bio Intelligence Service

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Ecodesign Preparatory Study – DG Energy Lot 24

Professional washing machines, dryers and dishwashers

Final Stakeholder Meeting on Dishwashers
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A study being conducted for DG ENER by Öko-Institut and Bio Intelligence Service

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Task 5 - Objectives

- Task 5: Assessment of Base Cases
  - general technical analysis of current products on the EU market: **environmental impact assessment** and **economic analysis**
  - objective is to capture the market as a whole, both “good” and “bad” products
  - functional analysis of the system to which the product belongs, including a rough estimate of the overall impacts
  - building on the results of Tasks 1 – 4: *very important to validate data already included in these tasks*
  - most of the environmental and Life Cycle Cost analysis will be built on these Base Cases throughout the rest of the study

Task 5 - Methodology

Task 5: Assessment of Base Cases

- use of EcoReport: tool that has to be used within the MEEuP
- sources of data: stakeholder surveys and literature

  The Base Case inputs are aggregated data, intended to represent average values for the EU market.

Structure:

5.1 Product specific inputs
5.2 Definition of Base Case
5.3 Base-Case environmental impact assessment
5.4 Base-Case Life Cycle Cost
5.5 EU 27 total impact

Definition of Base-Cases

- 6 base-cases were necessary to represent the professional dishwasher market. *Are they representative?*

Base-Case	Name	Average capacity	Purchase price
BC 1	Undercounter water-change	200 dishes/hour	3 200
BC 2	Undercounter one-tank	550 dishes/hour	3 500
BC 3	Hood-type	860 dishes/hour	4 700
BC 4	Utensil/Pot	0.42 m^2 (rack area) 20 cycles per hour	10 500
BC 5	Conveyor-type one-tank	1 750 dishes/hour	15 000
BC 6	Conveyor-type multi-tank	3 600 dishes/hour	45 000

Task 5 - Results (2/17)

- EcoReport Inputs
  - Bill of Materials (BOM): *(inputs of base-case 2)*

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category Click &select	Material or Process select Category first !
1	Stainless steel	49760.0	3-Ferro	25-Stainless 18/8 coil
2	Polypropylene (PP)	4565.0	1-BlkPlastics	4-PP
3	Polyamide (PA)	500.0	2-TecPlastics	11-PA 6
4	Epoxy	1000.0	2-TecPlastics	14-Epoxy
5	Acrylonitrile Butadiene Styrene (ABS)	70.0	1-BlkPlastics	10-ABS
6	Pumps (copper)	2500.0	4-Non-ferro	30-Cu tube/sheet
7	Pumps (stack of sheets)	2500.0	3-Ferro	22-St tube/profile
8	Pumps (stainless steel wave)	2250.0	3-Ferro	25-Stainless 18/8 coil
9	Pumps (Al)	2250.0	4-Non-ferro	26-Al sheet/extrusion
10	Cable (copper)	1100.0	4-Non-ferro	29-Cu wire
11	Cable sheath (PVC)	600.0	1-BlkPlastics	8-PVC
12	Cable sheath (silicone, EDPM)	300.0	1-BlkPlastics	1-LDPE
13	Electronics (control)	500.0	6-Electronics	98-controller board
14	Gaskets (EDPM)	2040.0	1-BlkPlastics	1-LDPE
15				
16	Packaging (polystyrene)	500.0	1-BlkPlastics	5-PS
17	Packaging (wood)	6000.0	7-Misc.	56-Cardboard
18	Packaging (cardboard)	2750.0	7-Misc.	56-Cardboard

EcoReport Inputs

- Bill of Materials (BOM): not all types of materials are included in the EcoReport database (e.g. wood, POM or EDPM are missing)

- We made assumptions and neglected some materials/took the most similar material included in the database (e.g. LDPE instead of EPDM, cardboard instead of wood)

EcoReport Inputs

Manufacturing inputs *(inputs of base-case 2)*

MANUFACTURING Description	Weight in g	Percentage Adjust
OEM Plastics Manufacturing (fixed)	9575	
Foundries Fe/Cu/Zn (fixed)	0	
Foundries Al/Mg (fixed)	0	
Sheetmetal Manufacturing (fixed)	56760	
PWB Manufacturing (fixed)	0	
Other materials (Manufacturing already included)	12850	
Sheetmetal Scrap (Please adjust percentage only)	2838	5%

Sheetmetal scrap percentage assumed at 5% (including all metals)

EcoReport Inputs

- Distribution inputs: *(inputs of base-case 2)*

DISTRIBUTION (incl. Final Assembly) Description		Answer
Is it an ICT or Consumer Electronics product <15 kg ?		NO
Is it an installed appliance (e.g. boiler)?		YES
Volume of packaged final product in m^3	in m3	0,48

Travel distance is not an input. Assumptions are made in EcoReport.

