Final Report

Methodology for Ecodesign of Energy-related Products

MEErP 2011

Methodology Report

Part 1: Methods

Contractor:

COWI Belgium sprl -in association with- **Van Holsteijn en Kemna B.V. (VHK)**

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PREFACE

The present report has been prepared by COWI Belgium in association with Van Holsteijn en Kemna (VHK), as member of the COWI Consortium, under the Multiple Framework Contract for Technical Assistance Activities in the field of energy and transport policy (TREN/R1/350-2008 lot 3), and in response to the Terms of Reference included in the Contract No. SI2.581529 "Technical assistance for an update of the Methodology for the Ecodesign of Energy-using Products (MEEuP)".

Sustainable industrial policy aims in particular at developing a policy to foster environmental and energy efficient products in the internal market. The Ecodesign Directive 2009/125/EC is the cornerstone of this approach. It establishes a framework for the setting of ecodesign requirements for energy-related products with the aim of ensuring the free movement of those products within the internal market. Directive 2009/125/EC repealed the original Directive 2005/32/EC for the setting of ecodesign requirements for energy-using products.

The Methodology for the Ecodesign of Energy-using Products (MEEuP)[1] was developed in 2005 to contribute to the creation of a methodology allowing evaluating whether and to which extent various energy-using products fulfil certain criteria that make them eligible for implementing measures under the Ecodesign Directive 2005/32/EC.

Against this background the objective of the underlying study is twofold:

1.) To review the effectiveness and update, whenever necessary, the Ecodesign Methodology after having been applied for 5 years in ecodesign studies and contributed to the evaluation of implementing measures on energy-using products.

2.) To extend the Ecodesign Methodology to Energy-related Products to evaluate whether and to which extent new energy-related products fulfil certain criteria for implementing measures under the Ecodesign Directive 2009/125/EC.

The study is conducted according to the four tasks specified in the tender specifications, including public stakeholder involvement:

1. Information sourcing and publicity
2. Extension of the Methodology to Energy-related Products
3. Update of the Methodology Report
4. Update of the EcoReport Tool

The present MEErP 2011 Methodology Report covers Task 3 (excluding procedural part). The updated EcoReport tool is contained in a separate spreadsheet file.

A separate MEErP 2011 Project Report covers Task 1.

[1] http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm: VHK BV, Netherlands: Methodology Study Ecodesign of Energy-using Products, MEEuP Methodology Report, Tender No.: ENTR/03/96, Final Report: 28/11/2005

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ACRONYMNS

Acronym	Description
AA	Annual Average (concentration)
AAQ	Ambient Air Quality (Directive)
ANSI	American National Standards Institute
AOT40	derived parameter for the protection of vegetation from the effect of ground-level ozone
AP	Acidification Potential
As	Arsenic (HM)
ASHRAE	American Standards
B2B	Business-to-Business (market, product)
B2C	Business-to-Consumer (market, product)
BaP	Benzo(a)pyrene (in PAH group)
BAT	Best Available Technology
BaU	Business-as-Usual (scenario for the baseline)
BC	Base Case (average EU product defined for analysis)
BNAT	Best Not (yet) Available Technology
BOM	Bill-of-Materials
CAP	Common Agricultural Policy
Cd	Cadmium (HM)
CH	Central Heating
CH4/CH_4	methane (gas)
CLRTAP	Convention on Long-Range Transboundary Air Pollution (a.k.a. LRTAP)
CO_2 eq.	carbon dioxide equivalent (GWP)
COWI	COWI Belgium (contractor of the study)
Cr	Chrome (HM, when used without Roman figure suffix relates to Cr-III or Cr-IV, not Cr VI)
Cu	Copper (HM)
dB(A)	decibel A-rated (noise power)
DLS	Directional Light Sources
DMC	Domestic Material Consumption
DoE	US Department of Energy
EAA	European Aluminium Association
EAP	(EU) Environmental Action Plan
EC	European Commission
ECB	European Central Bank
ECCP	The European Commission's European Climate Change Programme
EEA	European Environmental Agency
EEB	European Environmental Bureau
EIA	Environmental Impact Assessment (cf. Directive 85/337/EEC & 97/11/EC)
ELCD	European Life Cycle Database (EC JRC-Ispra)
ELV	Emission Limit Value
ENER	European Commission, DG Energy
ENTR	European Commission, DG Enterprise
EoL	End-of-Life
EP	Eutrophication Potential
EPBD	Energy Performance of Buildings Directive (cf. recast 2010/31/EU)
EPER	European Pollutant Emission Register (predecessor of E-PRTR)
E-PRTR	European Pollutant Release and Transfer Register
EQS	Environmental Quality Standards
ErP	Energy-related Product(s)
ESD	Energy Services Directive
ESO	European Standardisation Organisation (CEN, CENELEC, ETSI)
ETC/SCP	The European Topic Centre on Sustainable Consumption and Production
ETS	Emission Trading System (a.k.a. EU-ETS)
EU-27	European Union of 27 Member States (for statistical data, as opposed to EU-25, EU-15, EU-32)
EuP	Energy-using Product(s)
Eurelectric	Association of EU electric utility companies
Eurofer	Industry association of EU iron & steel producers
Eurostat	EU statistics office
F-gas	regulation on fluorinated greenhouse gases
GCV	Gross Calorifc Value (of fuels, a.k.a. upper heating value Hs)
GDP	Gross Domestic Product (in Euro)
GHG	GreenHouse Gas
GPP	Green Public Procurement
GWP	Global Warming Potential, if not specified then over a 100-year period (GWP-100)
HCH	hexachlorocyclohexane (in the POP group)
HFCs	Hydrofluorocarbons
Hg	Mercury (HM)
HM	Heavy Metals
HS8	product classification for Eurostat trade statistics
HVAC	Heating, Ventilation and Air Conditioning
IA	Impact Assessment (usually relates to the Commission's IA study following Ecodesign preparatory study)
IAQ	Indoor Air Quality
IEA	International Energy Agency
IIASA	International Institute for Advanced Systems Analysis (work on acidification, e.g. RAINS model)
ILCD	International Reference Life Cycle Data System (EC JRC Ispra)
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
ISO	International Standardisation Organisation
JIS	Japanese Institute for Standards
JRC	Joint Research Centre (of European Commission)
kt	kilo tonne (1000 metric tonnes, 10^6 kg)
Lbl	Label (short for energy label scenario)
LBNL	Lawrence Berkely National Laboratories
LCA	(environmental) Life Cycle Assessment
LCC	Life Cycle Costs
LCD	Liquid Cristal Display
LCI	(environmental) Life Cycle Inventory
LCIA	(environmental) Life Cycle Impact Assessment

LCP	Large Combustion Plants (directive, now incorporated in the recast Industrial Emissions directive 2010/75/EC)
LED	Light Emitting Diode
LFS	Eurostat Labour Force Survey
LLCC	Least Life Cycle Costs (lowest point on an LCC curve)
MAC	Maximum Allowable Concentration
Marcogaz	Association of gas utilities
MEErP	Methodology for Ecodesign of Energy-related Products (methodology for Directive 2009/125/EC)
MEEuP	Methodology for Ecodesign of Energy-using Products (methodology for repealed Directive 2005/32/EC)
MEPS	Minimum Energy/Efficiency Performance Standard
Mt	Mega tonnes (10^6 metric tonnes; 10^9 kg)
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne. Data in this report relate to version 1.1 for data 2002-2007 or version 2 from 2008 onwards.
NCV	Net Calorific Value (of fuels, a.k.a. lower heating value Hi)
NDLS	Non-Directional Light Sources
NEC	National Emission Ceilings (directive, a.k.a. NECD)
Ni	Nickel (HM)
NMVOC	Non Methane VOC
NPV	Net Present Value (in economic calculations)
ODP	Ozone Depletion Potential
ODS	Ozone Depleting Substances
OEM	Original Equipment Manufacturer (supplier)
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead (HM)
PBD	polybrominated biphenyls
PBDE	polybrominated diphenyl ethers
PCB	polychlorinated biphenyls (in the POP group)
PFCs	Perfluorocarbons
PJ	Peta Joule (10^{15} Joule)
PM	Particulate Matter <=10 µm
PM10	Particulate Matter with 2.5 µm <particle size <= 10 µm
PM2.5	Particulate Matter with particle size <= 2.5 µm
POP	Persistent Organic Pollutants
PRIMES	Energy forecast model, developed by ICCS-NTUA for EC, DG ENER
PRODCOM	Eurostat production statistics of EU-27 (including classification)
PWF	Present Worth Factor (in economic calculations)
RoHS	Restriction of Hazardous Substances (directive)
SF6/SF_6	sulphur hexafluoride
SIP/SCP	Sustainable Industrial Policy/Sustainable Consumption and Production (action plan)
SME	Small- or Medium Enterprise
SO_2 eq.	sulphur dioxide equivalent (acidification)
TCDD	tetrachlorodibenzodioxin (in the POP group; dioxin)
TEC	Treaty on the European Communities (until 1.12.2009)
Teq	Total equivalent (unit used for POPs)
TFEU	Treaty on the Functioning of the European Union (since 1.12.2009)
TWh	Tera Watt hour (10^{12} Watt hour)
TWhe	Tera Watt hour electric
UNECE	United Nations Economic Commission for Europe (Gothenburg and Århus Protocol)
UNFCCC	United Nations Framework Convention on Climate Change (under which the Kyoto protocol resides)
VHK	Van Holsteijn en Kemna (author of the study, in association with COWI Belgium)
VOC	Volatile Organic Compounds
VOLY	Value of Life Years
VSL	Value Statistical Life
WEEE	Waste of Electrical and Electronic Equipment
WFD	Water Framework Directive
WTO	World Trade Organisation (treaty)
Zn	Zinc (HM)

Country denominators

AT	Austria
BE	Belgium
BU	Bulgaria
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
EL	Greece
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom

Numericals

million 10^6 **; billion** 10^9 **; trillion** 10^{12}

nano (n) 10^{-9}; micro (µ) 10^{-6}; milli (m) 10^{-3}; kilo (k) 10^3; Mega (M) 10^6; Giga (G) 10^9; Tera (T) 10^{12}; Peta (P) 10^{15}

All units are metric (tonne=1000 kg)

':' ;'-' ; 'na'; ' ' = data not available; '0'= rounded value is zero

INTRODUCTION

General

Over the past 5 years MEEuP 2005 has proven to be an effective methodology for Ecodesign preparatory studies. The new MEErP 2011 can and should now focus more on the 'how' instead of the 'why'.

This is the key message from stakeholders following a questionnaire reported in the MEErP 2011 Project Report

The underlying MEErP 2011 Methodology Report is thus on maintaining the qualities of the former MEEuP methodology, extending the scope also to energy-related products and providing more guidance to analysts and stakeholders involved in the Ecodesign preparatory studies.

To this end, the MEErP 2011 Methodology Report is divided into two parts:

- **Part 1 has a focus on the methods and contains (socio)economic data, the essential environmental characterisation factors and the description of the EcoReport 2011 tool (added as separate .xls file);**
- Part 2 deals with the background EU environmental policies, LCIA data and other reference data from past and ongoing preparatory studies.

For policy makers and stakeholders that have concerns over the validity of the MEErP for other impacts besides energy consumption during the use phase, the new MEErP expands the sections on the environmental indicators, providing key numbers, trends, main sources of the impacts and how the parameter was included in Ecodesign studies so far. This can be found in Part 2.

In this Part 1, the structure is clear-cut and linear. After describing the legal background in the introductory section, the subsequent chapters 1 to 7 deal –one chapter per task—with the specific data, considerations and calculation methods per task.

The updated Ecoreport 2011 tool is added as a separate .xls file with an improved manual and characterisation factors that are updated to reflect the changes in Community legislation 2005-2010.

Objective and scope of Ecodesign

The design of the methodology in the former MEEuP 2005 was enshrined in the Directive 2005/32/EC on Ecodesign of Energy-using Products. For the new methodology MEErP 2011 it is proposed to follow the same route with the recast Directive 2009/125/EC on Ecodesign of Energy-related Products (hereafter 'Ecodesign directive')[2].

The core of the recast is the extension of the scope from EuP to ErP which can be found in Chapter 3.2.

But as regards other items, much of the relevant legislative text has not changed.

[2] DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (recast). OJ L 285, 31.10.2009, pp. 10-35.

