	0	1134
2	HDPE	g	0	0	0	0
3	LLDPE	g	0	10	16	4
4	PP	g	0	0	0	0
5	PS	g	0	177	142	57
6	EPS	g	0	36	796	51
8	PVC	g	0	110	47	33
10	ABS	g	0	36	17	11
11	PA 6	g	0	546	244	167
11	PA 6	g	0	0	799	41
12	PC	g	0	0	0	0
14	Epoxy	9	0	0	0	0
15	Rigid PUR	g	79	0	0	53
16	flex PUR	g	0	0	0	0
19	Aramid fibre	g	0	0	0	0
21	St sheet galv.	g	328	63	145	244
22	St tube/profile	g	0	0	14	1
23	cast iron	g	0	0	0	0
24	Ferrite	g	0	0	0	0
25	Stainless 18/8 coil	g	0	17	153	13
26	AL sheet extr.	g	0	0	0	0
27	Al diecast	g	0	0	0	0
29	Cu wire	g	0	100	179	37
30	Cu tube/sheet	g	2571	63	410	1753
31	CuZn38 cast	g	0	65	441	41
39	powder coating	g	0	0	0	0
42	LCD per m2 scrn	g	0	0	29	1
44	big caps & coils	g	0	0	260	13
45	slots / ext. ports	g	0	0	27	1
46	IC's avg.,5%Si,Au	g	0	0	1	0
47	IC's avg., 1% Si	g	0	0	2	0
48	SMD/ LED's avg.	g	0	0	4	0
49	PWB 1/2 lay 3.75kg/m2	g	0	0	56	3
52	Solder SnAg4Cu0.5	g	0	0	7	0
98	controller board	g	74	0	0	49
54	glass/ mineral	g				0
56	Cardboard	g	0	108	330	47
57	Office paper	g	0	8	78	6
	not specified	g	757	0	61	508
	TOTAL	**g**	**5509**	**1338**	**4257**	**4267**

XS

Row nr	Mat/process	unit	XS	XS	XS	XS	XS
			ESWH 20	EIWH H 8	EIWH E 8	GIWH 9,4 P	BC XS
1	LDPE	g	1762	0	0	0	488
2	HDPE	g	0	0	0	0	0
3	LLDPE	g	0	16	16	0	11
4	PP	g	0	0	0	0	0
5	PS	g	0	146	142	0	97
6	EPS	g	0	506	796	0	342
8	PVC	g	0	64	47	0	42
10	ABS	g	0	28	17	764	63
11	PA 6	g	0	374	244	0	246
11	PA 6	g	0	875	799	0	581
12	PC	g	0	1	0	0	0
14	Epoxy	g	0	0	0	0	0
15	Rigid PUR	g	970	0	0	0	269
16	flex PUR	g	0	0	0	0	0
19	Aramid fibre	g	0	1	0	0	0
21	St sheet galv.	g	5019	86	145	5899	1787
22	St tube/profile	g	0	0	14	0	0
23	cast iron	g	0	0	0	245	14
24	Ferrite	g	0	0	0	167	10
25	Stainless 18/8 coil	g	0	44	153	557	64
26	AL sheet extr.	g	0	0	0	0	0
27	Al diecast	g	0	0	0	412	24
29	Cu wire	g	0	66	179	0	46
30	Cu tube/sheet	g	3235	311	410	892	1156
31	CuZn38 cast	g	0	214	441	345	167
39	powder coating	g	164	0	0	0	45
42	LCD per m2 scrn	g	0	17	29	0	12
44	big caps & coils	g	0	0	260	0	5
45	slots / ext. ports	g	0	0	27	0	1
46	IC's avg.,5%Si,Au	g	0	0	1	0	0
47	IC's avg., 1% Si	g	0	0	2	0	0
48	SMD/ LED's avg.	g	0	0	4	0	0
49	PWB 1/2 lay 3.75kg/m2	g	0	0	56	0	1
52	Solder SnAg4Cu0.5	g	0	0	7	0	0
98	controller board	g	88	83	0	144	87
54	glass/ mineral	g					0
56	Cardboard	g	0	130	330	0	90
57	Office paper	g	0	11	78	0	9
	not specified	g	1208	12	61	73	348
	TOTAL	**g**	**12446**	**2985**	**4257**	**9500**	**6004**

S

Row nr	Mat/process	unit	S ESWH 30	S EIWH 18 H	S EIWH 18 E	S GIWH 18 I	S BC S
1	LDPE	g	1823	0	0	0	1344
2	HDPE	g	0	0	0	0	0
3	LLDPE	g	0	16	16	0	2
4	PP	g	0	0	0	0	0
5	PS	g	0	142	146	0	16
6	EPS	g	0	796	506	0	74
8	PVC	g	0	47	64	0	6
10	ABS	g	0	17	28	1046	162
11	PA 6	g	0	244	374	0	33
11	PA 6	g	0	799	875	0	92
12	PC	g	0	0	1	0	0
14	Epoxy	g	0	0	0	0	0
15	Rigid PUR	g	1860	0	0	0	1371
16	flex PUR	g	0	0	0	0	0
19	Aramid fibre	g	0	0	1	0	0
21	St sheet galv.	g	9710	145	86	8073	8403
22	St tube/profile	g	0	14	0	0	1
23	cast iron	g	0	0	0	335	51
24	Ferrite	g	0	0	0	229	35
25	Stainless 18/8 coil	g	0	153	44	762	128
26	AL sheet extr.	g	0	0	0	0	0
27	Al diecast	g	0	0	0	564	86
29	Cu wire	g	0	179	66	0	14
30	Cu tube/sheet	g	3899	410	311	1220	3101
31	CuZn38 cast	g	0	441	214	473	110
39	powder coating	g	327	0	0	0	241
42	LCD per m2 scrn	g	0	29	17	0	3
44	big caps & coils	g	0	260	0	0	16
45	slots / ext. ports	g	0	27	0	0	2
46	IC's avg.,5%Si,Au	g	0	1	0	0	0
47	IC's avg., 1% Si	g	0	2	0	0	0
48	SMD/ LED's avg.	g	0	4	0	0	0
49	PWB 1/2 lay 3.75kg/m2	g	0	56	0	0	4
52	Solder SnAg4Cu0.5	g	0	7	0	0	0
98	controller board	g	101	0	83	198	109
54	glass/ mineral	g					0
56	Cardboard	g	0	330	130	0	27
57	Office paper	g	0	78	11	0	5
	not specified	g	1658	61	12	100	1242
	TOTAL	**g**	**19378**	**4257**	**2985**	**13000**	**16678**

M

Row nr	Mat/process	unit	M	M	M	M	M	M	M
			ESWH 80	EIWH 23 H	EIWH 23 E	GIWH 21 I	GIWH 27 I	GSWH 80 P	BC M
1	LDPE	g	1186	0	0	0	0	0	552
2	HDPE	g	0	0	0	0	0	0	0
3	LLDPE	g	0	16	16	0	0	0	2
4	PP	g	0	0	0	0	0	112	3
5	PS	g	0	146	142	0	0	0	19
6	EPS	g	0	506	796	0	0	0	89
8	PVC	g	0	64	47	0	0	0	7
10	ABS	g	0	28	17	1287	1609	0	493
11	PA 6	g	0	374	244	0	0	0	41
11	PA 6	g	0	875	799	0	0	0	113
12	PC	g	0	1	0	0	0	0	0
14	Epoxy	9	0	0	0	0	0	0	0
15	Rigid PUR	g	2052	0	0	0	0	3364	1054
16	flex PUR	g	0	0	0	0	0	0	0
19	Aramid fibre	g	0	1	0	0	0	0	0
21	St sheet galv.	g	23597	86	145	9936	12420	40667	15976
22	St tube/profile	g	0	0	14	0	0	0	1
23	cast iron	g	0	0	0	413	516	0	157
24	Ferrite	g	0	0	0	282	353	0	107
25	Stainless 18/8 coil	g	0	44	153	938	1172	0	371
26	AL sheet extr.	g	0	0	0	0	0	0	0
27	Al diecast	g	0	0	0	695	868	1000	294
29	Cu wire	g	0	66	179	0	0	0	17
30	Cu tube/sheet	g	624	311	410	1502	1877	0	911
31	CuZn38 cast	g	0	214	441	582	727	2500	339
39	powder coating	g	1215	0	0	0	0	0	566
42	LCD per m2 scrn	g	0	17	29	0	0	0	3
44	big caps & coils	g	0	0	260	0	0	0	18
45	slots / ext. ports	g	0	0	27	0	0	0	2
46	IC's avg.,5%Si,Au	g	0	0	1	0	0	0	0
47	IC's avg., 1% Si	g	0	0	2	0	0	0	0
48	SMD/ LED's avg.	g	0	0	4	0	0	0	0
49	PWB 1/2 lay 3.75kg/m2	g	0	0	56	0	0	0	4
52	Solder SnAg4Cu0.5	g	0	0	7	0	0	0	0
98	controller board	g	141	83	0	243	304	0	164
54	glass/ mineral	g							0
56	Cardboard	g	0	130	330	0	0	0	32
57	Office paper	g	0	11	78	0	0	0	6
	not specified	g	1678	12	61	123	154	2324	901
	TOTAL	**g**	**30493**	**2985**	**4257**	**16000**	**20000**	**49967**	**22244**