- EcoReport Inputs
  - Use phase inputs:
  - For each base case, consumer behaviour (described in Task 3) is very important to determine the quantity of consumables used: electricity, water, detergent, rinsing aid
  - These consumables affect both the environmental impacts and the life cycle costs (operating costs)

EcoReport Inputs

- Use phase inputs: *(inputs of base-case 2)*

USE PHASE Description		unit	
Product Life in years	8	years	
Electricity			
On-mode: Consumption per hour, cycle, setting, etc.	4867	kWh	
On-mode: No. Of hours, cycles, settings, etc. / year	1	#	
Consumables (excl, spare parts)			material
Water	52,02	m^3/year	83-Water per m3
Auxilliary material 1 (Click & select)	174	kg/ year	80-Detergent dishw.

Any comments on the consumption of electricity, water, detergent?

Gas option not included in the base-cases

EcoReport Inputs

- Use phase inputs *(inputs of base-case 2)*

Maintenance, Repairs, Service		
No. of km over Product-Life	1000	km / Product Life
Spare parts (fixed, 1% of product materials & manuf.)	792	g

Comment: The distance for maintenance and repair should depend on the base case considered (higher for heavy duty products)

Proposition: 100 km/year to be assumed for the maintenance and repair services. Too low or realistic?

EcoReport Inputs

- End of life inputs: *(inputs of base-case 2)*

Description		
Substances released during Product Life and Landfill		
Refrigerant in the product (Click & select)	0	g
Percentage of fugitive & dumped refrigerant	0%	
Mercury (Hg) in the product	0	g Hg
Percentage of fugitive & dumped mercury	0%	
Disposal: Environmental Costs perkg final product		
Landfill (fraction products not recovered) in g en %	1584	2%
Incineration (plastics & PWB not re-used/recycled)	6703	g
Plastics: Re-use & Recycling ("cost"-side)	2873	g
Re-use, Recycling Benefit	in g	% of plastics fraction
Plastics: Re-use, Closed Loop Recycling (please edit%)	96	1%
Plastics: Materials Recycling (please edit% only)	2777	29%
Plastics: Thermal Recycling (please edit% only)	6703	70%
Electronics: PWB Easy to Disassemble ? (Click&select)	0	YES
Metals & TV Glass & Misc. (95% Recycling)	66130	

Refrigerant in heat pumps will be included in the BAT analysis (Task 7)

Comment: fraction going to landfill is very small: 2%.

Proposition: 5% more realistic?

Task 5 - Results (10/17)

EcoReport Inputs

➢ Economic/market inputs: *(inputs of base-case 2)*

Table . Inputs for EU-Totals & LCC

nr	INPUTS FOR EU-Totals & economic Life Cycle Costs Description		unit
A	Product Life	8	years
B	Annual sales	0,1382	mln. Units/year
C	EU Stock	1,314323	mln. Units
D	Product price	3500	Euro/unit
E	Installation/acquisition costs (if any)	0	Euro/ unit
F	Fuel rate (gas, oil, w ood)	0	Euro/GJ
G	Electricity rate	0,145	Euro/kWh
H	Water rate	2,64	Euro/m3
I	Aux. 1: Detergent dishw .	3	Euro/kg
J	Aux. 2 :None	0	Euro/kg
K	Aux. 3: None	0	Euro/kg
L	Repair & maintenance costs	1540	Euro/ unit
M	Discount rate (interest minus inflation)	4,0%	%
N	Present Worth Factor (PWF) (calculated automatically)	6,73	(years)
O	Overall Improvement Ratio STOCK vs. NEW, Use Phase	1,09	

EcoReport Inputs

- Overall improvement ratios:

Base-Case	Improvement between ten year old product and new product			Overall improvement ratio
	Energy consumption	Water consumption	Global improvement	
1. Undercounter water-change	-	-	-	1.09
2. Undercounter one-tank	30%	16%	23%	1.09
3. Hood-type	29%	16%	22.5%	1.09
4. Utensil/Pot	29%	20%	24.5%	1.10
5. One-tank conveyor-type	37%	35%	36%	1.22
6. Multi-tank conveyor-type	37%	33%	35%	1.30

Any comment on the improvement ratios between stock products and sales?