The prime objective of Ecodesign is derived from its legal basis, i.e. Article 95 of the Treaty of the European Communities (TEC) now Article 114 of the Treaty on the Functioning of the European Union (TFEU) about the adoption of harmonising legislation which has as object the establishment and functioning of the internal market.[3]

It is based on the concept that the disparities between the laws or administrative measures adopted by the Member States in relation to the ecodesign of energy-related products can create barriers to trade and distort competition in the Community and may thus have a direct impact on the establishment and functioning of the internal market. The harmonisation of national laws is the only means to prevent such barriers to trade and unfair competition.

The second objective is making a contribution to sustainable development, in which context the recitals of the Ecodesign directive mention the Integrated Product Policy (IPP), the Sixth Community Environment Action Plan (EAP)[4], Communities greenhouse gas emission targets, European Climate Change Programme[5], objectives relating to security of energy supply, Thematic Strategy on the Sustainable Use of Natural Resources, etc..

Article 1

Subject matter and scope

1. This Directive establishes a framework for the setting of Community ecodesign requirements for energy-related products with the aim of ensuring the free movement of such products within the internal market.

2. This Directive provides for the setting of requirements which the energy-related products covered by implementing measures must fulfil in order to be placed on the market and/or put into service. It contributes to sustainable development by increasing energy efficiency and the level of protection of the environment, while at the same time increasing the security of the energy supply. [...]

More recently, i.e. after publication of the Ecodesign directive, a number of important policy documents confirm the Ecodesign priorities, as will be discussed in Chapter 4.

The product definition of energy-related products is given in Article 2 of the Ecodesign directive.

In Art. 2(1), the Ecodesign directive defines '*Energy-related product', (a 'product')* to mean "*any good that has an impact on energy consumption during use which is placed on the market and/or put into service, and includes parts intended to be incorporated into energy-related products covered by this Directive which are placed on the market and/or put into service as individual parts for end-users and of which the environmental performance can be assessed independently;"*

In Art. 2(2), the Ecodesign directive defines *'components and sub-assemblies'* as "*parts intended to be incorporated into products which are not placed on the market and/or put into service as individual parts for end-users or the environmental performance of which cannot be assessed independently*" and thus cannot be considered 'Energy-related products' in the scope of the directive.

Eligibility of products

According to the Ecodesign directive (Art. 15(2)), products are eligible for measures if they meet the following criteria:

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[3] Treaty on the European Communities (TEC). It was replaced by the TFEU Treaty on the Functioning of the European Union which entered into force on 1st of December 2009, following the Lisbon Treaty of Lisbon 13 Dec. 2007. The content of article 95 TEC was moved to article 114 TFEU.

[4] Decision No 1600/2002/EC of the European Parliament and of the Council, OJ L 242, 10.9.2002, p. 1.

[5] EC, Second ECCP Progress Report: Can we meet our Kyoto targets?, April 2003. See http://ec.europa.eu/clima/documentation/eccp/index_en.htm

(a) the product shall represent a significant volume of sales and trade, indicatively more than 200 000 units a year within the Community according to the most recently available figures;

(b) the product shall, considering the quantities placed on the market and/or put into service, have a significant environmental impact within the Community, as specified in the Community strategic priorities as set out in Decision No 1600/2002/EC6; and

(c) the product shall present significant potential for improvement in terms of its environmental impact without entailing excessive costs, taking into account in particular:

(i) the absence of other relevant Community legislation or failure of market forces to address the issue properly; and

(ii) a wide disparity in the environmental performance of products available on the market with equivalent functionality.

Key words in Article 15(2), sub a) are 'significant volume' and 'indicatively', indicating some flexibility on the part of the Commission in electing product groups and designing measures. Furthermore, in this context, the Ecodesign directive explicitly refers to 'volume' of sales and trade, and not to 'value'. Finally, the Ecodesign directive gives no explicit guidance regarding the grouping of products under one Ecodesign measure.

The Art. 15(2) has not changed from the repealed Ecodesign directive 2005/32/EC and therefore the way that the European Commission has dealt with the given flexibility in past preparatory studies might give some guidance in this respect.

Table 1. Selected results from preparatory studies 2006-2011

Product groups	Unit sales 2005-2010	Value sales 2005-2010	Energy impact 2005-2010	Energy saving (vs. BaU 2020)	Other impacts, excl. energy & fuel-related GHG emissions
	mln. /a	bln. EUR/a	Twhe*/a	Twhe/a	emissions/resources
non-domestic ventilation units	1.4	20 (c+i)	127-206*	400*	noise?
CH boilers (incl. combi)	6.6	50 (c+i)	1190*	303*	NO_x, CO, C_xH_y, SO_2
electric motors >750 W (all types)	9.0	3.1 (m)	1067	140.0	
dom. non-direct.l light sources (NDLS)	2000.0	3 (c)	112	87.0	Hg (mercury)
dedicated water heaters	9.8	4.5 (c+i)	215**	45**	NO_x
circulators	14.0	-	54	35.0	
televisions	32.0	-	54	30.0	
dom. directional light sources (DLS)	330.0	1.3 (c)	31	25.0	Hg (mercury)
solid fuel small combustion installations	3.4	11.7 (c+i)	150	20.0	VOC (OCG), CO, PM, NO_x
non-dom. airco chillers	0.1	-	90	20.0	GWP refrigerant
non-dom. refrig. & freezers	1.6	-	58	20.0	GWP refrigerant
dom. vacuum cleaners	45.0	3 (c)	19	16.0	PM? noise?
dom. ventilation units	7.8	1 (c)	19-26*	7+30*	noise
room air conditioners	4.7	7.9 (c+i)	30	6.0	GWP refrigerant
dom. refrig. and freezers	20.0	-	122	4.0	GWP refrigerant
complex set top boxes	10.0	-	6	3.5	
water pumps	1.6	1.52 (m)	117	3.3	
dom. dishwashers	6.0	3.2 (c)	25	2.0	water
dom. range hoods	6.5	0.5 (c)	6	2.0	noise
dom. washing machines	14.0	6.1 (c)	35	1.5	water
non-dom. vacuum cleaners***	1.3	-	2	1.5	
printers***	28.1	-	9	0.2	

Source: VHK compilation, March 2011

[6] refers to the Sixth Community Environmental Action Plan (hereafter '6tht EAP')

Notes:

1) Values are taken from a selection of completed and ongoing preparatory studies and may be subject to change.
2) Impacts and savings mentioned may be overlapping (e.g. ventilation and CH boilers, motors and their applications).
3) Ventilation impacts show 2 numbers: the first is the electricity consumption, the second shows the (heating) fuel savings.
4) 'Other impacts' means that aspects were taken into account/ studies, not necessarily --e.g. due to lacking test standards-- (already) translated into requirements. Items with a '?' are or could be subject of ongoing pstudies (no Commission Working Document issued yet)

Legend:
dom.=domestic; refrig.=refrigerators; BAU=Business-As-Usual scenario; (c)=consumer price incl. VAT; (c+i)= consumer price + installation; (m)= manufacturer selling prices; - = not (easily) available from study

Twhe = TWh electric.

***= TWhe equivalent at 1 Twhe = 10 PJ primary energy or**
****=ca. 80% TWhe and 20% Twhe equivalent (=fossil fuel)**

***= not subject to individual Ecodesign measure, but regulated in a larger cluster

The Table 1 shows that the number of 200.000 units should indeed be seen as indicative. For consumer products (B2C) it represents roughly replacement sales a product with a product life of 10 years and a market penetration of 1% in a mature market. For consumer products, a minimum of 1 million products, equivalent to 5 % market penetration in the 200 million EU27-households is more in line with the products studied up till now.

For non-domestic products, a number of 200.000 unit sales is relatively high and may cause to miss out on important saving opportunities such as for air conditioning chillers. The non-domestic market is very diverse and segments are much smaller. For instance, the 'manufacturing industry' (NACE Sector D) is 2.1 million enterprises and 'retail' (NACE sector G) represents no more than 3,5 million enterprises. The largest NACE group, commercial 'services' (group K) is 5 million enterprises. Minimum annual sales of 50.000 units, possibly even as low as a few thousand units/a if the impact is very significant, could be more appropriate as a criterion for non-domestic (industrial and/or tertiary sector) products.

Art. 15 (5) lays down the implementing measures shall meet all the following criteria:

(a) there shall be no significant negative impact on the functionality of the product, from the perspective of the user;

(b) health, safety and the environment shall not be adversely affected;

(c) there shall be no significant negative impact on consumers in particular as regards the affordability and the life cycle cost of the product;

(d) there shall be no significant negative impact on industry's competitiveness;

(e) in principle, the setting of an ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers; and

(f) no excessive administrative burden shall be imposed on manufacturers.

Amongst others, these stipulations imply that --if it is not possible to formulate measures that meet these criteria—the product groups are not eligible for measures.

It is difficult to formulate ex ante, i.e. without a preparatory study, whether any of these significant impacts apply. But for instance in the case of products with health and safety implications (medical and safety equipment) it would be prudent to dedicate extra analysis on the subject to exclude a possible negative impact.

It is an important task of the preparatory studies to analyse the Art 15 (2) and (5) criteria.

The following chapters in this report will provide guidance on how to establish whether these conditions are met.

Preparing draft measures, legal background

The Ecodesign directive 2009/125/EC prescribes that in preparing a draft implementing measure, the Commission shall make a series of analyses and assessments, which hereafter shall be referred to as "the preparatory study". The underlying Methodology for the Ecoddesign of Energy-related Products (MEErP) is intended to provide operational guidance to the Commission and possible contractors providing technical assistance to the Commission, hereafter referred to as "the analyst(s)", in performing the preparatory study in accordance with the stipulations in the Ecodesign directive. The preparatory study is concluded with a preparatory study report. Note that where appropriate the preparatory study may also serve as a preparation of prossible draft implementing measures under the Energy Labelling directive 2010/30/EC.

The stages following the preparatory study involve the proposal of the draft implementing measures in the form of a Commission Working Document (WD), the preparation of an accompanying Commission Impact Assessment (IA, primary internal document, ultimately published with the publication of the legislation), stakeholder consultations bilaterally and in one or more Consultation Forums (CF), approval by the Cabinet, Inter Service Consultation (ISC), vote by the Ecodesign Regulatory Committee (RC), approval by the European institutions and publication in the Official Journal (OJ).

Note that the stages following the preparatory study are not covered by the MEErP although the MEErP seeks to anticipate the requirements of these subsequent stages. More specifically, the underlying methodology is designed so that it can be integrated in the Commission Impact Assessment.

Following stakeholder comments (see MEErP 2011 Project Report) the MEErP structure makes a clear split between

- Tasks 1 to 4 (product definitions, standards and legislation; economic and market analysis; consumer behaviour and local infrastructure; technical analysis) that have a clear focus on data retrieval and initial analysis and
- Tasks 5 (assessment of base case), 6 (improvement potential) and 7 (policy, scenario, impact and sensitivity analysis) with a clear focus on modeling.

Tasks 1 to 4 have a dual purpose. They should not only provide the inputs for the modeling in Tasks 5 to 7, but they are also intended for capacity building. After having read the first 4 Task reports policy makers and all stakeholders should have enough background to talk to each other and have a basic understanding of each other's problems.

Tasks 5 to 7 are intended to provide the analysis whether and which ecodesign requirements should be set for the energy-related product. As such the preparatory study is the first step in the Commission's decision making process towards the subsequent process of drawing up draft legislation, comprising the consultation of interested stakeholders in the Ecodesign Consultation Forum, the Commission's Impact Assessment, the vote by Member States in the Regulatory Committee, the scrutiny by European Parliament and Council and the adoption of legislation. As an alternatively to legislation, the industry may propose a self-regulation or the Commission may propose no measure.

More specifically, the tasks entail:

Task 1 - Scope (definitions, standards and legislation);

Task 2 – Markets (volumes and prices);

Task 3 – Users (product demand side);

Task 4 - Technologies (product supply side, includes both BAT and BNAT);

Task 5 – Environment & Economics (Base case LCA & LCC);

Task 6 – Design options;

Task 7 – Scenarios (Policy, scenario, impact and sensitivity analysis).