L

Row nr	Mat/process	unit	ESWH 120	GIWH 40 l	GSWH 120 P	BC L
1	LDPE	g	1279	0	0	937
2	HDPE	g	0	0	0	0
3	LLDPE	g	0	0	0	0
4	PP	g	0	0	135	6
5	PS	g	0	0	0	0
6	EPS	g	0	0	0	0
8	PVC	g	0	0	0	0
10	ABS	g	0	1770	0	395
11	PA 6	g	0	0	0	0
11	PA 6	g	0	0	0	0
12	PC	g	0	0	0	0
14	Epoxy	g	0	0	0	0
15	Rigid PUR	g	1656	0	6320	1495
16	flex PUR	g	0	0	0	0
19	Aramid fibre	g	0	0	0	0
21	St sheet galv.	g	24840	13662	60754	23949
22	St tube/profile	g	0	0	0	0
23	cast iron	g	0	567	0	126
24	Ferrite	g	0	388	0	86
25	Stainless 18/8 coil	g	0	1290	0	288
26	AL sheet extr.	g	0	0	0	0
27	Al diecast	g	0	955	1450	278
29	Cu wire	g	0	0	0	0
30	Cu tube/sheet	g	2113	2065	0	2008
31	CuZn38 cast	g	0	800	3175	320
39	powder coating	g	1537	0	0	1126
42	LCD per m2 scrn	g	0	0	0	0
44	big caps & coils	g	0	0	0	0
45	slots / ext. ports	g	0	0	0	0
46	IC's avg.,5%Si,Au	g	0	0	0	0
47	IC's avg., 1% Si	g	0	0	0	0
48	SMD/ LED's avg.	g	0	0	0	0
49	PWB 1/2 lay 3.75kg/m2	g	0	0	0	0
52	Solder SnAg4Cu0.5	g	0	0	0	0
98	controller board	g	51	335	0	112
54	glass/ mineral	g				0
56	Cardboard	g	0	0	0	0
57	Office paper	g	0	0	0	0
	not specified	g	1603	170	3254	1357
	TOTAL	**g**	**33079**	**22000**	**75089**	**32482**

XL

Row nr	Mat/process	unit	XL ESWH 150	XL GSWH 150 P	XL BC XL
1	LDPE	g	1599	0	1471
2	HDPE	g	0	0	0
3	LLDPE	g	0	0	0
4	PP	g	0	161	13
5	PS	g	0	0	0
6	EPS	g	0	0	0
8	PVC	g	0	0	0
10	ABS	g	0	0	0
11	PA 6	g	0	0	0
11	PA 6	g	0	0	0
12	PC	g	0	0	0
14	Epoxy	9	0	0	0
15	Rigid PUR	g	2070	7183	2478
16	flex PUR	g	0	0	0
19	Aramid fibre	g	0	0	0
21	St sheet galv.	g	31051	77572	34762
22	St tube/profile	g	0	0	0
23	cast iron	g	0	0	0
24	Ferrite	g	0	0	0
25	Stainless 18/8 coil	g	0	0	0
26	AL sheet extr.	g	0	0	0
27	Al diecast	g	0	2070	165
29	Cu wire	g	0	0	0
30	Cu tube/sheet	g	2641	0	2430
31	CuZn38 cast	g	0	4105	327
39	powder coating	g	1922	0	1769
42	LCD per m2 scrn	g	0	0	0
44	big caps & coils	g	0	0	0
45	slots / ext. ports	g	0	0	0
46	IC's avg.,5%Si,Au	g	0	0	0
47	IC's avg., 1% Si	g	0	0	0
48	SMD/ LED's avg.	g	0	0	0
49	PWB 1/2 lay 3.75kg/m2	g	0	0	0
52	Solder SnAg4Cu0.5	g	0	0	0
98	controller board	g	64	0	59
54	glass/ mineral	g			0
56	Cardboard	g	0	0	0
57	Office paper	g	0	0	0
	not specified	g	2004	3679	2138
	TOTAL	**g**	**41351**	**94771**	**45612**

XXL

Row nr	Mat/process	unit	XXL	XXL	XXL
			ESWH 250	GSWH 250 P	BC XXL
1	LDPE	g	2665	0	2563
2	HDPE	g	0	0	0
3	LLDPE	g	0	0	0
4	PP	g	0	161	6
5	PS	g	0	0	0
6	EPS	g	0	0	0
8	PVC	g	0	0	0
10	ABS	g	0	0	0
11	PA 6	g	0	0	0
11	PA 6	g	0	0	0
12	PC	g	0	0	0
14	Epoxy	9	0	0	0
15	Rigid PUR	g	3451	9929	3699
16	flex PUR	g	0	0	0
19	Aramid fibre	g	0	0	0
21	St sheet galv.	g	51751	98083	53527
22	St tube/profile	g	0	0	0
23	cast iron	g	0	0	0
24	Ferrite	g	0	0	0
25	Stainless 18/8 coil	g	0	0	0
26	AL sheet extr.	g	0	0	0
27	Al diecast	g	0	2200	84
29	Cu wire	g	0	0	0
30	Cu tube/sheet	g	4401	0	4232
31	CuZn38 cast	g	0	4300	165
39	powder coating	g	3203	0	3080
42	LCD per m2 scrn	g	0	0	0
44	big caps & coils	g	0	0	0
45	slots / ext. ports	g	0	0	0
46	IC's avg.,5%Si,Au	g	0	0	0
47	IC's avg., 1% Si	g	0	0	0
48	SMD/ LED's avg.	g	0	0	0
49	PWB 1/2 lay 3.75kg/m2	g	0	0	0
52	Solder SnAg4Cu0.5	g	0	0	0
98	controller board	g	106	0	102
54	glass/ mineral	g			0
56	Cardboard	g	0	0	0
57	Office paper	g	0	0	0
	not specified	g	3341	5704	3432
	TOTAL	**g**	**68918**	**120377**	**70891**

Miscellaneous

	Solar systems (per m2)			Heat pumps (correct for power pNom)			
	glazed	unglazed	evac-tube	Air source HP		Ground source HP	
Mat.process	1m2	1m2	1m2	80L / 300W	120L / 300W	7kW	>20kW
1-LDPE		5183		1186	1279		
2-HDPE							
3-LLDPE							
4-PP						3920	7840
5-PS							
6-EPS	208	208	208				
8-PVC	42	42	42	158	209		
10-ABS	200	200	713				
11-PA 6							
11-PA 6							
12-PC							
14-Epoxy							
15-Rigid PUR	1950		417	2615	2404	5880	11760
16-flex PUR							
19-Aramid fibre							
21-St sheet galv.	329	329	329	42728	50271	154000	308000
22-St tube/profile							
23-cast iron	429	429	429				
24-Ferrite							
25-Stainless 18/8 coil	71	71	71	124	165		
26-AL sheet extr.	2604			360	479		
27-Al diecast	96	96	96				
29-Cu wire	221	221	221				
30-Cu tube/sheet	9896	4375	12063	2560	4686	26040	52080
31-CuZn38 cast	654	654	1279	900	1197	28000	56000
39-powder coating				1305	1657		
42-LCD per m2 scrn							
44-big caps & coils							
45-slots / ext. ports							
46-IC's avg.,5%Si,Au							
47-IC's avg., 1% Si							
48-SMD/ LED's avg.							
49-PWB 1/2 lay 3.75kg/m2							
52-Solder SnAg4Cu0.5							
98-controller board	113	113	113	141	51	15120	30240
52 - glass	6779		7458				
56-Cardboard							
57-Office paper							
not specified	38	38	38	2387	2545	47040	94080
TOTAL	23629	11958	23475	54463	64943	280000	560000