Task 5 - Results (12/17)

EcoReport Outputs

➢ Environmental impacts *(outputs of base-case 2)*:

Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
Resources Use and Emissions		Material	Manuf.	**Total**	**BUTION**		Disposal	Recycl.	**Total**	
Materials	**unit**									
Bulk Plastics	g			**8075**			5653	2423	**8075**	**0**
TecPlastics	g			**1500**			1050	450	**1500**	**0**
Ferro	g			**54510**			1090	53420	**54510**	**0**
Non-ferro	g			**5850**			117	5733	**5850**	**0**
Coating	g			**0**			0	0	**0**	**0**
Electronics	g			**500**			500	0	**500**	**0**
Misc.	g			**8750**			175	8575	**8750**	**0**
Total weight	g			**79185**			8585	70600	**79185**	**0**
								see note!		
Other Resources & Waste							debet	credit		
Total Energy (GER)	MJ	5392	1284	**6676**	**585**	**455849**	578	715	**-137**	**462973**
of which, electricity (in primary MJ)	MJ	928	766	**1694**	**1**	**408845**	0	11	**-11**	**410530**
Water (process)	ltr	4328	11	**4339**	**0**	**444519**	0	7	**-7**	**448851**
Water (cooling)	ltr	1410	355	**1765**	**0**	**1090226**	0	58	**-58**	**1091932**
Waste, non-haz./ landfill	g	106962	4428	**111389**	**269**	**526777**	1951	41	**1910**	**640345**
Waste, hazardous/ incinerated	g	390	0	**390**	**5**	**10451**	6703	6	**6696**	**17543**
Emissions (Air)										
Greenhouse Gases in GWP100	kg CO2 eq.	422	72	**494**	**36**	**19976**	43	45	**-3**	**20503**
Ozone Depletion, emissions	mg R-11 eq.				negligible					
Acidification, emissions	g SO2 eq.	3905	309	**4214**	**108**	**117048**	89	62	**27**	**121397**
Volatile Organic Compounds (VOC)	g	12	0	**12**	**10**	**210**	2	1	**1**	**233**
Persistent Organic Pollutants (POP)	ng i-Teq	475	31	**505**	**2**	**2977**	14	0	**14**	**3497**
Heavy Metals	mg Ni eq.	7908	72	**7980**	**14**	**8378**	156	0	**156**	**16528**
PAHs	mg Ni eq.	331	0	**331**	**24**	**1416**	0	1	**-1**	**1771**
Particulate Matter (PM, dust)	g	496	48	**544**	**1641**	**11319**	796	2	**794**	**14298**
Emissions (Water)										
Heavy Metals	mg Hg/20	4965	0	**4966**	**0**	**2686**	47	0	**47**	**7699**
Eutrophication	g PO4	136	1	**137**	**0**	**74627**	3	0	**2**	**74766**
Persistent Organic Pollutants (POP)	ng i-Teq				negligible					

Task 5 - Results (13/17)