Tasks 1 to 4 can be performed in parallel, whereas 5, 6 and 7 are sequential (see diagram)

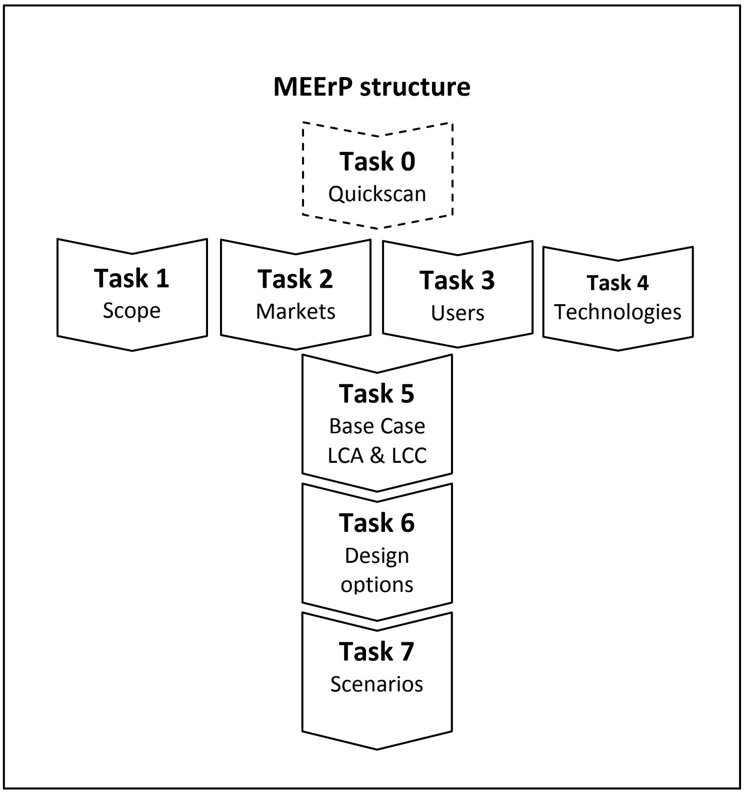

Figure 1: MEErP structure

Task 0 is an optional task for the case of large or inhomogeneous product groups, where it is recommended to carry out a first product screening, considering the environmental impact and potential for improvement of the products as referred to in Article 15 of the Ecodesign Directive. The objective is to re-group or narrow the product scope, as appropriate from an ecodesign point of view, for the subsequent analysis in tasks 1-7.

Task 1 should define the product category and define the system boundaries of the 'playing field' for ecodesign. It is important for a realistic definition of design options and improvement potential and it is also relevant in the context of technically defining any implementing legislation or voluntary measures (if any). Furthermore, Task 1 is the basis for the test and calculation methods to be used to regulate relevant ecodesign parameters. It should be checked whether accurate, reliable and reproducible methods exist and/or, if they don't exist or the methods are partly flawed, how this problem could be addressed. Finally, Task 1 is important as it makes

- an inventory of what measures already exist in the EU (with possible regulatory failures),
- it analyzes the legislation in EU Member States, which the Ecodesign directive tries to harmonise for the sake of a single market and
- it indicates –also in view of the global competitiveness and hinting at feasible target levels— what measures have been taken in the rest of the world outside the EU.

Task 2 aims

- To place the product group within the total of EU industry and trade policy (subtask 2.1).
- To provide market and cost inputs for the EU-wide environmental impact of the product group (subtask 2.2).
- To provide insight in the latest market trends so as to indicate the place of possible ecodesign measures in the context of the market-structures and ongoing trends in product design (subtask 2.3, also relevant for the impact analyses in Task 3).
- to provide a practical data set of prices and rates to be used in a Life Cycle Cost (LCC) calculation (Subtask 2.4).

Task 3 Consumer behaviour can - in part - be influenced by product-design but overall it is a very relevant input for the assessment of the environmental impact and the Life Cycle Costs of a product. One aim is to identify barriers and restrictions to possible ecodesign measures, due to social, cultural or infra-structural factors. A second aim is to quantify relevant user-parameters that influence the environmental impact during product-life and that are different from the Standard test conditions as described in Subtask 1.2. [7]

Task 4 entails a general technical analysis of current products on the EU-market and provides general inputs for the definition of the Base case(s) (task 5) as well as the identification of the improvement potential (task 6).

As mentioned, the new Task 4 now incorporates the full range of technical reporting, from a description of the existing products up to BAT (Best Available Technoloy) and BNAT (Best Not yet Available Technology).

Task 5 requires that one or more average EU product (s) have to be defined or a representative product category as the "Base-case" for the whole of the EU-27 has to be chosen. On this Base-Case most of the environmental and Life Cycle Cost analyses will be built throughout the rest of the study. The Base-Case is a conscious abstraction of reality, necessary one for practical reasons. Having said that, the question if this abstraction leads to inadmissible conclusions for certain market segments will be addressed in the impact- and sensitivity analysis.

The description of the Base-Case is the synthesis of the results of Tasks 1 to 4 and the point-of-reference for tasks 6 (improvement potential) and 7 (policy, scenario, impact and sensitivity analysis).

With respect of former MEEuP 2005 there is no longer a distinction between a Standard BaseCase, i.e. using impact values (efficiency etc.) as published by industry in accordance with test standards, and a Real-Life BaseCase, i.e. using impact values as they occur in practice. Only the latter is required, where the analysts will use a multiplier to translate the Standard values into Real-Life values.

[7] Examples are the actual temperature-settings for laundry and dishwashing equipment, the loading efficiency (real load vs. nominal capacity) for a whole range of appliances, power management enabling rate for ICT equipment, etc.

Task 6 Identifies design options, their monetary consequences in terms of Life Cycle Cost 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.), while taking into account for the purchase price development the manufacturers' R&D and investment costs. 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 more subject to promotion measures than restrictive action. The BNAT indicates long-term possibilities and helps to define the exact scope and definition of possible measures.

Task 7 summarizes and totals the outcomes of all previous tasks. It looks at suitable policy means to achieve the potential e.g. implementing LLCC as a minimum and BAT as a promotional target, using legislation or voluntary agreements, labelling, benchmarks and possible incentives. It draws up scenarios 1990 – 2020/2030/2050 quantifying the improvements that can be achieved vs. a Business-as-Usual scenario and compares the outcomes with EU environmental targets.

It makes an estimate of the impact on consumers (purchasing power) and industry (employment, profitability, competitiveness, investment level, etc.) as described in Annex II of the Ecodesign Directive 2009/125/EC, explicitly describing and taking into account the typical design cycle (platform change) in a product sector. Finally, in a sensitivity analysis of the main parameters it studies the robustness of the outcome, amongst others regarding energy prices and societal costs.

Art 15(3) to 15(10) of the Ecodesign directive set out the legal basis for preparing Ecodesign draft implementing measures:

3. In preparing a draft implementing measure, the Commission shall take into account any views expressed by the Committee referred to in Article 19(1)[8] and shall further take into account:
(a) Community environmental priorities, such as those set out in Decision No 1600/2002/EC or in the Commission's European Climate Change Programme (ECCP); and
(b) relevant Community legislation and self-regulation, such as voluntary agreements, which, following an assessment in accordance with Article 17, are expected to achieve the policy objectives more quickly or at lesser expense than mandatory requirements.

4. In preparing a draft implementing measure the Commission shall:
(a) consider the life cycle of the product and all its significant environmental aspects, inter alia, energy efficiency. The depth of analysis of the environmental aspects and of the feasibility of their improvement shall be proportionate to their significance. The adoption of ecodesign requirements on the significant environmental aspects of a product shall not be unduly delayed by uncertainties regarding the other aspects;
(b) carry out an assessment, which shall consider the impact on the environment, consumers and manufacturers, including SMEs, in terms of competitiveness — including in relation to markets outside the Community — innovation, market access and costs and benefits;
(c) take into account existing national environmental legislation that Member States consider relevant;
(d) carry out appropriate consultation with stakeholders;
(e) prepare an explanatory memorandum of the draft implementing measure based on the assessment referred to in point (b); and
(f) set implementing date(s), any staged or transitional measure or periods, taking into account, in particular, possible impacts on SMEs or on specific product groups manufactured primarily by SMEs. ….

6. Implementing measures shall lay down ecodesign requirements in accordance with Annex I and/or Annex II. EN L 285/20 Official Journal of the European Union 31.10.2009. Specific ecodesign requirements shall be introduced for

[8] Intended is the Ecodesign Regulatory Committee

selected environmental aspects which have a significant environmental impact. Implementing measures may also provide that no ecodesign requirement is necessary for certain specified ecodesign parameters referred to in Annex I, Part 1.

7. The requirements shall be formulated so as to ensure that market surveillance authorities can verify the conformity of the product with the requirements of the implementing measure. The implementing measure shall specify whether verification can be achieved directly on the product or on the basis of the technical documentation.

8. Implementing measures shall include the elements listed in Annex VII.

9. Relevant studies and analyses used by the Commission in preparing implementing measures should be made publicly available, taking into account in particular easy access and use by interested SMEs.

10. Where appropriate, an implementing measure laying down ecodesign requirements shall include provisions on the balancing of various environmental aspects. Those measures, designed to amend non-essential elements of this Directive by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 19(3).

Annexes I and II are referenced in Art. 15 and provide more detail. Note that Annex II specifically mentions the 'technical, environmental and economic analysis', which is now commonly known as the 'Ecodesign preparatory study'.

ANNEX I
Method for setting generic ecodesign requirements (referred to in Article 15(6))

Generic ecodesign requirements aim at improving the environmental performance of products, focusing on significant environmental aspects thereof without setting limit values. The method referred to in this Annex must be applied when it is not appropriate to set limit values for the product group under examination. The Commission must, when preparing a draft implementing measure to be submitted to the Committee referred to in Article 19(1), identify significant environmental aspects which must be specified in the implementing measure.

In preparing implementing measures laying down generic ecodesign requirements pursuant to Article 15, the Commission must identify, as appropriate to the product covered by the implementing measure, the relevant ecodesign parameters from among those listed in Part 1, the information supply requirements from among those listed in Part 2 and the requirements for the manufacturer listed in Part 3.

Part 1. Ecodesign parameters for products […]. See checklist. Table 1

Part 2. Requirements relating to the supply of information

Implementing measures may require information to be supplied by the manufacturer that may influence the way the product is handled, used or recycled by parties other than the manufacturer. This information may include, as applicable:

(a) information from the designer relating to the manufacturing process;

(b) information for consumers on the significant environmental characteristics and performance of a product, accompanying the product when it is placed on the market to allow consumers to compare these aspects of the products;

(c) information for consumers on how to install, use and maintain the product in order to minimise its impact on the environment and to ensure optimal life expectancy, as well as on how to return the product at end-of-life, and, where appropriate, information on the period of availability of spare parts and the possibilities of upgrading products; and (d) information for treatment facilities concerning disassembly, recycling, or disposal at end-of-life. Information should be given on the product itself wherever possible. This information must take into account obligations under other Community legislation, such as Directive 2002/96/EC.

Part 3. Requirements for the manufacturer

1. Addressing the environmental aspects identified in the implementing measure as capable of being influenced in a substantial manner through product design, manufacturers of products must perform an assessment of the product model throughout its lifecycle, based upon realistic assumptions about normal conditions and purposes of use. Other environmental aspects may be examined on a voluntary basis.

On the basis of this assessment, manufacturers must establish the product's ecological profile. It must be based on environmentally relevant product characteristics and inputs/outputs throughout the product life cycle expressed in physical quantities that can be measured.

2. Manufacturers must make use of this assessment to evaluate alternative design solutions and the achieved environmental performance of the product against benchmarks. The benchmarks must be identified by the Commission in the implementing measure on the basis of information gathered during the preparation of the measure. The choice of a specific design solution must achieve a reasonable balance between the various environmental aspects and between environmental aspects and other relevant considerations, such as safety and health, technical requirements for functionality, quality, and performance, and economic aspects, including manufacturing costs and marketability, while complying with all relevant legislation.

The following checklist of ecodesign parameters is taken from Annex I, Part 1.

Table 1. CHECKLIST ECODESIGN PARAMETERS

1.1		**In so far as they relate to product design, significant environmental aspects must be identified with reference to the following phases of the life cycle of the product:**
	a	raw material selection and use;
	b	manufacturing;
	c	packaging, transport, and distribution;
	d	installation and maintenance;
	e	use; and
	f	end-of-life, meaning the state of a product having reached the end of its first use until its final disposal.
1.2		**For each phase, the following environmental aspects must be assessed where relevant:**
	a	predicted consumption of materials, of energy and of other resources such as fresh water;
	b	anticipated emissions to air, water or soil;
	c	anticipated pollution through physical effects such as noise, vibration, radiation, electromagnetic fields;

d expected generation of waste material; and

e possibilities for reuse, recycling and recovery of materials and/or of energy, taking into account Directive 2002/96/EC.