ANNEX B

TECHNICAL FEATURES Design Options

XXS

INPUTS CH
WATER HEATER LOAD

	XXS		XXS		XXS		XXS
	ESWH 10	*EIWH H 8*		*EIWH E 8*			*ESWh smart*
wh envelope volume	0.01	0.02	m3	0.02	m3		
combustion air intake	3 -none (electr)	3 -none (electr)		3 -none (electr)			
noise	30.00	30.00	dB-A	30.00	dB-A		
outdoors?	no	no		no			
primary energy factor for Qfuel	2.50	2.50		2.50			
Max. heat power (output) Pmax	2.00	8.00	kW	8.00	kW		
Min. heat power (output) Pmin	2.00	4.00	kW	0.10	kW		
Steady s. fuel eff. Pmax ηmax	99%	99%		99%			
Steady s. fuel eff. Pmin ηmin	99%	99%		99%			
Heat loss off at 50°C Pbstby	0.10	0.10	kW	0.10	kW		
airfuelmixer	5 -none (elec)	5 -none (elec)		5 -none (elec)			
Pilotflame power Pign (0= none)	0.000	0.000	kW	0.000	kW		
Electricity at Poff elstby	0.000	0.000	kW	0.001	kW		
Electricity at Pmax elmaxon	0.000	0.000	kW	0.002	kW		
Electricity at Pmin elminon	0.000	0.000	kW	0.002	kW		
WH mass extcl. tank bmass	0.01	1.30	kg	4.20	kg		
Water content DHWloop	0.00	0.30	ltr	1.50	ltr		
instant. temperature ctrl. dhwmix	1-none	2-hydraulic		3-electronic			
Tank volume Vdhw	10	0	ltr	0	ltr		
Tank ref. heat loss Pstbydhw	114	114	W	114	W		
smart. control factor dhwsmart	no	no		no			yes
mixingfactor dhwV40	1.60	1.60		1.60			
heat trans dhwtrap ?	no	no		no			yes
Heat transfer. storeheatex	3 -direct and/or electric	3 -direct and/or electric		3 -direct and/or electric			

XS

INPUTS CH

WATER HEATER LOAD	XS	XS	XS	XS	
	ESWH 20(smart)	*EIWH H 8*	*EIWH E 8*	*GIWH 9,4 P*	GIWH self ign
wh envelope volume	0.03	0.02	0.02	0.06	
combustion air intake	3 -none (electr)	3 -none (electr)	3 -none (electr)	2 -open	
noise	30,00 dB A	30,00 dB A	30,00 dB A	30,00 dB A	
outdoors?	no	no	no	no	
primary energy factor for	2.50	2.50	2.50	1.00	
Max. heat power (output)	2.00	8.00	8.00	9.40	
Min. heat power (output)	2.00	8.00	0.10	5.00	
Steady s. fuel eff. Pmax	99%	99%	99%	85%	
Steady s. fuel eff. Pmin	99%	99%	99%	85%	
Heat loss off at 50°C Pbstby	0.10	0.05	0.05	0.10	
airfuelmixer	5 -none (elec)	5 -none (elec)	5 -none (elec)	1 -atmospheric	
Pilotflame power Pign. (0=	0.000	0.000	0.000	0.080	
Electricity at Poff elstby	0.000	0.000	0.001	0.000	0.01
Electricity at Pmax elmaxon	0.010	0.000	0.002	0.000	0.05
Electricity at Pmin elminon	0.010	0.000	0.002	0.000	0.05
WH mass extcl. tank bmass	0.01	2.80	4.20	9.50	
Water content DHWloop	0.00	0.30	0.25	1.50	
instant. temperature ctrl	1-none	2-hydraulic	3-electronic	2-hydraulic	
Tank volume Vdhw	20	0	0	0	
Tank ref. heat loss Pstbydhw	114	114	114	114	
smart. control factor	no (yes for 'smart')	no	no	no	
mixingfactor dhwV40	1.60	1.60	1.60	1.60	
heat trans dhwtran ?	no (yes for 'smart')	no	no	yes	
Heat transfer. storeheatex	3 -direct and/or electric	3 -direct and/or electric	3 -direct and/or	3 -direct and/or electric	

S

INPUTS CH

WATER HEATER LOAD

	S		S		S		S	
	ESWH 30		*EIWH 18 H*		*EIWH 18 E*		*GIWH 18 I*	
wh envelope volume	0.10	m3	0.05	m3	0.05	m3	0.10	m3
combustion air intake	3 -none (electr)		3 -none (electr)		3 -none (electr)		2 -open	
noise	30.00	dB-A	30.00	dB-A	30.00	dB-A	30.00	dB-A
outdoors?	no		no		no		no	
primary energy factor for Qfuel	2.50		2.50		2.50		1.00	
Max. heat power (output) Pmax	2.50	kW	18.00	kW	18.00	kW	17.50	kW
Min. heat power (output) Pmin	2.50	kW	6.00	kW	0.10	kW	7.00	kW
Steady s. fuel eff. Pmax, nmax	99%		99%		99%		85%	
Steady s. fuel eff. Pmin., nmin	99%		99%		99%		85%	
Heat loss off at 50°C Pbstby	0.05	kW	0.05	kW	0.10	kW	0.10	kW
airfuelmixer	5 -none (elec)		5 -none (elec)		5 -none (elec)		1 -atmospheric	
Pilotflame power Pign. (0= none)	0.000	kW	0.000	kW	0.000	kW	0.000	kW
Electricity at Poff elstby	0.000	kW	0.000	kW	0.001	kW	10.000	kW
Electricity at Pmax elmaxon	0.000	kW	0.000	kW	0.002	kW	10.000	kW
Electricity at Pmin elminon	0.000	kW	0.000	kW	0.002	kW	10.000	kW
WH mass extcl. tank bmass	0.01	kg	2.80	kg	4.20	kg	11.00	kg
Water content DHWloop	0.00	ltr	0.40	ltr	0.25	ltr	2.50	ltr
instant. temperature ctrl. dhwmix	1-none		2-hydraulic		3-electronic		2-hydraulic	
Tank volume Vdhw	30	ltr	0	ltr	0	ltr	0	ltr
Tank ref. heat loss Psthydhw	114	W	114	W	114	W	114	W
smart. control factor dhwsmart	no		no		no		no	
mixingfactor dhwV40	1.60		1.60		1.60		1.60	
heat trans dhwtrap ?	no		no		no		no	
Heat transfer. storeheatex	3 -direct and/or electric		3 -direct and/or electric		3 -direct and/or electric		3 -direct and/or electric	