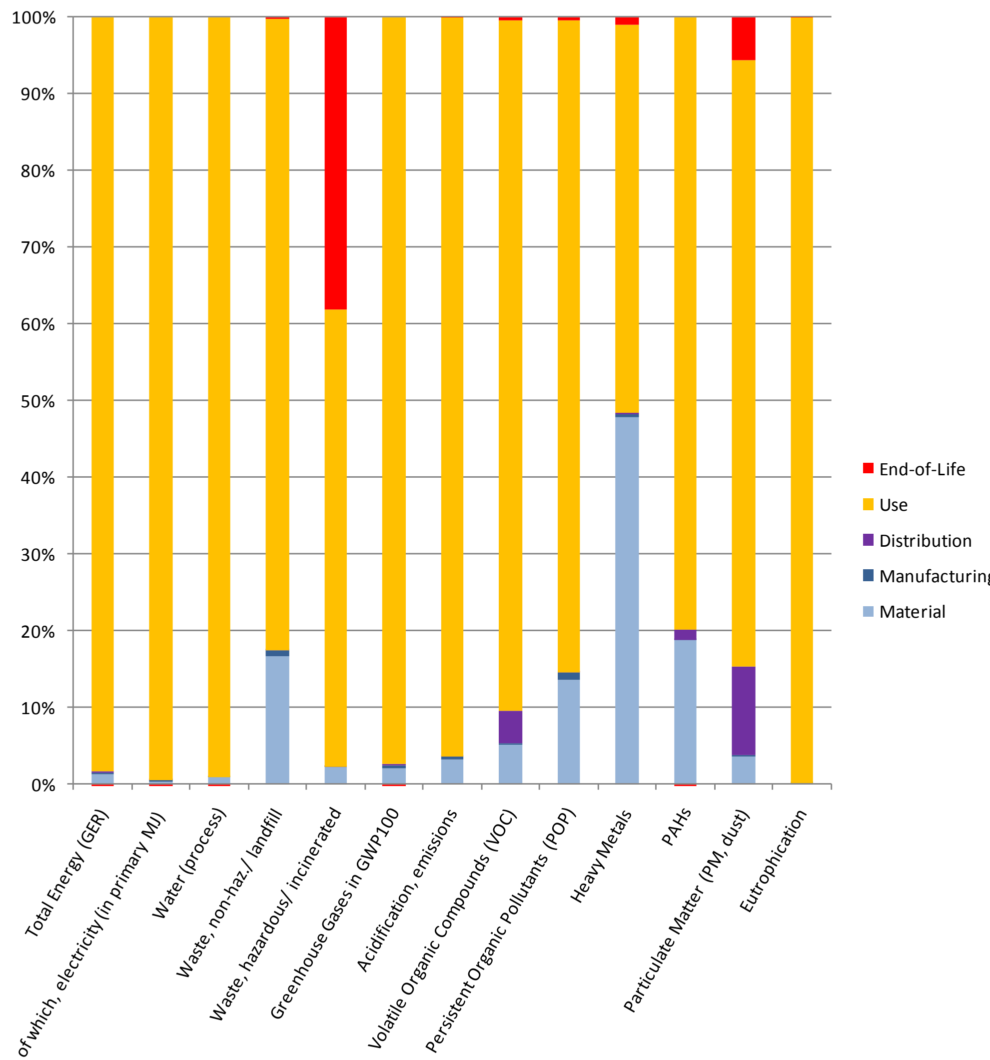
EcoReport Outputs

- Environmental impacts:

  (outputs of base-case 2)

- Predominance of the use phase: electricity for most impacts, detergent for eutrophication, water for water usage
- Manufacturing: stainless steel (POP and HM), aluminium (PAHs)

All BCs show similar profiles



EecoReport Outputs

- Environmental impacts conclusions:

Improvement options should mainly focus on reducing energy, water and detergent consumption

Reducing weight and volume is also relevant

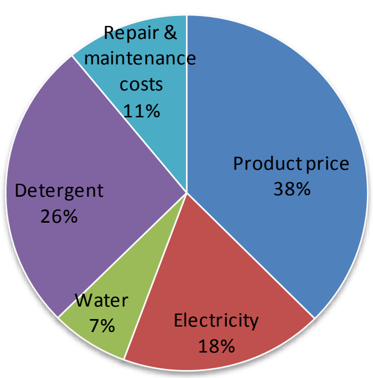
EcoReport Outputs

Economic analysis:

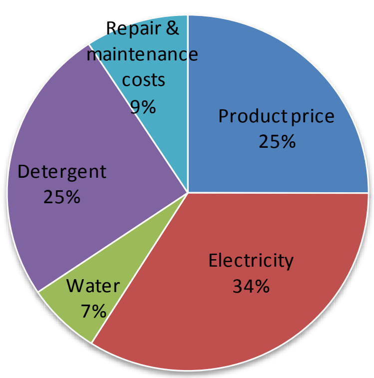
The life cycle cost is obtained by adding the product price, the maintenance costs and the cost of resources and consumables during lifetime

Item	Base-Case					
	1	2	3	4	5	6
Product price (€)	3 200	3 500	4 700	10 500	15 000	45 000
Repair and maintenance costs (€)	939	1 296	1 740	3 888	5 162	14 169
Electricity cost (€)	1 557	4 751	5 523	6 104	30 854	109 003
Water cost (€)	595	925	1 442	1 508	6 081	19 946
Detergent/Rinse aid cost (€)	2 252	3 514	5 494	5 736	23 144	75 914
Life Cycle Cost (€)	8 542	13 987	18 899	27 736	80 240	264 032