1.3 **In particular, the following parameters must be used, as appropriate, and supplemented by others, where necessary, for evaluating the potential for improving the environmental aspects referred to in point 1.2:**

a weight and volume of the product;

b use of materials issued from recycling activities;

c consumption of energy, water and other resources throughout the life cycle;

d use of substances classified as hazardous to health and/or the environment according to Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances (1) and taking into account legislation on the marketing and use of specific substances, such as Council Directive 76/769/EEC of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (2) or Directive 2002/95/EC;

e quantity and nature of consumables needed for proper use and maintenance;

f ease for reuse and recycling as expressed through: number of materials and components used, use of standard components, time necessary for disassembly, complexity of tools necessary for disassembly, use of component and material coding standards for the identification of components and materials suitable for reuse and recycling (including marking of plastic parts in accordance with ISO standards), use of easily recyclable materials, easy access to valuable and other recyclable components and materials; easy access to components and materials containing hazardous substances;

g incorporation of used components;

h avoidance of technical solutions detrimental to reuse and recycling of components and whole appliances;

i extension of lifetime as expressed through: minimum guaranteed lifetime, minimum time for availability of spare parts, modularity, upgradeability, reparability;

j amounts of waste generated and amounts of hazardous waste generated;

k emissions to air (greenhouse gases, acidifying agents, volatile organic compounds, ozone depleting substances, persistent organic pollutants, heavy metals, fine particulate and suspended particulate matter) without prejudice to Directive 97/68/EC of the European Parliament and of the Council of 16 December 1997 on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery (3);

l emissions to water (heavy metals, substances with an adverse effect on the oxygen balance, persistent organic pollutants); and

m emissions to soil (especially leakage and spills of dangerous substances during the use phase of the product, and the potential for leaching upon its disposal as waste).

n Miscellaneous health-related impacts for user and direct environment: Noise, Radiation (e.g. radon in building materials), Vibration (e.g. of machine tools)

ANNEX II
Method for setting specific ecodesign requirements
(referred to in Article 15(6))

Specific ecodesign requirements aim at improving a selected environmental aspect of the product. They may take the form of requirements for reduced consumption of a given resource, such as a limit on the use of a resource in the various stages of an product's life cycle, as appropriate (such as a limit on water consumption in the use phase or on the quantities of a given material incorporated in the product or a requirement for minimum quantities of recycled material).

In preparing implementing measures laying down specific ecodesign requirements pursuant to Article 15, the Commission must identify, as appropriate to the product covered by the implementing measure, the relevant ecodesign parameters from among those referred to in Annex I, Part 1, and set the levels of these requirements, in accordance with the regulatory procedure referred to in Article 19(2), as follows:

1. A technical, environmental and economic analysis must select a number of representative models of the product in question on the market and identify the technical options for improving the environmental performance of the product, keeping sight of the economic viability of the options and avoiding any significant loss of performance or of usefulness for consumers.

The technical, environmental and economic analysis must also identify, for the environmental aspects under consideration, the best-performing products and technology available on the market.

The performance of products available on international markets and benchmarks set in other countries' legislation should be taken into consideration during the analysis as well as when setting requirements.

On the basis of this analysis, and taking into account economic and technical feasibility as well as the potential for improvement, concrete measures must be taken with a view to minimising the product's environmental impact.

Concerning energy consumption in use, the level of energy efficiency or consumption must be set aiming at the life cycle cost minimum to end-users for representative product models, taking into account the consequences on other environmental aspects. The life cycle cost analysis method uses a real discount rate on the basis of data provided from the European Central Bank and a realistic lifetime for the product; it is based on the sum of the variations in purchase price (resulting from the variations in industrial costs) and in operating expenses, which result from the different levels of technical improvement options, discounted over the lifetime of the representative product models considered. The operating expenses cover primarily energy consumption and additional expenses in other resources, such as water or detergents.

A sensitivity analysis covering the relevant factors, such as the price of energy or other resource, the cost of raw materials or production costs, discount rates, and, where appropriate, external environmental costs, including avoided greenhouse gas emissions, must be carried out to check if there are significant changes and if the overall conclusions are reliable. The requirement will be adapted accordingly.

A similar methodology may be applied to other resources such as water.

2. For the development of the technical, environmental and economic analyses, information available in the framework of other Community activities may be used.

The same applies for information available from existing programmes applied in other parts of the world for setting the specific ecodesign requirement of products traded with the European Union's economic partners.

3. The date of entry into force of the requirement must take the redesign cycle for the product into account.

The implementation of the Article 15 criteria in an operational methodology is the subject of the following chapters.

MEErP Structure

The following is an overview of all activities foreseen in the MEErP. The relevant parts are repeated at the outset of each of the following chapters, but this complete overview also serves to provide the Commission with a comprehensive format for administrative purposes.

Executive Summary

The executive summary for stakeholders and the Commission, summarising all tasks completed, should be regularly updated for each stakeholder meeting and meeting with the Commission.

Task 0. First product screening (optional)

In case of large or inhomogeneous product groups, it is recommended to carry out a first product screening, considering the environmental impact and potential for improvement of the products as referred to in Article 15 of the Ecodesign Directive. The objective is to re-group or narrow the product scope, as appropriate from an ecodesign point of view, for the subsequent analysis in tasks 1-7.

Task 1. SCOPE

1.1. Product Scope

1.1.1 Identify relevant
- a Prodcom category or categories (Eurostat);
- b categories according to EN- or ISO-standard(s);
- c labelling categories (EU Energy Label or Eco-label), if not defined by the above.

1.1.2 Define preliminary product scope, including preliminary product definitions, taking into account that categorisation shall preferrably be linked to primary performance parameter (the "functional unit") if needed sub-categorsation can take place on the basis of secondary performance parameters and for indirect ErPs the affected energy system(s)

1.2. Test standards (EU, Member State and third country level)

1.2.1 Identify and shortly describe
- 1.2.1.1 EN or ISO/IEC test standards
- 1.2.1.2 Mandates issued by the European Commission to the European Standardisation Organisations (ESOs)
- 1.2.1.3 if applicable, test standards in individual Member States
- 1.2.1.4 where relevant, third country test standards (e.g. ASHRAE, ANSI, JIS, etc.) regarding the test procedures for
- a primary and secondary functional performance parameters under 1.1
- b resources use (energy and materials, incl. waste) and emissions
- c safety (inflammatbility, electric safety, EMC, stability, etc.)
- d noise and vibrations (if applicable)
- e other product-specific test procedures possibly posing barriers for Ecodesign measures

1.2.2 Do a comparative analysis for overlapping test standards on performance, resources use and/or emissions

1.2.3 Analyse and report on
- a new test standards being developed (describe major changes)
- b possible problems on accuracy (tolerances), reproducibility and to what extend the test standards reflect real-life; draft outlines of mandate(s) to the ESOs as appropriate.
- c differences between standards covering the same subjects (comparative analysis)

1.3 Legislation (EU, Member State and third country level)

Identify and shortly describe the relevance for the product scope of
- 1.3.1 EU legislation (legislation on resources use and environmental impact, EU voluntary agreements, labels)
- 1.3.2 Member State legislation (as above, for legislation indicated as relevant by Member States), including a comparative analysis.
- 1.3.3 Third country legislation (as above, for third country legislation), including a comparative analysis

2 MARKETS

2.1 Generic economic data

Identify and report

a. EU Production;
b. Extra-EU Trade;
c. Intra-EU Trade;
d. EU sales and trade= production + import - export.

Data should relate to the latest full year for which at least half of the Member States have reported to Eurostat. Preferably data should be in physical volume (e.g. units) and in money units and split up per Member State. Information for this subtask should be derived from official EU statistics so as to be coherent with official data used in EU industry and trade policy.

2.2 Market and stock data

In physical units, for EU-27, for each of the categories as defined in 1.1 and for reference years

a. 1990 (Kyoto and "20-20-20" reference);
b. 2010 (or most recent real data);
c. 2013-2016 (forecast, presumable entry into force of measures);
d. 2020-2030-2050 (forecast, years in which all new ecodesigns of today will be absorbed by the market).

The following parameters are to be identified:

a. Installed base ("stock") and penetration rate;
b. Annual sales growth rate (% or physical units);
c. Average Product Life (in years), in service, and a rough indication of the spread (e.g. standard deviation);
d. Total sales/ real EU-consumption, (also in €, when available);
e. Replacement sales (derived);
f. New sales (derived).

2.3 Market trends

2.3.1. General market trends (growth/ decline, if applicable per segment), trends in product-design and product-features.

2.3.2 Market channels and production structure; identification of the major players (associations, large companies, share SMEs, employment);

2.3.3 Trends in product design/ features, illustrated by recent consumer association tests (valuable, but not necessarily fully representative of the diversity of products put on the market);

2.4 Consumer expenditure base data

For each of the categories defined in subtask 1.1, determine:

a. Average EU consumer prices, incl. VAT (for consumer prices; streetprice)/ excl. VAT (for B2B products), in Euro.
b. Consumer prices of consumables (detergent, toner, paper, etc.) (€/kg or €/piece);
c. Repair and Maintenance costs (€/product life);
d. Installation costs (for installed appliances only);
e. Disposal tariffs/ taxes (€/product);

For electricity, fossil fuel, water, interest, inflation and discount rates use values for Jan. 2011 in MEErP Chapter 2, including the average annual price increases mentioned there .

For regional differentiation of consumer prices (for sensitivity analysis) also see Chapter 2

2.5 Recommendations

Make recommendations on

2.5.1 refined product scope from the economical/ commercial perspective (e.g. exclude niche markets)
2.5.2 barriers and opportunities for Ecodesign from the economical/ commercial perspective

3 USERS

3.1 System aspects use phase, for ErP with direct energy consumption

Identify, retrieve and analyse data, report on the environmental & resources impacts during the use phase for ErP with a direct energy consumption effect, with impact levels subdivided in

3.1.1 a strict product/ component scope (e.g. steady state efficiency and emissions at nominal load, as in traditional standards)

3.1.2 an extended product approach: considering that the ErP will be subject to various loads/user demands; the product scope could extend to controllability (flexibility and efficiency to react to different load situations, e.g. modulating burner, variable speed drive,'inverter'), the quality of possible controls (sensors, actuators, central processing unit) and/or the quality of auxiliary devices that may or may not be part of the ErP as placed on the market (e.g. separate heat recovery devices such as PFHRD[9])

Examples of possibly important factors to consider, depending on the nature of the ErP, are:

- Load efficiency (real load vs. nominal capacity);
- Temperature- and/or timer settings;
- Dosage, quality and consumption of auxiliary inputs (detergents, paper- and toner use, etc.);
- Frequency and characteristic of use (e.g. hours in on, standby or off mode);
- Identification of use of second hand auxiliary inputs during product life (e.g. toner, recycled paper);
- Power management enabling-rate and other user settings;
- Best Practice in sustainable product use, amongst others regarding the items above.

3.1.3 a technical systems approach: considering that the ErP is part of a larger product system and –through certain features of the ErP—can influence the functional performance and/or the resources use and emissions of that of that larger product system. E.g. central heating boiler regulation influencing indoor temperature fluctuation (discomfort), thus increasing heat demand. Other example: combination and possible synergy from combining strict ErP with other ErP (consumer electronics TV/ PC/ phone/ camera; combi-boiler with both space and hot water heating; hybrid boiler combining gas boiler with heat pump, etc.). Note that this still considers solutions of which the ErP is a physical part.

3.1.4 a functional systems approach: considering that often there are several ways to realize the basic function. E.g. water-based (hydronic) heating systems versus air-based heating systems, various modes of food preparation, etc.. This analysis will often not directly affect a single Ecodesign legislation, but it is of strategic interest to guarantee coherence and consistency between the various ErP being regulated.

3.2 System aspects use phase, for ErP with indirect energy consumption effect

Identify, retrieve and analyse data, report on the indirect environmental & resources impacts during the use phase for ErP with an indirect energy consumption effect (e.g. windows, insultation material, shower head, water taps), specifically

3.2.1 describe the affected energy system(s), i.e. the systems/products whose energy consumption in the use phase of the ErP is influenced by features of the ErP

3.2.2 repeat Tasks 1.2, 1.3 (relevant standards, legislation) and Task 2 (economic and market analysis) for the affected energy system, but only related to technical parameters that relevant for the aforementioned interaction with the ErP and only in as much as they are not already taken into account in Task 1 and 2 for the ErP.

3.2.3 information retrieval and analysis of the use phase energy consumption of the affected energy system (repeat 3.1 but only for the use phase of the affected energy system).

3.2.4 assess the interaction between the ErP and the affected energy system: describe the basic physical/chemcical or other parameters and mechanisms behind the interaction, possible backed-up by statistical data or field trial or laboratory data.