M

INPUTS CH

WATER HEATER LOAD

	M	M	M	M	M	M
	ESWH 80	*EIWH 23 H*	*EIWH 23 E*	*GIWH 21 I*	*GIWH 27 I*	*GSWH 80 P*
wh envelope volume	0.18 m3	0.05 m3	0.05 m3	0.10 m3	0.12 m3	0.18 m3
combustion air intake	3 -none (electr)	3 -none (electr)	3 -none (electr)	1 -room sealed	1 -room sealed	2 -open
noise	30.00 dB-A	30.00 dB-A	30.00 dB-A	45.00 dB-A	45.00 dB-A	30.00 dB-A
outdoors?	no	no	no	no	no	no
primary energy factor for Qfuel	2.50	2.50	2.50	1.00	1.00	1.00
Max. heat power (output) Pmax	2.50 kW	23.00 kW	23.00 kW	21.00 kW	27.00 kW	5.00 kW
Min. heat power (output) Pmin	2.50 kW	6.00 kW	0.10 kW	8.40 kW	10.80 kW	5.00 kW
Steady s. fuel eff. Pmax, ηmax	99%	99%	99%	85%	85%	75%
Steady s. fuel eff. Pmin , ηmin	99%	99%	99%	85%	85%	75%
Heat loss off at 50°C Pbstby	0.10 kW	0.05 kW	0.05 kW	0.10 kW	0.05 kW	0.05 kW
airfuelmixer	5 -none (elec)	5 -none (elec)	5 -none (elec)	2 -pneumatic	2 -pneumatic	1 -atmospheric
Pilotflame power Pign (0=	0.000 kW	0.000 kW	0.000 kW	0.000 kW	0.000 kW	0.080 kW
Electricity at Poff elstby	0.000 kW	0.000 kW	0.001 kW	0.000 kW	0.000 kW	0.000 kW
Electricity at Pmax elmaxon	0.000 kW	0.000 kW	0.002 kW	0.000 kW	0.000 kW	0.000 kW
Electricity at Pmin elminon	0.000 kW	0.000 kW	0.002 kW	0.000 kW	0.000 kW	0.000 kW
WH mass extcl. tank bmass	0.01 kg	2.80 kg	4.20 kg	13.00 kg	16.00 kg	10.00 kg
Water content DHWloop	0.00 ltr	0.50 ltr	0.25 ltr	3.00 ltr	4.00 ltr	0.00 ltr
instant. temperature ctrl. dhwmix	1-none	2-hydraulic	3-electronic	2-hydraulic	2-hydraulic	1-none
Tank volume Vdhw	80 ltr	0 ltr	0 ltr	0 ltr	0 ltr	80 ltr
Tank ref. heat loss Psthvdhw	114 W	114 W	114 W	114 W	114 W	114 W
smart. control factor dhwsmart	no	no	no	no	no	no
mixingfactor dhwV40	1.60	1.60	1.60	1.60	1.60	1.60
heat trans dhwtrap ?	no	no	no	no	no	no
Heat transfer. storeheatex	3 -direct and/or	3 -direct and/or	3 -direct and/or	3 -direct and/or	3 -direct and/or	3 -direct and/or

Additional options:

for SOLEL add 3m2 glazed collector to ESWH

for GSWH smart change storage settings to 'smart'

for COMBi-storage enter combi from basecase in ECOBOILER mode = 'smart' settings for storage, for COMBISOL add 6m2 glazed collector

ASHP defined with 0.25kW compressor Pnom and COP 2.5

For SOLGAS define gas instantaneous and add 3m2 glazed collector

For GSWH SOL define GSWH and add 6m2 glazed collector

L

DESIGN OPTIONS; Column Nr.	41		42		43	
INPUTS CH						
WATER HEATER LOAD	L		L		L	
	ESWH 120		*GIWH 40 l*		*GSWH 120 P*	
wh envelope volume	0,39	m3	0,12	m3	0,39	m3
combustion air intake	3 -none (electr)		1 -room sealed		2 -open	
noise	30,00	dB-A	45,00	dB-A	45,00	dB-A
outdoors?	no		no		no	
primary energy factor for Qfuel	2,50		1,00		1,00	
Collector area Asol	0,00	m2	0,00	m2	0,00	m2
Collector type solcollector	1 -glazed		1 -glazed		1 -glazed	
HP type (Tsrc/Tsnk)	3 -El. air/ water 7/50		3 -El. air/ water 7/50		3 -El. air/ water 7/50	
Nominal Power Phpnom	0,00	kW	0,00	kW	0,00	kW
Nominal COP COPnom	0,00		0,00		0,00	
Use (also) vent. exhaust air ?	no		no		no	
Tank volume Vhp	0	ltr	0	ltr	0	ltr
Tank ref. heat loss Pstbyhp	104	W	104	W	104	W
Extra pump hppump	0	W	0	W	0	W
Max. heat power (output) Pmax	2,50	kW	40,00	kW	7,50	kW
Min. heat power (output) Pmin	2,50	kW	16,00	kW	7,50	kW
Steady s. fuel eff. Pmax ηmax	99%		85%		75%	
Steady s. fuel eff. Pmin ηmin	99%		85%		75%	
Heat loss off at 50°C Pbstby	0,10	kW	0,05	kW	0,10	kW
airfuelmixer	5 -none (elec)		5 -none (elec)		1 -atmospheric	
Pilotflame power Pign (0= none)	0,000	kW	0,000	kW	0,080	kW
Electricity at Poff elstby	0,000	kW	0,000	kW	0,000	kW
Electricity at Pmax elmaxon	0,000	kW	0,000	kW	0,000	kW
Electricity at Pmin elminon	0,000	kW	0,000	kW	0,000	kW
WH mass extcl. tank bmass	0,01	kg	21,00	kg	15,00	kg
Water content DHWloop	0,00	ltr	4,50	ltr	0,00	ltr
instant. temperature ctrl. dhwmix	1-none		2-hydraulic		1-none	
-						
Tank volume Vdhw	120	ltr	0	ltr	120	ltr
Tank ref. heat loss Pstbydhw	114	W	114	W	114	W
smart control factor dhwsmart	no		no		no	
mixingfactor dhwV40	1,65		1,65		1,65	
heat traps dhwtrap ?	no		no		no	
Heat transfer storeheatex	3 -direct and/or electric		3 -direct and/or electric		3 -direct and/or electric	

Additional options:

for SOLEL add 3m2 glazed collector to ESWH

for GSWH smart change storage settings to 'smart'

for COMBi-storage enter combi from basecase in ECOBOILER mode = 'smart' settings for storage, for COMBISOL add 6m2 glazed collector

ASHP defined with 0.3kW compressor Pnom and COP 2.5

For SOLGAS define gas instantaneous and add 3m2 glazed collector

For GSWH SOL define GSWH and add 6m2 glazed collector

XL

DESIGN OPTIONS; Column Nr.	51		52	
INPUTS CH				
WATER HEATER LOAD	XL		XL	
	ESWH 150		*GSWH 150 P*	
wh envelope volume	0,45	m3	0,45	m3
combustion air intake	3 -none (electr)		2 -open	
noise	30,00	dB-A	45,00	dB-A
outdoors?	no		no	
primary energy factor for Qfuel	2,50		1,00	
Collector area Asol	0,00	m2	0,00	m2
Collector type solcollector	1 -glazed		1 -glazed	
HP type (Tsrc/Tsnk)	3 -El. air/ water 7/50		3 -El. air/ water 7/50	
Nominal Power Phpnom	0,00	kW	0,00	kW
Nominal COP COPnom	0,00		0,00	
Use (also) vent. exhaust	no		no	
Tank volume Vhp	0	ltr	0	ltr
Tank ref. heat loss	104	W	104	W
Extra pump hppump	0	W	0	W
Max. heat power (output) Pmax	3,00	kW	9,30	kW
Min. heat power (output) Pmin	3,00	kW	9,30	kW
Steady s. fuel eff. Pmax ηmax	99%		75%	
Steady s. fuel eff. Pmin ηmin	99%		75%	
Heat loss off at 50°C Pbstby	0,10	kW	0,05	kW
airfuelmixer	5 -none (elec)		1 -	
Pilotflame power Pign (0= none)	0,000	kW	0,080	kW
Electricity at Poff elstby	0,000	kW	0,000	kW
Electricity at Pmax	0,000	kW	0,000	kW
Electricity at Pmin elminon	0,000	kW	0,000	kW
WH mass extcl. tank	0,01	kg	20,00	kg
Water content DHWloop	0,00	ltr	0,00	ltr
instant. temperature ctrl. dhwmix	1-none		1-none	
Tank volume Vdhw	150	ltr	150	ltr
Tank ref. heat loss Pstbydhw	114	W	114	W
smart control factor dhwsmart	no		no	
mixingfactor dhwV40	1,65		1,65	
heat traps dhwtrap ?	no		no	
Heat transfer storeheatex	3 -direct and/or electric		3 -direct and/or electric	