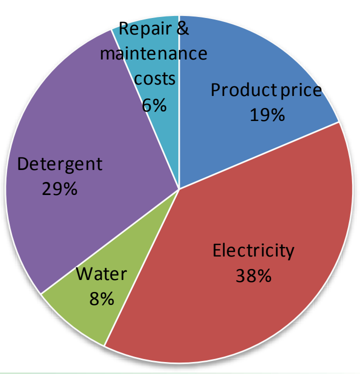
BC 1 - Under counter, water change



BC 2 - Under counter, one tank



BC 5 - One-tank, conveyor-type

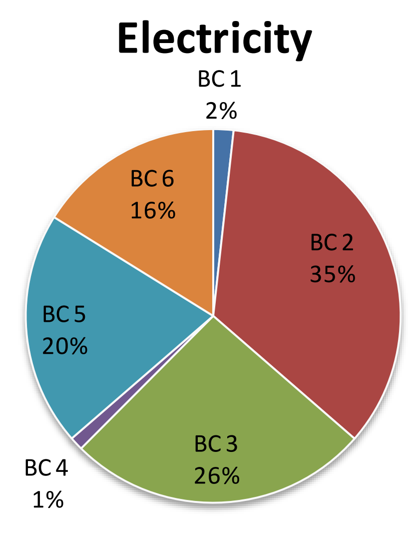


Task 5 - Results (16/17)

EcoReport Outputs

- Environmental impacts: shares of BCs in total impacts of the stocks per year

Environmental Impact	Base-Case					
	1	2	3	4	5	6
Total Energy (GER) (in PJ)	4.6	82.6	61.9	2.8	46.4	36.5
of which electricity (in TWh)	0.4	7.0	5.3	0.2	4.1	3.3
Water process (in million m^3)	7.6	80.2	59.7	2.5	31.0	22.9
Waste, non-hazardous/landfill (in kt)	6.2	110.0	82.8	3.9	65.0	44.9
Waste, hazardous/ incinerated (in kt)	0.24	2.85	1.96	0.10	1.59	0.97
Emissions to air						
Greenhouse Gases in GWP100 (in Mt CO_2 eq.)	0.20	3.65	2.73	0.12	2.05	1.60
Acidification, emissions (in kt SO_2 eq.)	1.2	21.6	16.2	0.7	12.2	9.5
Volatile Organic Compounds (VOC) (in kt)	0.004	0.041	0.029	0.002	0.020	0.015
Persistent Organic Pollutants (POP) (in g i-Teq.)	0.03	0.61	0.46	0.02	0.34	0.25
Heavy Metals (in ton Ni eq.)	0.17	2.63	2.08	0.12	1.48	0.83
PAHs (in ton Ni eq.)	0.03	0.30	0.20	0.01	0.14	0.08
Particulate Matter (PM, dust) (in kt)	0.33	2.44	1.45	0.10	0.72	0.32
Emissions to water						
Eutrophication (in kt PO_4)	1.31	13.38	9.98	0.42	4.98	3.69



Total:
20.3 TWh of electricity

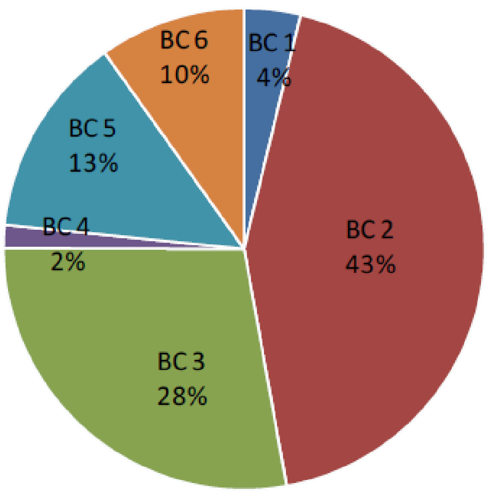
Task 5 - Results (17/17)

EcoReport Outputs

➢ Economic analysis: EU Totals

Base-cases' share of the total annual expenditure in 2009:

Environmental Impact	Base-Case						Total
	1	2	3	4	5	6	
EU-27 sales (in units)	20 000	138 200	65 900	2 600	6 600	1 300	234 600
Share of the EU-27 sales	8.5%	58.9%	28.1%	1.1%	2.8%	0.6%	100%
Product Price(in million €)	64	484	310	27	99	59	1 042
Electricity (in million €)	51	1 011	560	25	371	296	2 313
Water (in million €)	19	197	146	6	73	54	496
Detergent (in million €)	67	686	511	21	228	158	1 672
Repair and maintenance costs (in million €)	28	253	162	14	51	30	538
Total (in million €)	229	2 631	1 690	94	821	597	6 062



38% of the total costs are due to electricity consumption,

8% to water consumption,

28% to detergent consumption and

17% to product purchase prices.

Next Task

Next task:

- Task 6: Technical analysis of BAT and BNAT

Contacts

Thanks for your attention!

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