3.2.5 quantify the energy use and the energy-related resources & environmental impacts during the use phase of the affected energy system(s) that is influenced by the ErP, following the outcomes of the relevant parts of Tasks 4 to 7 for the affected energy system.

[9] PFHRD= Passive Flue gas Heat Recovery Device (extracts residual heat from central heating boiler flue gas and uses them for sanitary hot water heating with a high energy saving potential)

3.3 End-of-Life behaviour

Identify, retrieve and analyse data, report on consumer behaviour (avg. EU) regarding end-of-life aspects. This includes:

- 3.3.1 Product use & stock life (=time between purchase and disposal);
- 3.3.2 Repair- and maintenance practice (frequency, spare parts, transportation and other impact parameters);
- 3.3.3 Collection rates, by fraction (consumer perspective);
- 3.3.4 Estimated second hand use, fraction of total and estimated second product life (in practice);
- 3.3.5 Best Practice in sustainable product use, amongst others regarding the items above.

3.4 Local Infra-structure

Identify, retrieve and analyse data, report on barriers and opportunities relating to the local infra-structure regarding

- 3.4.1 Energy: reliability, availability and nature
- 3.4.2 Water (e.g. use of rain water, possibilities for “hot fill” dishwashers);
- 3.4.3 Telecom (e.g. hot spots, WLAN, etc.);
- 3.4.4 Installation, e.g. availability and level of know-how/training of installers;
- 3.4.5 Physical environment, e.g. fraction of shared products, possibilities for shared laundry rooms, etc.

3.5 Recommendations

Make recommendations on

- 3.5.1 refined product scope from the perspective of consumer behaviour and infrastructure
- 3.5.2 barriers and opportunities for Ecodesign from the perspective of consumer behaviour and infrastructure

4 TECHNOLOGIES

Identify, retrieve and analyse data, report on

4.1 Technical product description, illustrated with data on performance, price, resources/emissions impact of

- 4.1.1 Existing products (working towards definition of BaseCases)
- 4.1.2 Products with standard improvement (design) options
- 4.1.3 Best Available Technology BAT (best of products on the market)
- 4.1.4 Best Not yet Available Technology BNAT (best of products in field tests, labs, etc.)

4.2 Production, distribution and end-of-life, specifically regarding

- 4.2.1 Product weight and Bills-of-Materials (BOMs), preferably in EcoReport format (see Task 5)
- 4.2.2 Assessment of the primary scrap production during sheet metal manufacturing
- 4.2.3 Packaging materials
- 4.2.4 Volume and weight of the packaged product
- 4.2.5 Actual means of transport employed in shipment of components, sub-assemblies and finished products[10]
- 4.2.6 Materials flow and collection effort at end-of-life (secondary waste), to landfill/ incineration/ recycling/ re-use (industry perspective)
- 4.2.7 Technical product life (time-to-failure of critical parts)

4.3 **Recommendations** for

- 4.3.1 refined product scope from the technical perspective (e.g. exclude special applications for niche markets)
- 4.3.2 barriers and opportunities for Ecodesign from a technical perspective
- 4.3.3 the typical design cycle for this product and thus approximately appropriate timing of measures

[10] note that the EcoReport 2011 software tool uses average mix of transport modes by type of product. If the ErP deviates substantially from the average transport mix, this can be corrected ex-post. This would give the industry sectors with an environmentally-friendly transport policy (local suppliers, ship instead of airplane) an option to take their effort into account

5 ENVIRONMENT & ECONOMICS

5.1 Product-specific inputs

Choose from the previous tasks the most appropriate information
From all tasks 1 to 4:
Definition of the base case(s) (from all previous Tasks 1 to 4)
with per Base Case

Task 1: The most appropriate test standard for performance and consumption data

Task 2: EU-27 annual unit sales 2010
EU-27 unit stock 2010
Purchase price. the installation costs (specify end-of-life disposal costs comprised in product price)
Repair and maintenance costs
Unitary rates for energy, water and/or other consumables
Discount, inflation, interest rates to be applied
Product service life

Task 3 Annual resources consumption (energy, water, consumables, from Task 3.1) and emissions caused during product life (from Task 3.2);
Product use&stock life, if appropriate (i.e. if deviates substantially from product service life)
As appropriate, multiplier(s) to transform standard test data to real-life consumption data
Average user demand/ load
Collection rate at end-of-life (per fraction if applicable)

Task4 Product weight and Bill-of-Materials (BOM), preferably in EcoReport format (from Task 4)
Primary scrap production during sheet metal manufacturing (avg. EU);[12]
Volume and weight of the packaged product avg. EU;
Selected EU scenario at end-of-life of materials flow for:
- Disposal (landfill, pyrolytic incineration);
- Thermal Recycling (non-hazardous incineration optimised for energy recovery);
- Re-use or materials recycling scenario.

5.2 Base-Case Environmental Impact Assessment.

Using the EcoReport and the above inputs calculate emission/resources categories in MEErP format for
Raw Materials Use and Manufacturing;
Distribution;
Use phase;
End-of-Life Phase.

Furthermore, if more than one type of resource is used in the use phase, make a split-up between resources and their individual impacts.

5.3 Base-Case Life Cycle Costs for consumer

Combining the results from tasks 2 and 3 for the Real-Life Base-Case determine the Life Cycle Costs
LCC = PP + PWF * OE + EoL, where LCC is Life Cycle Costs, PP is the purchase price, OE is the operating expense, PWF (Present Worth Factor) is PWF= {1 – 1/(1+ r) N }/r , in which N is the product life and r is the discount rate minus the growth rate of running cost components (e.g. energy, water rates) and EoL the End-of-Life costs

5.4 EU Totals

Aggregate the Real-Life Base-Case environmental impact data and the Life Cycle Cost data (subtask 5.3 and 5.4) to EU-27 level, using stock and market data from task 2, indicating

5.4.1. The life cycle environmental impact and total LCC of the new products designed in 2010 or most recent year for which there are reliable date (this relates to a period of 2010 up to 2010+product life);

5.4.2 The annual (2010) impact of production, use and (estimated) disposal of the product group, both in terms of the annual environmental impacts and the annual monetary costs for consumers.

6 DESIGN OPTIONS

6.1 Options
Identify and describe (aggregated clusters of) design options to be taken into account (from Task 4, typically 4 to 8 design options are appropriate)

6.2 Impacts
Assess quantitatively the environmental improvement per option using the EcoReport tool. Compare the outcomes and report only on impacts that change significantly with the design options

6.3 Costs
Assess/ estimate price increase due to implementation of these design options, either on the basis of prices of products on the market and/or by applying a production cost model with sector-specific margins.

6.4 Analysis LLCC and BAT

6.4.1 Rank the individual design options by LCC (e.g. option 1, option 2, option 3;

6.4.2 Determine/ estimate possible positive or negative ('rebound') side effects of the individual design measures;

6.4.3 Estimate the accumulative improvement and cost effect of implementing the ranked options simultaneously (e.g. option 1, option 1+2, option 1+2+3, etc.), also taking into account the above side-effects;

6.4.4 Rank the accumulative design options; draw LCC-curves (1st Y-axis= LLCC, 2nd Y-axis= impact (e.g. energy), X-axis= options); identify the Least Life Cycle Cost (LLCC) point and the point with the Best Available Technology (BAT);

6.5 Long-term targets (BNAT) and systems analysis
Discussion of long-term technical potential on the basis of outcomes of applied and fundamental research, but still in the context of the present product archetype;
Discussion of long-term potential on the basis of changes of the total system to which the present archetype product belongs: Societal transitions, product-services substitution, dematerialisation, etc.

7 SCENARIOS

7.1 Policy analysis

7.1.1 Describe stakeholder consultation during preparatory study

7.1.2 Describe barriers (and opportunities) for improvements environmental impact; opportunities for Ecodesign measures (from Tasks 1-4)

7.1.3 Describe pro's and cons of (combinations of) Ecodesign measures and other policy instruments (e.g. self regulation, energy label, EPBD); identify and describe overlaps with exisiting legislation

7.1.4 Select policy measures for further analysis, including timing and target levels, notably the options should

- Be based on the exact definition of the products, according to subtask 1.1 and modified/ confirmed by the other tasks;
- Provide ecodesign requirements, such as minimum (or maximum) requirements[11];
- Be complemented, where appropriate, with (dynamic) labelling and benchmark categories linked to possible incentives, relating to public procurement or direct and indirect fiscal instruments. In case of energy labelling, labelling categories should be proposed;
- Where appropriate, apply existing standards or propose needs/ generic requirements for harmonised standards to be developed;
- Provide measurement requirements, including measurement standards and/or methods;
- Consider possible self-regulation, such as voluntary agreement or sectoral benchmarks initiatives;
- Provide requirements on installation of the product or on user information.]

[11] Ecodesign requirements should always address improvements in terms of environmental performance, not in terms of technologies.

7.2 Scenario analysis

7.2.1 Set up a stock model for the baseline (Business-as-Usual BaU); calculate for the period 1990-2030, preceded by an appropriate built-up period (product life), for the following parameters per year X (X=1990-2030):

a. annual sales in X (from Task 2, with actual and interpolated values), subdivided in new (incl. 1st time users) and replacement sales;

b. annual stock of product (from Task 2)= accumulative sales in X and preceeding L-1 years (L=product life) minus products discarded in actual year (=sales in year X-L);

c. annual stock (number) or impact (e.g. in kWh) of the affected energy system (for indirect ErP);

d. annual net performance demand per unit (from Task 3), including growth rate if appropriate;

e. for significant impacts only: average unitary impact(s) (e.g. kWh energy and/or g emissions per performance unit, directly or indirectly) for products sold; this is the (set of) parameter(s) to be regulated;

f. total impact= stock units x performance demand per unit x unitary impact;

Report in a table showing 5 year intervals

Check the calculated total impact against values from this MEErP-report (when available) or other sources for consistency. Deviations of ± 15% are 'normal'; larger deviations require an explanation and possible adjustment of the stock model.

7.2.2 Calculate for the period 1990-2030 (with qualitative discussion of 2030-2050) for each of the options identified in 7.1.4 a scenario for total annual and accumulative impact of the policy mix, at the given timing and target level(s) (graphs and labels per impact type)

If no other data are available the following values may be assumed:

for the unitary impacts in the years of ('entry into force' minus 1-2 years) and 'implementation of (first) target' use interpolated values between baseline and (first) target

unitary impact levels in periods after target implementation, the impact depends on the policy mix: In the time period after minimum requirements alone, the market is usually assumed to pick up the baseline trend after 1 year; when combined with other measures (e.g. labelling) the trend stays more positive than baseline for at least 5 years. Timely revision of labelling may prolong that period by ca. 3 years

7.3 Impact analysis industry and consumers

7.3.1 Introduce economic parameters in the stock model:

a. Introduce baseline product price (from previous tasks), in Net Present Value for a reference year (e.g. 2010), taking into account inflation rates as given in MEErP

b. Introduce unitary energy, water, consumable rates, annual repair and maintenance costs.

c. Introduce dynamic parameters: inflation rate, growth rate unitary prices (energy, water, etc.)

d. Simplify the relationship between a product's unitary impacts and product purchase price: determine a linear price elasticity from known anchor points (BaseCase, LLCC, BAT) for price and unitary impact.

e. Determine the turnover rate per employment (from Task 2)

f. Determine the cost and margin built-up for the average product (%), with relative shares for OEMs, Manufacturer, Wholesale, Retail, VAT and other tax.

g. Introduce variables and mathematical relations in the stock model as appropriate (see also sensitivity analysis)

7.3.2 Calculate for the period 1990-2030 (with qualitative discussion of 2030-2050) for each of the options identified in 7.1.4 a scenario for total impact of the policy mix, at the given timing and target level(s) (graphs and labels per impact type)

a. EU-27 running costs including and excluding taxes (indicator of utility income and government income from energy/water/etc. VAT and other tax) in Euro2010, 1990-2030

b. EU-27 consumer expenditure, 1990-2030

c. EU-27 annual revenue industry, wholesale, retail, product VAT and other taxes (mln. Euro) in Euro2010, for reference years 2020 ad 2030 (or 2050 instead of 2030 for construction products)

d. indicative share of SMEs, share in industry revenue; qualitative discussion of possible effect

e. employment (no. of jobs) industry, wholesale, retail/installers for reference years 2020 and 2030;

7.4 Sensitivity analysis of the main parameters.

Recalculate selected scenarios for variation in

a. higher and lower (50%) energy prices;

b. higher and lower (50%) elasticity between product price and unitary impact parameter;

c. new target levels or differences in timing as indicated by the Commission services;

d. life cycle costs including societal LCC **:**
Extend the calculation of the base-case Life Cycle Costs for the end-user with the societal costs for emissions indicated in Chapter 6, using the outcome of Task 5.2 (emissions in mass per product over product life) and the monetary values per emission (in €/unit of mass) in Chapter 7
and report on the in-/decrements (in tables)

7.5 Summary

7.5.1 Summarise the main policy recommendations per product

7.5.2 Summarize the main outcomes of the scenarios for Baseline, 2020 and 2030 (2050 for construction products)

7.5.3 Summarize the risk of possible negative impacts on health, safety, etc. in one +/- table

Reporting and highlights per task

In as much as the tasks in the methodology require the use of specific calculation methods, tools and harmonised data, these are provided in the following chapters 1 to 7 (tasks 1 to 7).