Additional options:

for SOLEL add 3.6m2 glazed collector to ESWH

for GSWH smart change storage settings to 'smart'

for COMBi-storage enter combi from basecase in ECOBOILER mode = 'smart' settings for storage, for COMBISOL add 6m2 glazed collector

ASHP defined with 0.3kW compressor Pnom and COP 2.5

For SOLGAS define gas instantaneous and add 3m2

For GSWH SOL define GSWH and add 6m2 glazed

XXL

INPUTS CH
WATER HEATER LOAD

	XXL		XXL	
	ESWH 250		*GSWH 250 P*	
wh envelope volume	0.60	m3	0.60	m3
combustion air intake	3 -none (electr)		2 -open	
noise	30.00	dB-A	45.00	dB-A
outdoors?	no		no	
primary energy factor for Qfuel	2.50		1.00	
Collector area **Asol**	0.00	m2	0.00	m2
Collector type **solcollector**	1 -glazed		1 -glazed	
HP type (Tsrc/Tsnk)	3 -El. air/ water 7/50		3 -El. air/ water 7/50	
Nominal Power **Phpnom**	0.00	kW	0.00	kW
Nominal COP **COPnom**	0.00		0.00	
Use (also) vent. exhaust air ?	no		no	
Tank volume **Vhp**	0	ltr	#REF!	ltr
Tank ref. heat loss **Pstbyhp**	104	W	104	W
Extra pump **hppump**	0	W	0	W
Max. heat power (output) **Pmax**	3.00	kW	15.60	kW
Min. heat power (output) **Pmin**	3.00	kW	15.60	kW
Steady s. fuel eff. Pmax **ηmax**	99%		75%	
Steady s. fuel eff. Pmin **ηmin**	99%		75%	
Heat loss off at 50°C **Pbstby**	0.10	kW	0.05	kW
airfuelmixer	5 -none (elec)		1 -atmospheric	
Pilotflame power **Pign** (0= none)	0.000	kW	0.080	kW
Electricity at Poff **elstby**	0.000	kW	0.000	kW
Electricity at Pmax **elmaxon**	0.000	kW	0.000	kW
Electricity at Pmin **elminon**	0.000	kW	0.000	kW
WH mass extcl. tank **bmass**	0.01	kg	25.00	kg
Water content **DHWloop**	0.00	ltr	0.00	ltr
instant. temperature ctrl. **dhwmix**	1-none		1-none	
Tank volume **Vdhw**	250	ltr	250	ltr
Tank ref. heat loss **Pstbydhw**	114	W	114	W
smart. control factor **dhwsmart**	no		no	
mixingfactor **dhwV40**	1.70		1.70	
heat trans **dhwtrap** ?	no		no	
Heat transfer. **storeheatex**	3 -direct and/or electric		3 -direct and/or electric	

Additional options:

for SOLEL add 3m2 glazed collector to ESWH

for GSWH smart change storage settings to 'smart'
for COMBi-storage enter combi from basecase in ECOBOILER mode = 'smart' settings for storage, for COMBISOL add 6m2 glazed collector

ASHP defined with 0.3kW compressor Pnom and COP 2.5
GSHP defined with NH3 HP 1.1kW/2.5COP
For SOLGAS define gas instantaneous and add 3m2 glazed collector
For GSWH SOL define GSWH and add 6m2 glazed collector

3XL

INPUTS			3XL GSHP Heat pump	3XL Solar	3XL ASHP
CH-power class	7-XXL	DHW power class	8 -3XL	8 -3XL	8 -3XL
boiler characteristics		controllers			
power input in kW*	115 kW	auto-timer control	yes	yes	yes
turndown ratio	33%	valve control	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K
standby heat loss %	1,00% of Qb8060	boiler temp control	6 -on/off RT	6 -on/off RT	6 -on/off RT
		electronic optimiser	no	no	no
steady st. efficiency *	5 -eff. 80/80/80/80		no	no	no
fuel (dewpoint)	1-gas				
air-fuel mix control	2 -pneumatic	solar (for combi only)			
		collector type		1 -glazed	
circ. pump power	7 -200W	collector surface m2		24,0	
fan power	6 -P=90W	tank position		1 -in heated space	
CPU power sb/on	8 -P=56/60W	CH-fraction served		0%	
controls power sb/on	3 -P=0/18W	El. back-up heater CH?		no	
comb. air intake	1 -room sealed	heat pump (HP)			
boiler mass (empty), kg	221 kg	Reference type	2 -El. water/ water (10/50)		3 -El. air/ water 7/50
water content in kg	20,0 kg	Power nominal in kW	4,0 kW		3,1
envelope volume in m3	1,50 m3	COP nominal (10/50)	4,6		2,5
noise level in dB-A	45 dB-A	Ratio CH : DHW	0%		0%
		CH-fraction served	100%		100%
emissions (in ppm at 3% O2)		El. back-up heater CH?	no		no
NOx *	≤20 ppm				
CO *	≤400 ppm	GWP Refrigerant HP	≤2000 GWP		
extra INPUTS HW	fossil-fuel		HP	solar	
tank volume in ltr	750 ltr. (453)		386 ltr.	500	**386 ltr.**
tank ref. heat loss	197W		142 W	4W/K	**142 W**
smart control ?	no 0%				
mixingfactor V40	1,65				
heat traps installed?	no				
loop losses		0,165 W/K.m2 Asol		0,165 W/K.m2 Asol	
back-up heater HW type?		1 -single coil from boiler	<	<	
el. pump power			180 W	180W	250W
use ventilation exhaust air ? (air/water only)			n.a.		yes

4XL

INPUTS			4XL GSHP Heat pump	4XL Solar	4XL ASHP
CH-power class	8 -3XL	DHW power class	9 -4XL	9 -4XL	9 -4XL
boiler characteristics		controllers			
power input in kW*	250 kW	auto-timer control	yes	yes	yes
turndown ratio	33%	valve control	2 -RTV 2K	2 -RTV 2K	2 -RTV 2K
standby heat loss %	1,00% of Qb8060	boiler temp control	6 -on/off RT	6 -on/off RT	6 -on/off RT
		electronic optimiser	no	no	no
steady st. efficiency *	5 -eff. 80/80/80/80		no	no	no
fuel (dewpoint)	1-gas				
air-fuel mix control	2 -pneumatic	solar (for combi only)			
		collector type		1 -glazed	
circ. pump power	8-800W	collector surface m2		46,0	
fan power	7-150W	tank position		1 -in heated space	
CPU power sb/on	8 -P=56/60W	CH-fraction served		0%	
controls power sb/on	3 -P=0/18W	El. back-up heater CH?		no	
comb. air intake	1 -room sealed	heat pump (HP)			
boiler mass (empty), kg	900 kg	Reference type	2 -El. water/ water (10/50)		3 -El. air/ water 7/50
water content in kg	100,0 kg	Power nominal in kW	6,0 kW		5.4
envelope volume in m3	2.0 m3	COP nominal (10/50)	4,7		2,5
noise level in dB-A	45 dB-A	Ratio CH : DHW	0%		0%
		CH-fraction served	100%		100%
emissions (in ppm at 3% O2)		El. back-up heater CH?	no		no
NOx *	≤20 ppm				
CO *	≤400 ppm	GWP Refrigerant HP	≤2000 GWP		
extra INPUTS HW	fossil-fuel		HP	solar	HP
tank volume in ltr	1500 ltr. (453)		773 ltr.	1000	**773 ltr.**
tank ref. heat loss	197W		200 W	6W/K	**200 W**
smart control ?	no 0%				
mixingfactor V40	1,65				
heat traps installed?	no				
loop losses				0,165 W/K.m2 Asol	
back-up heater HW type?		1 -single coil from boiler	<	<	<
el. pump power			250 W	180W	250W
use ventilation exhaust air ? (air/water only)			n.a.		yes

ANNEX C

BASECASES

ENVIRONMENTAL IMPACT

XXS

Environmental Impact BaseCases PER UNIT

ENVIRONMENTAL IMPACT PER UNIT OVER LIFE

		XXS		XXS		XXS		XXS		XXS	
		BC XXS		*ESWH 10*		*ESWH smart*		*EIWH H 8*		*EIWH E 8*	
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**5**		**6**		**6**		**1**		**4**	
of which											
Disposal	kg	**2**		**2**		**2**		**1**		**2**	
Recycled	kg	**3**		**3**		**3**		**0**		**2**	
OTHER RESOURCES											
Total Energy (GER)	GJ	**124**	123	**128**	127	**121**	120	**109**	108	**99**	98
of which, electric(in primary)	GJ	**123**	123	**127**	127	**120**	120	**108**	108	**98**	98
Water (process)	m3	**8**	8	**9**	8	**8**	8	**7**	7	**7**	7
Water (cooling)	m3	**329**	329	**338**	338	**320**	320	**288**	288	**261**	261
Waste, non-haz./ landfill	kg	**4**	3	**5**	3	**4**	3	**3**	2	**4**	2
Waste, hazardous/ incinerated	kg	**161**	143	**169**	147	**161**	139	**128**	125	**123**	113
EMISSIONS TO AIR											
GHG in GWP100	tCO2	**5**	5	**6**	6	**5**	5	**5**	5	**4**	4
AP Acidification	kgSOx	**32**	32	**33**	33	**31**	31	**28**	28	**25**	25
VOC Volatile Organic Comp.	kg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
POP Persist.Organic Poll.	mg i-Teq	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1
HMa Heavy Metals	mg Ni	**2**	2	**2**	2	**2**	2	**2**	2	**2**	2
PAHs	mg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
PM Particulate Matter	kg	**2**	2	**2**	2	**2**	2	**2**	1	**2**	1
EMISSIONS TO WATER											
HMw Heavy Metals	g Hg/20	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1
EP Eutrophication	g PO4	**5**	4	**5**	4	**5**	4	**5**	3	**7**	3

XS

Environmental Impact BaseCases PER UNIT

ENVIRONMENTAL IMPACT PER UNIT OVER LIFE

		XS		XS		XS		XS		XS	
		BC XS		*ESWH 20 smart*		*EIWH H 8*		*EIWH E 8*		*GIWH 9.4 self.ign.*	
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**6**		**12**		**3**		**4**		**10**	
of which											
Disposal	kg	**2**		**3**		**2**		**2**		**1**	
Recycled	kg	**3**		**9**		**1**		**2**		**8**	
OTHER RESOURCES											
Total Energy (GER)	GJ	**124**	123	**131**	130	**109**	108	**97**	96	**68**	67
of which, electric(in primary)	GJ	**109**	109	**130**	130	**108**	108	**96**	96	**0**	0
Water (process)	m3	**7**	7	**9**	9	**7**	7	**6**	6	**0**	0
Water (cooling)	m3	**291**	291	**346**	346	**288**	288	**257**	257	**0**	0
Waste, non-haz./ landfill	kg	**4**	3	**6**	3	**4**	2	**4**	2	**1**	0
Waste, hazardous/ incinerated	kg	**140**	126	**187**	150	**131**	125	**121**	112	**21**	0
EMISSIONS TO AIR											
GHG in GWP100	tCO2	**6**	6	**6**	6	**5**	5	**4**	4	**4**	4
AP Acidification	kgSOx	**29**	28	**34**	33	**28**	28	**25**	25	**1**	1
VOC Volatile Organic Comp.	kg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
POP Persist.Organic Poll.	mg i-Teq	**1**	1	**1**	1	**1**	1	**1**	1	**0**	0
HMa Heavy Metals	mg Ni	**2**	2	**3**	2	**2**	2	**2**	2	**0**	0
PAHs	mg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
PM Particulate Matter	kg	**2**	1	**2**	2	**2**	1	**2**	1	**1**	1
EMISSIONS TO WATER											
HMw Heavy Metals	g Hg/20	**1**	1	**1**	1	**1**	1	**1**	1	**0**	0
EP Eutrophication	g PO4	**8**	3	**11**	4	**7**	3	**7**	3	**4**	0

S

Environmental Impact BaseCases PER UNIT

ENVIRONMENTAL IMPACT PER UNIT OVER LIFE

		S		S		S		S		S	
		ESWH 30		*BC S*		*EIWH 18 H*		*EIWH 18 E*		*GIWH 18 E*	
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**19**		**16**		**4**		**3**		**16**	
of which											
Disposal	kg	**5**		**4**		**2**		**2**		**2**	
Recycled	kg	**15**		**12**		**2**		**1**		**14**	
OTHER RESOURCES											
Total Energy (GER)	GJ	**156**	154	**140**	139	**110**	109	**97**	97	**78**	77
of which, electric(in primary)	GJ	**154**	154	**119**	118	**109**	109	**96**	96	**0**	0
Water (process)	m3	**10**	10	**8**	8	**7**	7	**6**	6	**0**	0
Water (cooling)	m3	**412**	411	**316**	316	**292**	291	**257**	257	**0**	0
Waste, non-haz./ landfill	kg	**7**	4	**5**	3	**5**	3	**4**	2	**1**	0
Waste, hazardous/ incinerated	kg	**230**	179	**179**	137	**136**	127	**117**	112	**36**	0
EMISSIONS TO AIR											
GHG in GWP100	tCO2	**7**	7	**6**	6	**5**	5	**4**	4	**4**	4
AP Acidification	kgSOx	**40**	40	**31**	31	**28**	28	**25**	25	**2**	1
VOC Volatile Organic Comp.	kg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
POP Persist.Organic Poll.	mg i-Teq	**1**	1	**1**	1	**1**	1	**1**	1	**0**	0
HMa Heavy Metals	mg Ni	**3**	3	**2**	2	**2**	2	**2**	2	**0**	0
PAHs	mg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
PM Particulate Matter	kg	**3**	2	**2**	2	**2**	1	**2**	1	**1**	1
EMISSIONS TO WATER											
HMw Heavy Metals	g Hg/20	**1**	1	**1**	1	**1**	1	**1**	1	**0**	0
EP Eutrophication	g PO4	**17**	5	**13**	4	**7**	3	**7**	3	**6**	0