The underlying methodology for Ecodesign of Energy-related Products, hereafter 'MEErP' or 'MEErP 2011', is a recast and extension of the previous Methodology for the Ecodesign of Energy-using Products, hereafter referred to as 'MEEuP 2005'.

Although the documentation of the underlying MEErP 2011 is self contained and does not require any knowledge from MEEuP 2005 documents, it may be useful for readers that are familiar with the previous MEEuP 2005 to provide a short overview, highlighting the main differences. Note that a full side-by-side comparison of activities of MEEuP 2005 and MEErP 2011 is provided in the MEErP Project Report.

Compared to former MEEuP 2005, the background information on the description of current state of affairs for environmental impacts was greatly improved, also largely due to new and more comprehensive reporting by the European Environmental Agency (EEA). However, the size of the work would endanger the balance and readability of the report and it was therefore decided to split the report in two parts:

- Part 1 has a focus on the methods, (socio)economic data and contains only the essential environmental data (characterisation factors);
- Part 2 deals with the background environmental policies, LCIA data and quantitative data from past and ongoing preparatory studies.

The underlying Part 1 ('Methods') is similar in structure as the previous MEEuP 2005.

Part 2 ('Environmental policies and data') has a stronger focus on the operational side of the process, providing

- Policy descriptions, targets and sources. It supplies background information and streamlines future preparatory studies that need not to repeat, just update, the policy information;
- Official statistics & trends on resources use & emissions. It supplies the contractors and stakeholders with a means for a 'top-down' approach per resource or emission, to see whether a specific product group and/or sector has been identified for a specific impact category. Thus it is complementary to the results from 'bottom up' EcoReport tool in Part 1, where impact indicators are built from information on materials and processes for a specific product group and increases accuracy of contractor assessments. It will show more clearly

that Ecodesign is not *'just about energy'*[12] , but that in fact the apparent focus on energy or another impact can be explained from the nature of the product.

- Useful default data ('harmonised') on buildings, occupancy, etc. from past/ongoing Ecodesign studies. This aims to streamline future preparatory studies, as well as provide better comparability and a more robust analysis.

The following overview of changes at the level of individual tasks is subdivided by the most important motivations for the changes, i.e. to 'streamline'[13] the studies, to provide an update of existing items and to extend the study with new items, either following the contract or stakeholder input.

Streamlining

In general, the activities are described more clearly and more detailed. They aim to minimize the effort for 'micro-management' and the descriptions are ready-made for application in tender documents. Where appropriate, the first step in a preparatory study is an initial quick scan (Task 0), which aims to set research priorities within the product scope which can already be identified at the outset. For the technical analysis (Task 4) the general description, the technical assessment of a basecase (average product), Best Available Technologies (BAT) and expected future technologies (BNAT) are all combined. Amongst others this means that there is no more separate technical analysis of design options and BNAT. Although this is not completely in line with the linear process, it avoids repetition and allows analysts to write a comprehensive and logical analysis of all technical aspects of the product group.

In Task 2, the new MEErP does not require for every preparatory study to (again) give an overview of energy/water/ etc. rates and escalation (growth) rates. MEErP rates and prices are given for 1.1.2011 and if the growth stays within a bandwidth of 4% per year, the analyst can use –of course with the correct prices for the period under consideration—the default rates (see Chapter 2). Furthermore, as long as the discount rate and the growth ('escalation') rate are more or less balanced, the analyst can use a simple LCC formula that will help the ease of understanding of the analysis by policy makers.

The same will be true for a number of environmental analyses. Due to the results from past preparatory studies and due to efforts from Commission services and bodies, e.g. the European Environmental Agency, the Part 2 report of MEErP was able to supply a large number of EU-wide statistics that allow a 'top down' verification of the environmental analysis. This should reduce the number of disputes over areas with poor data availability, it saves time for the analysts and it enhances the comparability between the results from the various preparatory studies.

Updating

As required by contract, the whole report has been updated for new and updated EU legislation and policies that have been issued in the 2005-2011 period. Over this period, most of the environmental legislation has been recast, with often new emission limit values (ELVs) which thus have resulted in new characterisation factors for most of the Ecodesign environmental indicators. For many policies these updates were subtle, e.g. in the order of 10%, which can be seen as a sign that the underlying analyses and data have become more robust. The update of other directives, such as the amendments to RoHS, involved a higher level of detail in the list of excemptions.

New policies, such as the REACH directive and the strategy for Critical Raw Materials (CRM), were added to the indicators. Analysts that will carry out preparatory studies should consider CRM, if

[12] As was the perception of several stakeholders in the questionnaire (see MEErP 2011 Project Report)
[13] Make them more effective and efficient

applicable, as a new element of the MEErP, for example to check possible design options that substitute or make it easier to recover CRM components.

Also for the end-of-life stage the quantitative analysis has been made much more explicit and requiring new assessments of e.g. the stock-effect and the recyclability of not only electronics (as in MEEuP 2005) but also of some other items.

The accounting tool for the environmental analysis EcoReport has been thoroughly updated and not just by adjusting the unit indicator values with the updated characterisation The new internal structure has been redesigned to allow for easier third party use & maintenance. Also the EcoReport manual has been made more user-friendly. Where it was indispensable, e.g. in the case of electricity, the Ecodesign Unit Indicators have been brought up to date. Legacy indicators, e.g. for ozone depletion (ODP) and emissions of Persistant Organic Pollutants (POPs) to water, have been eliminated.

Unfortunately, not all of the new policies could be incorporated in EcoReport. Especially there where continuous updates of the underlying data are expected, such as with REACH, analysts will be required to make 'manual' analyses to complement the EcoReport assessments.

Finally, although rather an extension than an update, the new MEErP now gives much better guidance as regards the grouping of products (Task 1).

Extending

Most of the new items under the MEErP 2011 are extensions. Most importantly, the methodology has been extended to include not only energy-related products with a direct energy impact during the use phase (previously 'energy-using products' or 'EuP'), but also to include ErP with an indirect impact or both an indirect and direct impact. The principles of this extension as well as several examples are given in Chapter 3.2. Also the EcoReport tool has been extended accordingly with separate sections dealing with the direct and the indirect impacts in the use phase of the product.

Another issue is the distinction between 'extended product' and 'system' approaches. This item has been subject to numerous discussions in the past preparatory studies and the current MEErP provides much more guidance.

A third issue is the analysis of the end-of-life phase, where there has been a considerable extension as regards the quantitative analysis required. This extension has been driven by the new policy priorities as regards the conservation of resources within the European Union. The EcoReport, which in MEEuP 2005 relied more on default scenarios, has been completely reviewed and extended in this respect requiring much more and much more detailed data. In the MEErP Part 2 report as much as possible new background data were supplied on the issue in order to at least give analysts a head-start on the subject.

Task 7 (Chapter 7 of this report) has been completely reviewed. It gives a complete guidelines on how to set up the scenario-, policy- and sensitivity analysis. This should contribute in making the studies more comparable and make sure that this Task 7 results in the required level of analysis for the subsequent stages of the Commission's Impact Assessment.[14]

This is also the aim of the extensions of Task 1 and 2. In Task 1 it is now required to make a comprehensive comparative analysis of all test standards, including all 3rd country test standards, and legislation. In Task 2 a much greater effort should be made to retrieve comprehensive data for

[14] European Commission, IMPACT ASSESSMENT GUIDELINES, 15 January 2009, SEC(2009) 92.

reference years of sales and stock in every EU Member State. Also the time scope is expanded to 2030 (instead of former MEEuP 2025) and 2050 (new). The years 1990 (reference year for measures) and 2020 (reference for many EU strategies) are maintained.

For the economic analysis (Chapter 6) the escalation rate has been introduced, which indicates the expected energy price raise (extrapolated from historical data), which renders the LCC more realistic and at the same time more simple (see 'Streamlining').

A newcomer in the sensitivity analysis is the assessment of societal life cycle costs (Task 7). Monetary indicator values, taken from the latest EEA publication on the subject (Nov. 2011), provide analysts with a means to test the robustness of the Least-Life-Cycle-Cost targets not just from the perspective of the individual customer but also from the viewpoint of external damages (e.g. health impacts).

Finally, the EcoReport tool –apart from accommodating the previous changes-- has been extended to accommodate the wishes of analysts to be able to easily introduce Unit indicators for EXTRA MATERIALS through an extra data input sheet. In the RESULTS sheet, there is a table that presents the total impacts of the product as a fraction of the EU-27. For this the normalisation Table 24 is used. The result helps to give an immediate impression whether and on which impacts the product score can be called 'significant'.

The following chapters first repeat the Task structure from this chapter as a reminder and then give only guidance on the parts where it is needed. It assumes that the analyst will be capable of executing standard information data retrieval and analysis and will have the technical engineering know-how that is required.

1 TASK 1: SCOPE

Task 1. SCOPE

1.1. Product Scope

1.1.1 Identify relevant
- a Prodcom category or categories (Eurostat);
- b categories according to EN- or ISO-standard(s);
- c labelling categories (EU Energy Label or Eco-label), if not defined by the above.

1.1.2 Define preliminary product scope, including preliminary product definitions, taking into account that categorisation shall preferrably be linked to primary performance parameter (the "functional unit") if needed sub-categorsation can take place on the basis of secondary performance parameters and for indirect ErPs the affected energy system(s)

1.2. Test standards (EU, Member State and third country level)

1.2.1 Identify and shortly describe
- 1.2.1.1 EN or ISO/IEC test standards
- 1.2.1.2 Mandates issued by the European Commission to the European Standardisation Organisations (ESOs)
- 1.2.1.3 if applicable, test standards in individual Member States
- 1.2.1.4 where relevant, third country test standards (e.g. ASHRAE, ANSI, JIS, etc.)

regarding the test procedures for
- a primary and secondary functional performance parameters under 1.1
- b resources use (energy and materials, incl. waste) and emissions
- c safety (inflammatbility, electric safety, EMC, stability, etc.)
- d noise and vibrations (if applicable)
- e other product-specific test procedures possibly posing barriers for Ecodesign measures

1.2.2 Do a comparative analysis for overlapping test standards on performance, resources use and/or emissions

1.2.3 Analyse and report on
- a new test standards being developed (describe major changes)
- b possible problems on accuracy (tolerances), reproducibility and to what extend the test standards reflect real-life; draft outlines of mandate(s) to the ESOs as appropriate.
- c differences between standards covering the same subjects (comparative analysis)

1.3 Legislation (EU, Member State and third country level)

Identify and shortly describe the relevance for the product scope of
- 1.3.1 EU legislation (legislation on resources use and environmental impact, EU voluntary agreements, labels)
- 1.3.2 Member State legislation (as above, for legislation indicated as relevant by Member States), including a comparative analysis.
- 1.3.3 Third country legislation (as above, for third country legislation), including a comparative analysis

Product grouping, i.e. the exact definition of products to be included in a study or a measure, has played a very important role, not only during the whole of the preparatory studies but also before - i.e. in the tender stage - and after - during the design of legislation. This chapter tries to give some guidance on the subject which is part of Task 1.

In former MEEuP 2005 (par. 3.3.8) referring to ISO 14040 it was mentioned that the overriding principle for life cycle assessment - and thereby the clustering products - should be a quantifiable "*functional unit*". Ideally this means that the function of e.g. a refrigerator is the preservation of perishable food stuffs, a lamp should give light and a dishwasher should clean dishes. This should be the yardstick for clustering products in one preparatory study and apply specific Ecodesign measures that are technology-neutral. For instance, all products that serve domestic preservation of perishable foods should be brought into one cluster.

However, in the past Ecodesign studies, products were clustered as indicated in EN test standards and/or PRODCOM categories[15] , which are usually not technology-neutral. In fact, traditionally most EN standards and PRODCOM do aim to promote innovation, but try to avoid that unsafe and functionally inadequate products are placed on the market, very often by setting the features of best practice products as mandatory requirements. Although this is a very laudable and useful goal, it is not necessarily the best way to promote step-change innovation.

A classic example, outside the world of ErP, is the design of castor-wheeled and swivelled office chairs. In the 1950's when these products came on the market in larger volumes, the stability of the chairs was a concern. Especially with 4-legged office chairs, users tended to tip over when reaching out to grab certain items. As a result the test standard did not (or not only, depending on the standard) design a stability test for office chairs, but simply prescribed that all castor-wheeled office chairs should have 5 legs: End of discussion. But this also implied the end of innovation into all sorts of alternative ways to solve the stability problem and in fact there has been no innovation in this field ever since.

An example from the world of ErP is the refrigerator, intended to preserve perishable foodstuffs and serve drinks at the right consumption temperature. The current test standard prescribes that a domestic refrigerator is nothing more than a cooled storage volume of 5 °C at an ambient temperature of 20 °C. It misses the point of its functionality: Providing a single temperature cold storage volume is only one way of preserving food and thus the analysis misses out on several innovative solutions that would both increase performance and reduce the environmental impact of domestic food preservation. In fact, all sorts of new ideas like CO_2-protection, anti-bacterial aids, instant cooling, etc. are only met by reservation not only from the marketing directors, that don't see these features rewarded e.g. in an energy label, but also by green NGOs that perceive only the possible negative environmental impact. Without a test standard depicting also the positive side of e.g. silver-ions in the fridge lining, like avoiding the waste of a certain fraction of meat and other perishables, these new solutions will have a hard time to survive in the market.

Only when the test standard would step away from cooling as the one and only technical solution, there is room for step-change innovation. Of course this will not be easy. Accurate and reproducible testing of a certain quantity and variety of foodstuff test samples to determine which product does the best job in preserving the food-quality requires time and effort.

On the other hand, it is encouraging that most of the Ecodesign studies and measures have at least served as a catalyst for changing the test standards in the right direction.

For washing machines, which already implemented wash performance testing using artificial soiling samples, the new measures with lower temperature cycles are a further step in the right direction. For components such as motors, fans and circulators the Ecodesign measures implement, in the test standards or as a supplement, a move away from the full-load steady state testing and towards varying part-load profiles. For televisions new test standards have been developed allowing a more life-like evaluation of picture quality and energy. In space heating, space cooling and lighting fixtures the 'system approach', which is just another name for a more comprehensive evaluation of performance, is –albeit slow and incomplete-- starting to prevail over narrow product testing.

[15] Eurostat database for EU production

Within the Ecodesign preparatory studies - amongst others due to the technology-oriented approach - the functional performance has given rise to several complications:

a) product groups with multiple, alternative functionality (e.g. heating OR cooling mode, space heating OR water heating mode);

b) product groups with multiple, simultaneous functionality (e.g. ventilation AND cooling, grilling AND micro-wave, but also with the option of 'ventilation only' or 'micro-wave only');

c) product groups with the same basic performance parameter but at different capacity/sizes/intensities (e.g. domestic refrigerators and freezers with 10 sub-categories depending on the cabinet temperature and freezing capacity)

d) product groups with both integrated products and products with a modular built-up. The former usually applies to mass-produced and smaller sizes/capacities and the latter refers to smaller production series and bigger sizes/capacities (e.g. typical of most HVAC products[16]). The integrated product performance can (only) be tested as a whole; the modules are usually tested at their own partial contribution to the main function and/or –to guarantee comparability with integrated products-- testing applies to specific configurations

e) product groups that are parts/components/subassemblies. By definition the tested parameter can only be a very distant reflection of what happens in reality when the part/component is used for a specific application (e.g. efficiency of electric motors and industrial fans tested at constant speed, whereas good part-load behaviour – e.g. variable speed drive options—may be more important in practice).

f) product groups where the performance unit is a mix (weighted average) of operating modes occurring in practice (e.g. washing machines tested at a mix of washing cycles with different temperature settings, circulator pumps tested at a weighted mix of part-loads).

g) product groups where the basic performance unit is the same, but where wide differences in impact may occur due to operating conditions (e.g. 'climate' in case of space heating and cooling).

h) product groups with the same basic functionality but with many different technologies and test standards (e.g. central heating boilers, which can be gas-fired, oil-fired, heat pump driven, CHP-driven, electric resistance driven, etc. with for some sectors simple steady state tests and for other sectors seasonal efficiency weighted part-load testing).

i) product groups with a functionality that is not (easily) quantifiable (e.g. aesthetics of lighting fixtures/ luminaires, lighting quality of LED light sources).

j) product groups where there are no test standards for function performance or where the current test standards are under review (e.g. room air conditioners, LED light sources, vacuum cleaners, industrial fans, etc.).

As it turns out, in many cases the test standards are the key to a successful study and key to effective measures. Based on the experience in the past preparatory studies, the following guidelines can be given:

[16] HVAC= Heating Ventilation Air Conditioning

ad a. and b.

Multiple functionality

In case of multiple functionality, the Ecodesign measures should address and set minimum requirements for each functional parameter individually (not e.g. design a weighted average parameter).

In case of two roughly equivalent functions (heating and cooling, space heating and water heating) not only the minimum requirements should be addressed individually but also the scope of accompanying measures (e.g. two energy labels for one product). In the case that there are also products on the market that offer just one function (heating only, water heating only, etc.) this is the only way to create a level playing field for manufacturers and transparency for the consumer. And in that case the preparatory study should be split in two individual studies.

In case there is a clear primary function, the rating in accompanying measures has a focus on this main parameter (one energy label for one product) with separate information requirements for the secondary functions (e.g. noise, spin drying efficiency in a washing machine, etc.).

ad c.

Different capacities

In case a product group offers models differing widely in capacity/size/ intensity of the functional performance, the standard solution is to create appropriate (sub) categories. Consumer associations point out that should two categories be consumer-relevany (and not based on a domestic/commercial divide, for instance) the risk remains that products accomplishing the same function are not labelled on the same basis, thereby confusing consumers.

Another option, but less preferable, is to use the capacity or size itself as the functional unit. E.g. in the case of washing machines where the energy efficiency is measured in electricity use per kg of load capacity (in kWh/kg). Another example is domestic refrigeration where –despite the fact that also categories are used based on the cooling temperature and freezing capacity— the functional unit is in kWh electricity per unity of cabinet volume. In both cases there is a risk that this leads to larger appliances being more “efficient” (per capacity unit) than smaller ones, but with negative consequences for the environment because the absolute energy use increases. The remedy is in non-linear correction formulas, but the risk still remains.

ad d.

Integrated and modular products

The case with smaller capacity integrated products and larger capacity modular products is quite common in most products that are used both in a domestic and non-domestic ambient. The solution will depend on the share of the modular product in the total:

If the share is relatively small, e.g. 5-10% of the market, and the number of possible combinations limited then it might be sufficient to test pre-mounted modular configurations as they are placed on the market and ignore (not regulate) that also the modules themselves are placed as separate products/parts on the market and would be mounted by e.g. installers. The question whether the market share is small depends on the choice of the upper capacity limit of the scope which should be chosen wisely.

In case the products-built-from-modules represent a larger market share, set the Ecodesign requirements both at the level of the technical performance of the module (if possible) and at the level of pre-mounted products.

In case the products-built-from-modules represent almost all the market, set the requirements for the modules only. Regulation of the complete product, built from individual modules placed on the market, should then take place through (non-Ecodesign) legislation that regulates the products

- at the level of combinations offered by the installer/retailer (the so-called installer label),
- at the level of (building) permits (e.g. EPBD),
- after installation (e.g. EPBD certification, operating permits).

ad e.
Parts
In case the products are parts, components or sub-assemblies the same applies as for the modular products. Within Ecodesign only generic performance parameters can be tested, but this is usually a distant reflection of the actual performance when the part is used in a product and can never be a substitute testing of the full product ('good' individual parts don't always make a 'good' product). In this case at least a very serious attempt should be made to find/develop test standards that reflect the conditions in the future real-life application as truthful as possible. In many cases this will mean that in the tests the parts should be subject not only to steady state mode tests at full capacity but also to part load tests with possibly (depending on the product design) on-off behaviour.

ad f.
Mix of 3 or more operating modes
In case the performance of the whole product is a mix of operating modes, the main problem will be to find on one hand weighting and test conditions that are close to real life and on the other hand test procedures that are accurate, reproducible and affordable. Once this is established, which may involve a major effort, the rest of the preparatory study is relatively unproblematic.

ad g.
Different operating conditions (climates)
The problem of climatic differences influencing performance was eventually solved in several studies, in consensus with the stakeholders. As a first step, three climates are defined in terms of the frequency of the outdoor temperatures and solar irradiance: Average climate (meteo data from Strassbourg, F), Warmer climate (Athens, GR) and Colder climate (Helsinki, FI). For minimum Ecodesign requirements the Average climate is used. For the other climates Ecodesign information requirements apply, which can then be used in complementary measures (e.g. labeling). This approach is part of the work on practically all space heating and cooling devices and should also be used in other climate-dependent performance parameters.

ad h.
Identical function, different technology
The case of practically identical performance parameters with several different technologies is probably the most promising in terms of saving potential but also by far the most complex. It involves the differences between (industry) stakeholders, technical languages, national habits, test standards, perceived good practices, and multitudes of test standards. This is what happened with central heating boilers (gas-fired, oil-fired, electric resistance, heat pump driven, cogeneration-driven, solar-assisted and all their possible combinations) and - to a lesser degree - between electric and non-electric water heaters.

Although the decision making process is still ongoing, a few lessons can be drawn from what is now a 5 year experience:

- there is no standard solution, as the process is as much political as technical. Every industry sector - large or small, old or new - will initially perceive the common functional parameter as a threat and not as an opportunity. The basic approach is a thorough technical, comparative analysis of all the different test standards, find common denominators and principles with the stakeholders, develop accounting rules on this basis and draft first proposals for criticism.
- the market transformation of this type, where markets think in terms of function instead of their own technology, is slow and will take one or two decades
- the real time and effort for preparation of measures is proportionate to the number of different technologies, i.e. 5 times more than a normal preparatory study for boilers, 2-3 times more than the usual for water heating.
- The prevailing motivator to anyway adapt the product catalogue in the direction of possibly upcoming Ecodesign measures is usually anticipation of legislation. Therefore, already during the preparation of measures, there should be enough time for industrial stakeholders to develop new products and move their catalogue in the anticipated direction of measures. Otherwise, consensus is almost impossible.
- Every industrial interest group will have their input usually –as experience shows-- not only simultaneously but consecutively, despite the fact that a representative expert group was chosen initially. E.g. with boilers in 2006 the discussions were dominated by representatives from the gas- and oil-fired boiler industry, in 2007-2008 the controls industry, in 2007-2009 the heat pump industry, 2008-2009 the cogeneration industry, in 2009-mid 2010 the solar industry and then in 2010-2011 again the gas- and oil-fired boiler industry.
- The subjects of discussion are often very specialist and technically complex and therefore difficult to communicate to decision makers, yet may –and usually are-- very important for whether a saving potential is achieved or not ('the devil is in the detail'). Therefor it is indispensable that either the decision makers themselves or specialists in their service acquire or have the technical knowledge to make the right decision.

ad i.
Non-quantifiable functionality

Generally speaking, if a substantial part of the functional unit is not quantifiable then it is very difficult to propose quantitative minimum Ecodesign requirements. An example is the efficiency of domestic luminaires, which for sure is quantifiable (e.g. in lm/W) but where the legislator cannot propose a minimum without objections from citizens. Requirements should be modest (if any) and mainly directed at product information requirements that can subsequently be used in other policy instruments (e.g. labeling, perhaps incentives).

The aesthetical function extends not only to design objects, historical buildings and any other 'cultural' products, but also to more intangible aspects like 'light', 'taste' and many more functions where - without a clearly superior functional alternative - citizens would feel the legislator is limiting their consumer choice. Ecodesign information requirements - with consequent labeling and the promotion of incentives - would appear to be the most important way forward, leaving the ultimate choice to the consumer.

Consumer associations caution about the fact that too often hypothetical "citizens' concerns" are raised by interested parties to prevent the adoption of strong requirements. In reality, they argue, consumers are not put off by a limitation of "consumer choice" but because of the sub-par quality of the alternative options (e.g. CFLs in the case of lioght sources). Therefore the argument of 'non-quantifiable functionality' should be used sparingly, i.e. only where the cultural and historical values are truly dominant and/or no suitable alternatives exist, in order to avoid this loophole.

ad j.