M

Environmental Impact BaseCases PER UNIT

ENVIRONMENTAL IMPACT PER UNIT OVER LIFE

		M		M		M		M		M		M		M		M		M	
		BC M		*ESWH 80*		*SOLEL 12m2/80L*		*EIWH 23 E*		*COMB Instant. LT*		*GSHP 0,3/3,8*		*ASHP 0,3kW/2,5COP 80L*		*COMBI cond store 80L smart*		*SOLGAS 12m2 combi instant cond*	
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**20**		**30**		**314**		**4**		**5**		**145**		**54**		**46**		**319**	
of which																			
Disposal	kg	**3**		**5**		**59**		**2**		**1**		**19**		**7**		**6**		**60**	
Recycled	kg	**17**		**26**		**255**		**2**		**5**		**127**		**48**		**40**		**260**	
OTHER RESOURCES																			
Total Energy (GER)	GJ	**229**	228	**336**	334	**273**	247	**244**	243	**186**	186	**200**	187	**337**	334	**147**	144	**121**	94
of which, electric(in primary)	GJ	**98**	98	**334**	333	**251**	247	**243**	243	**17**	17	**86**	82	**334**	333	**18**	17	**35**	31
Water (process)	m3	**7**	7	**22**	22	**19**	16	**16**	16	**1**	1	**9**	5	**22**	22	**1**	1	**5**	2
Water (cooling)	m3	**261**	260	**890**	889	**669**	659	**647**	647	**46**	46	**220**	218	**891**	889	**47**	46	**92**	82
Waste, non-haz./ landfill	kg	**4**	2	**11**	8	**35**	6	**8**	6	**1**	0	**14**	2	**11**	8	**4**	0	**31**	1
Waste, hazardous/ incinerated	kg	**158**	113	**438**	387	**1544**	286	**291**	281	**31**	20	**415**	95	**495**	387	**95**	20	**1305**	36
EMISSIONS TO AIR																			
GHG in GWP100	tCO2	**12**	11	**15**	15	**12**	11	**11**	11	**10**	10	**10**	9	**15**	15	**8**	8	**6**	5
AP Acidification	kgSOx	**28**	27	**86**	86	**78**	64	**63**	62	**7**	7	**28**	23	**87**	86	**7**	6	**23**	9
VOC Volatile Organic Comp.	kg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
POP Persist.Organic Poll.	mg i-Teq	**1**	1	**3**	2	**5**	2	**2**	2	**0**	0	**3**	1	**3**	2	**1**	0	**3**	0
HMa Heavy Metals	mg Ni	**2**	2	**6**	6	**11**	4	**4**	4	**0**	0	**4**	1	**6**	6	**1**	0	**8**	1
PAHs	mg	**0**	0	**1**	1	**5**	1	**1**	1	**0**	0	**1**	0	**1**	1	**0**	0	**5**	0
PM Particulate Matter	kg	**2**	1	**4**	3	**8**	2	**3**	2	**2**	1	**4**	1	**3**	3	**2**	1	**7**	1
EMISSIONS TO WATER																			
HMw Heavy Metals	g Hg/20	**1**	1	**2**	2	**9**	2	**2**	2	**0**	0	**4**	1	**3**	2	**1**	0	**8**	0
EP Eutrophication	g PO4	**13**	3	**32**	10	**136**	8	**11**	7	**2**	1	**59**	3	**37**	10	**18**	1	**131**	1

L

Environmental Impact BaseCases PER UNIT

ENVIRONMENTAL IMPACT PER UNIT OVER LIFE

		L		L		L		L		L		L		L		L		L	
		BC L		*SOLEL 155L 3m2*		*GIWH 40 l*		*GSWH 120 smart*		*COMB LT 120L smart*		*COMBISOL LT 120/300L 6m2*		*AHP 120L 0,3kW/2,5COP*		*SOLGAS 40kW/3m2*		*GSWHSOL 6m2*	
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**172**		**75**		**22**		**75**		**72**		**214**		**65**		**93**		**146**	
of which																			
Disposal	kg	**26**		**22**		**3**		**10**		**10**		**37**		**7**		**16**		**23**	
Recycled	kg	**146**		**53**		**19**		**65**		**62**		**177**		**58**		**77**		**123**	
OTHER RESOURCES																			
Total Energy (GER)	GJ	**460**	452	**575**	553	**342**	341	**305**	300	**308**	303	**310**	294	**321**	316	**258**	250	**176**	165
of which, electric(in primary)	GJ	**299**	298	**564**	553	**0**	0	**3**	2	**17**	16	**72**	69	**317**	316	**61**	60	**58**	56
Water (process)	m3	**21**	20	**47**	37	**0**	0	**1**	0	**2**	1	**6**	5	**21**	21	**5**	4	**5**	4
Water (cooling)	m3	**798**	795	**1478**	1474	**0**	0	**8**	6	**45**	43	**191**	185	**845**	843	**162**	159	**155**	150
Waste, non-haz./ landfill	kg	**16**	7	**41**	13	**2**	0	**6**	0	**6**	0	**21**	2	**11**	7	**10**	1	**14**	1
Waste, hazardous/ incinerated	kg	**662**	346	**1009**	641	**49**	0	**131**	3	**119**	19	**784**	80	**508**	366	**420**	69	**496**	65
EMISSIONS TO AIR																			
GHG in GWP100	tCO2	**22**	22	**26**	24	**19**	19	**17**	17	**17**	17	**16**	15	**14**	14	**14**	13	**9**	8
AP Acidification	kgSOx	**83**	79	**155**	142	**6**	5	**6**	5	**10**	8	**29**	21	**83**	81	**22**	18	**21**	16
VOC Volatile Organic Comp.	kg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
POP Persist.Organic Poll.	mg i-Teq	**3**	2	**4**	4	**1**	0	**2**	0	**2**	0	**3**	0	**4**	2	**1**	0	**3**	0
HMa Heavy Metals	mg Ni	**7**	5	**13**	10	**1**	0	**1**	0	**1**	0	**5**	1	**6**	5	**3**	1	**4**	1
PAHs	mg	**2**	1	**3**	1	**0**	0	**0**	0	**0**	0	**3**	0	**1**	1	**1**	0	**1**	0
PM Particulate Matter	kg	**5**	3	**8**	4	**2**	1	**3**	1	**3**	1	**6**	1	**5**	3	**4**	1	**5**	1
EMISSIONS TO WATER																			
HMw Heavy Metals	g Hg/20	**4**	2	**11**	4	**0**	0	**1**	0	**1**	0	**5**	0	**3**	2	**3**	0	**3**	0
EP Eutrophication	g PO4	**54**	9	**136**	17	**8**	0	**27**	0	**29**	0	**84**	2	**40**	10	**36**	2	**56**	2

XL

Environmental Impact BaseCases PER UNIT

ENVIRONMENTAL IMPACT PER UNIT OVER LIFE

		XL		XL		XL		XL		XL		XL		XL		XL		XL	
		BC XL		*ESWH 150*		*SOLEL 3,6m2*		*GSWH 150 P*		*GSWH 150 smart*		*COMBI cond150L smart*		*ASHP 0,4kW/2,5COP*		*COMBIstoreSOL 6m2*		*GASinstSOL 6m2*	
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**60**		**41**		**126**		**95**		**95**		**77**		**65**		**219**		**306**	
of which																			
Disposal	kg	**9**		**6**		**22**		**11**		**11**		**11**		**7**		**38**		**57**	
Recycled	kg	**50**		**36**		**105**		**83**		**83**		**66**		**58**		**181**		**249**	
OTHER RESOURCES																			
Total Energy (GER)	GJ	**773**	769	**1026**	1023	**848**	837	**639**	633	**456**	450	**450**	445	**415**	410	**279**	262	**236**	210
of which, electric(in primary)	GJ	**523**	522	**1023**	1022	**839**	837	**1**	0	**5**	3	**41**	40	**411**	410	**86**	83	**82**	78
Water (process)	m3	**35**	35	**68**	68	**57**	56	**0**	0	**1**	0	**3**	3	**28**	27	**7**	6	**8**	5
Water (cooling)	m3	**1394**	1392	**2728**	2727	**2236**	2232	**2**	0	**12**	9	**109**	106	**1095**	1093	**228**	221	**218**	208
Waste, non-haz./ landfill	kg	**17**	12	**27**	24	**31**	19	**6**	0	**7**	0	**8**	1	**13**	9	**22**	2	**30**	2
Waste, hazardous/ incinerated	kg	**699**	605	**1268**	1185	**1415**	970	**164**	0	**168**	4	**153**	46	**616**	475	**806**	96	**1346**	91
EMISSIONS TO AIR																			
GHG in GWP100	tCO2	**37**	36	**45**	45	**37**	37	**35**	35	**25**	25	**24**	24	**18**	18	**15**	14	**12**	11
AP Acidification	kgSOx	**139**	138	**264**	263	**220**	216	**11**	10	**9**	8	**18**	16	**107**	106	**32**	24	**36**	22
VOC Volatile Organic Comp.	kg	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
POP Persist.Organic Poll.	mg i-Teq	**5**	3	**8**	7	**7**	5	**2**	0	**2**	0	**2**	0	**4**	3	**3**	1	**3**	1
HMa Heavy Metals	mg Ni	**10**	9	**18**	18	**17**	14	**1**	0	**1**	0	**2**	1	**8**	7	**6**	1	**9**	1
PAHs	mg	**1**	1	**2**	2	**3**	2	**0**	0	**0**	0	**0**	0	**1**	1	**3**	0	**5**	0
PM Particulate Matter	kg	**6**	4	**9**	7	**10**	5	**4**	1	**4**	1	**4**	1	**6**	3	**7**	1	**8**	1
EMISSIONS TO WATER																			
HMw Heavy Metals	g Hg/20	**4**	3	**7**	7	**8**	5	**1**	0	**1**	0	**1**	0	**3**	3	**5**	1	**8**	1
EP Eutrophication	g PO4	**46**	16	**61**	31	**87**	26	**32**	0	**33**	0	**33**	1	**43**	13	**88**	3	**116**	2

XXL

Environmental Impact BaseCases PER UNIT

ENVIRONMENTAL IMPACT PER UNIT OVER LIFE

		XXL *BC XXL*		XXL *SOLEL 7m2*		XXL *GSWH 250 P*		XXL *COMBI LT 250L smart*		XXL *GSWH 250 smart*		XXL *COMBIStoreSOL 6m2*		XXL *ASHP 0,5/2,5*		XXL *GAHP 1,1kW/COP1,4*		XXL *GSWHSOL 12m2*	
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**80**		**234**		**120**		**93**		**120**		**235**		**97**		**280**		**404**	
of which																			
Disposal	kg	**11**		**41**		**15**		**15**		**15**		**42**		**11**		**36**		**68**	
Recycled	kg	**69**		**194**		**105**		**78**		**105**		**193**		**87**		**244**		**336**	
OTHER RESOURCES																			
Total Energy (GER)	GJ	**1119**	1112	**945**	925	**752**	744	**549**	542	**542**	534	**512**	494	**495**	487	**427**	402	**287**	256
of which, electric(in primary)	GJ	**990**	989	**928**	924	**1**	0	**38**	37	**5**	3	**83**	81	**488**	487	**284**	274	**83**	78
Water (process)	m3	**66**	66	**64**	62	**1**	0	**3**	2	**1**	0	**7**	5	**33**	32	**25**	18	**9**	5
Water (cooling)	m3	**2639**	2636	**2473**	2465	**3**	0	**103**	99	**12**	9	**222**	215	**1301**	1299	**735**	731	**221**	208
Waste, non-haz./ landfill	kg	**29**	23	**42**	21	**9**	0	**10**	1	**9**	0	**24**	2	**16**	11	**30**	6	**37**	2
Waste, hazardous/ incinerated	kg	**1297**	1146	**1913**	1072	**205**	0	**184**	43	**208**	4	**837**	93	**776**	565	**936**	318	**1502**	91
EMISSIONS TO AIR																			
GHG in GWP100	tCO2	**50**	50	**42**	40	**42**	41	**30**	30	**30**	30	**27**	26	**22**	21	**21**	19	**15**	13
AP Acidification	kgSOx	**258**	256	**247**	238	**13**	11	**19**	17	**11**	9	**35**	27	**127**	125	**84**	72	**38**	23
VOC Volatile Organic Comp.	kg	**0**	0	**0**	0	**1**	1	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
POP Persist.Organic Poll.	mg i-Teq	**8**	6	**9**	6	**3**	0	**2**	0	**3**	0	**4**	1	**6**	3	**7**	2	**6**	1
HMa Heavy Metals	mg Ni	**18**	17	**21**	16	**2**	0	**2**	1	**2**	0	**6**	1	**10**	8	**10**	5	**9**	1
PAHs	mg	**2**	2	**5**	2	**0**	0	**0**	0	**0**	0	**3**	0	**1**	1	**2**	1	**5**	0
PM Particulate Matter	kg	**10**	6	**12**	6	**5**	1	**5**	1	**5**	1	**7**	1	**7**	4	**8**	2	**10**	1
EMISSIONS TO WATER																			
HMw Heavy Metals	g Hg/20	**7**	6	**11**	6	**1**	0	**1**	0	**1**	0	**5**	1	**4**	3	**8**	2	**9**	1
EP Eutrophication	g PO4	**78**	30	**140**	28	**43**	0	**44**	1	**43**	0	**99**	2	**61**	15	**119**	8	**152**	2

3XL

Environmental Impact BaseCases PER UNIT

		3XL		3XL		3XL		3XL	
		BC 3XL (sepcyl 750L)		*Solar 24M2/500L*		*GSHP 4kW/COP3.8*		*ASHP 3.1kW/2.5COP*	
ENVIRONMENTAL IMPACT PER UNIT OVER LIFE									
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**187**		**896**		**810**		**65**	
of which									
Disposal	kg	**29**		**163**		**118**		**7**	
Recycled	kg	**158**		**733**		**692**		**58**	
OTHER RESOURCES									
Total Energy (GER)	GJ	**1191**	1174	**804**	728	**830**	761	**870**	863
of which, electric(in primary)	GJ	**54**	52	**98**	86	**188**	172	**156**	155
Water (process)	m3	**5**	3	**14**	6	**22**	11	**11**	10
Water (cooling)	m3	**147**	139	**260**	230	**484**	459	**414**	413
Waste, non-haz./ landfill	kg	**21**	1	**88**	2	**83**	4	**7**	4
Waste, hazardous/ incinerated	kg	**1193**	61	**4248**	100	**4025**	200	**321**	179
EMISSIONS TO AIR									
GHG in GWP100	tCO2	**65**	64	**43**	39	**44**	40	**46**	46
AP Acidification	kgSOx	**41**	30	**76**	32	**93**	53	**52**	51
VOC Volatile Organic Comp.	kg	**1**	1	**1**	0	**1**	0	**1**	1
POP Persist.Organic Poll.	mg i-Teq	**3**	0	**9**	1	**15**	1	**3**	1
HMa Heavy Metals	mg Ni	**7**	1	**24**	2	**26**	3	**4**	3
PAHs	mg	**1**	0	**12**	0	**5**	0	**1**	0
PM Particulate Matter	kg	**10**	1	**23**	2	**21**	2	**10**	2
EMISSIONS TO WATER									
HMw Heavy Metals	g Hg/20	**6**	0	**26**	1	**25**	1	**2**	1
EP Eutrophication	g PO4	**93**	2	**360**	3	**375**	5	**35**	5

4XL

Environmental Impact BaseCases PER UNIT

ENVIRONMENTAL IMPACT PER UNIT OVER LIFE

		4XL		4XL		4XL		4XL	
		BC 4XL (sepcyl 1500L)		*Solar 46M2/1000L*		*GSHP 6kW/COP4.1*		*ASHP 5.4kW/COP2.5*	
MATERIALS		**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE	**TOTAL**	USE
TOTAL	kg	**530**		**1948**		**1090**		**97**	
of which									
Disposal	kg	**81**		**348**		**154**		**11**	
Recycled	kg	**449**		**1600**		**936**		**87**	
OTHER RESOURCES									
Total Energy (GER)	GJ	**2514**	2469	**1509**	1345	**1465**	1369	**1640**	1631
of which, electric(in primary)	GJ	**67**	61	**185**	160	**206**	181	**1632**	1631
Water (process)	m3	**8**	4	**28**	11	**30**	12	**109**	109
Water (cooling)	m3	**183**	162	**491**	426	**512**	482	**4351**	4349
Waste, non-haz./ landfill	kg	**57**	1	**192**	4	**107**	4	**43**	38
Waste, hazardous/ incinerated	kg	**3278**	71	**9425**	185	**4653**	209	**2103**	1891
EMISSIONS TO AIR									
GHG in GWP100	tCO2	**138**	136	**82**	73	**80**	74	**72**	71
AP Acidification	kgSOx	**81**	52	**155**	59	**116**	64	**422**	420
VOC Volatile Organic Comp.	kg	**2**	2	**1**	1	**1**	1	**1**	1
POP Persist.Organic Poll.	mg i-Teq	**8**	0	**20**	1	**20**	1	**13**	11
HMa Heavy Metals	mg Ni	**18**	1	**53**	3	**31**	3	**29**	28
PAHs	mg	**4**	0	**26**	0	**6**	0	**4**	3
PM Particulate Matter	kg	**19**	2	**44**	2	**29**	2	**18**	10
EMISSIONS TO WATER									
HMw Heavy Metals	g Hg/20	**18**	0	**56**	1	**31**	1	**11**	11
EP Eutrophication	g PO4	**261**	2	**796**	5	**486**	6	**96**	50