Functionality test standards under review

Product groups where the test standards are under review is a very common situation. In many ways, this is an ideal situation showing that the industrial stakeholders recognize that the current standards - when used in mandatory legislation - would be inadequate. In other situations, especially if the revision process is stretched over many years, many of the initially noble reforms tend to mix with the vested interests of individual companies. It requires technical knowledge of the Commission and/or its advisers to recognize these situations. Especially if a test standard is not finalized at the time of publication of an Ecodesign Regulation, the Commission may publish a transitional method which is intended to be used by industry while waiting for the new test standards to become fully accepted. In this context the Ecodesign Horizontal Mandate to CEN/CENELEC should be mentioned.

Finally, there is a disadvantage that there are vey few, if any, tested values on which the preparatory study can base its assessment of targets (or suitable class limits for energy labeling, if appropriate).

2 TASK 2: MARKETS

2 MARKETS

2.1 Generic economic data

Identify and report

a. EU Production;
b. Extra-EU Trade;
c. Intra-EU Trade;
d. EU sales and trade= production + import - export.

Data should relate to the latest full year for which at least half of the Member States have reported to Eurostat. Preferably data should be in physical volume (e.g. units) and in money units and split up per Member State. Information for this subtask should be derived from official EU statistics so as to be coherent with official data used in EU industry and trade policy.

2.2 Market and stock data

In physical units, for EU-27, for each of the categories as defined in 1.1 and for reference years

a. 1990 (Kyoto and "20-20-20" reference);
b. 2010 (or most recent real data);
c. 2013-2016 (forecast, presumable entry into force of measures);
d. 2020-2030-2050 (forecast, years in which all new ecodesigns of today will be absorbed by the market).

the following parameters are to be identified:

a. Installed base (“stock”) and penetration rate;
b. Annual sales growth rate (% or physical units);
c. Average Product Life (in years), in service, and a rough indication of the spread (e.g. standard deviation);
d. Total sales/ real EU-consumption, (also in €, when available);
e. Replacement sales (derived);
f. New sales (derived).

2.3 Market trends

2.3.1. General market trends (growth/ decline, if applicable per segment), trends in product-design and product-features.

2.3.2 Market channels and production structure; identification of the major players (associations, large companies, share SMEs, employment);

2.3.3 Trends in product design/ features, illustrated by recent consumer association tests (valuable, but not necessarily fully representative of the diversity of products put on the market);

2.4 Consumer expenditure base data

For each of the categories defined in subtask 1.1, determine:

a. Average EU consumer prices, incl. VAT (for consumer prices; streetprice)/ excl. VAT (for B2B products), in Euro.
b. Consumer prices of consumables (detergent, toner, paper, etc.) (€/kg or €/piece);
c. Repair and Maintenance costs (€/product life);
d. Installation costs (for installed appliances only);
e. Disposal tariffs/ taxes (€/product);

For electricity, fossil fuel, water, interest, inflation and discount rates use values for Jan. 2011 in MEErP Chapter 2, including the average annual price increases mentioned there .

For regional differentiation of consumer prices (for sensitivity analysis) also see Chapter 2

2.5 Recommendations

Make recommendations on

2.5.1 refined product scope from the economical/ commercial perspective (e.g. exclude niche markets)
2.5.2 barriers and opportunities for Ecodesign from the economical/ commercial perspective

2.1 Introduction

For most tasks in the Methodology, economical calculations are vital. Also, following stakeholder comments (Project Report), there have been requests for more guidance and harmonised energy, water and other rates.

Paragraph 2.2 gives the relevant calculation method for apparent consumption. Paragraphs 2.3 to 2.8 give prices and growth rates of energy, water, inflation and interest as well as some guidance on the purchase price and installation costs.

2.2 Sales and Trade

MEErP Task 2 requires the assessment of the apparent EU-27 sales and trade from Eurostat data on production (PRODCOM) and extra-EU trade (HS8 classification). Stock effects are assumed negligible.

In formula:

EU-27 Sales and trade = EU-27 PRODUCTION + EU-27 IMPORT – EU-27 EXPORT

Data is to be shown both in volume and in value, whereas "volume" is explicitely required in Article 15 of the Ecodesign Directive and "value" is an additional information for the impact assessment. Values relate to the manufacturer selling price (msp), not to the end consumer price. Volumes are mostly given in product units, but in some cases may be expressed in product weight (kg).

As mentioned by many stakeholders, Eurostat data for these particular items are usually not very reliable for the analysis of individual products, but they do represent the official source for EU policy and as such are a valuable to the policy makers.

2.3 Energy rates for private households

The energy rates given here are valid for Jan. 2011. As is elaborated in Chapter 7, it is proposed to use these rates in all preparatory studies studies, adjusted with an overall escalation rate of 4%/a (energy price growth rate corrected for inflation).

Boundary condition is that the real inflation-corrected energy prices growth rates do not deviate more than 1%-point from the given 4%. If that happens, the differentiated LCC calculation with actual prices should be followed.

Apart from simplifying the calculations, the largest advantage of this approach is that the monetary outcomes of all studies will be comparable.

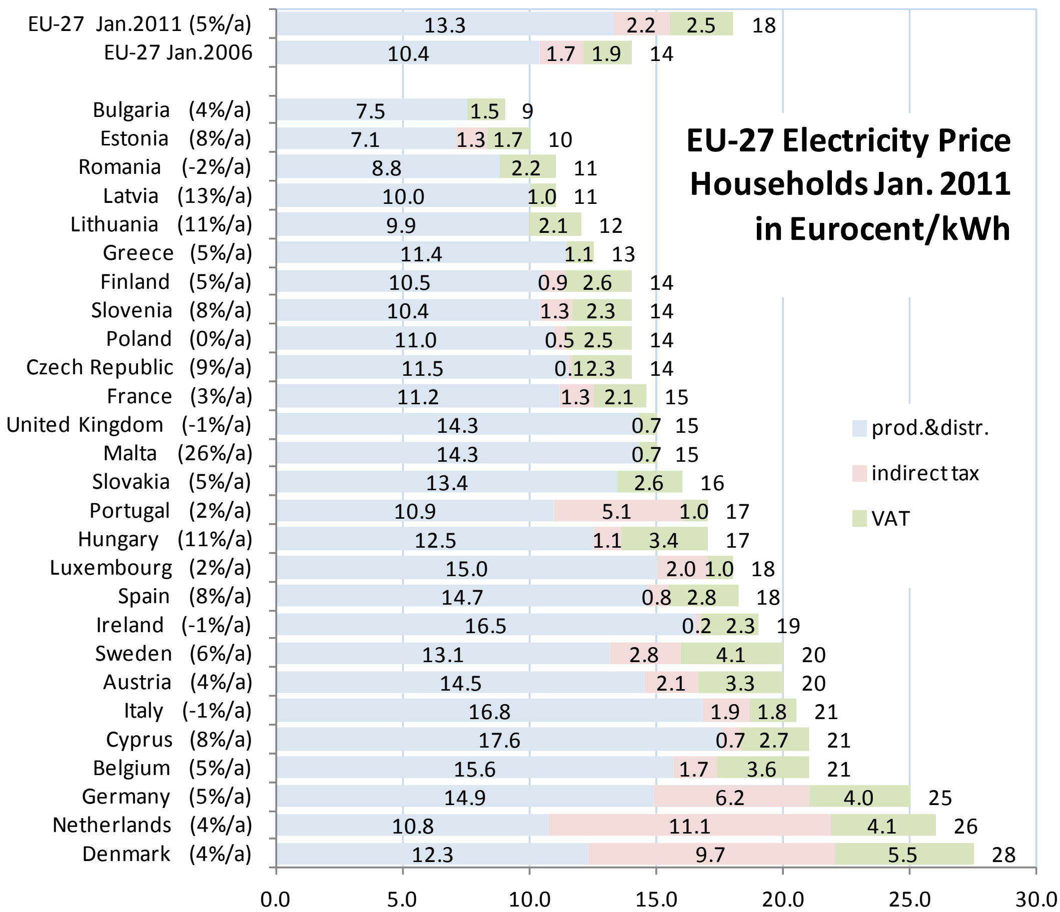

Figure 2 EU-27 Electricity prices households Jan. 2011 (recent annual growth rates in brackets, in %/a)

Sources: Eurostat, nrg_pc_204, (consumption 2500-5000 kWh/a). (extract March 2011), supplemented by
NL: CBS Statline, Elektriciteitsprijzen (extract March 2011) [data NL]
FR: http://www.observatoire-electricite.fr/2010/node/68 , Electricity prices households in constant Euro 2009.

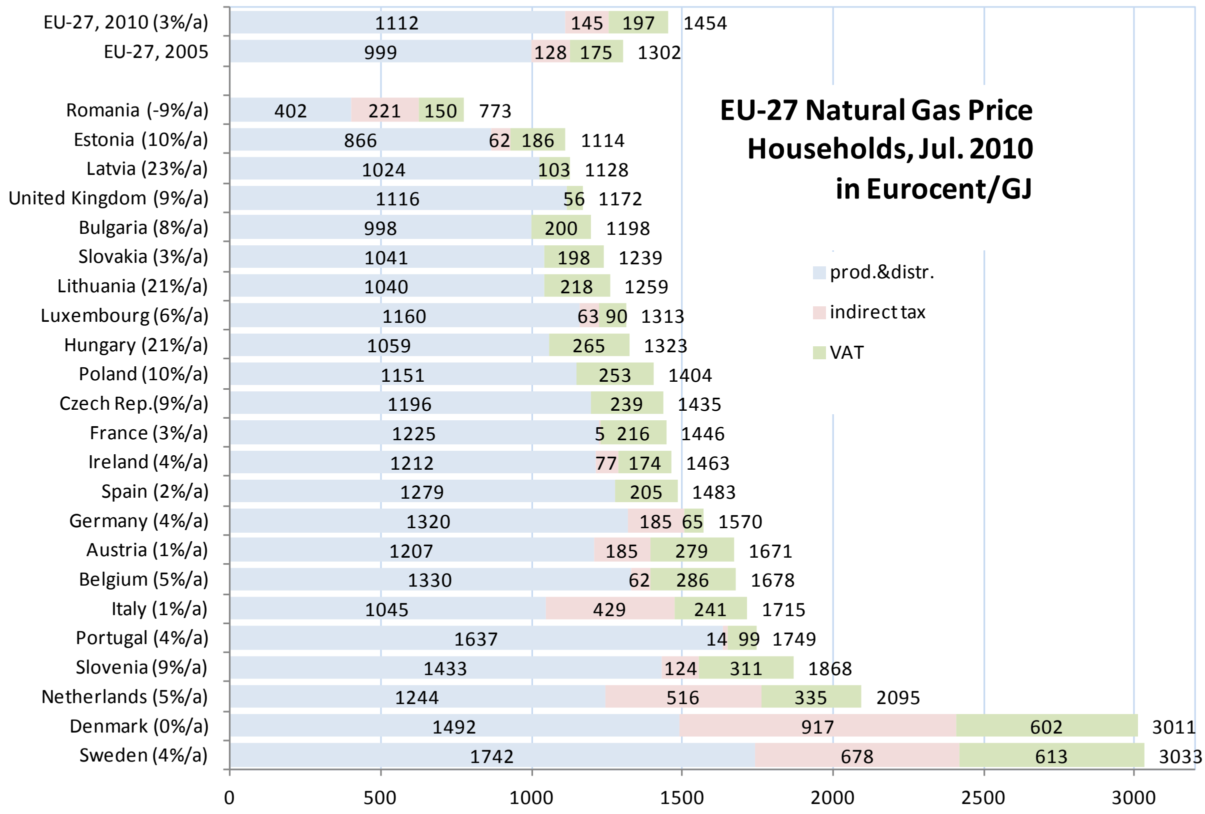

Figure 3 EU-27 Natural Gas Price Households, July 2010, in Eurocent/GJ. (in brackets annual growth rate in %/a)

Source: Eurostat, database table nrg_pc_202

Prices for annual consumption between 20 and 200 GJ. GJ is measured in Net Calorific Value (NCV)
Annual growth rate based on average price increase 2005-2010; for BG and RO based on 2008-2010.
Note that no prices are given for Malta, Greece, Cyprus and Finland, because there is no gas distribution grid.
Note that IEA price trends are higher than Eurostat (avg. EU >4%/a).

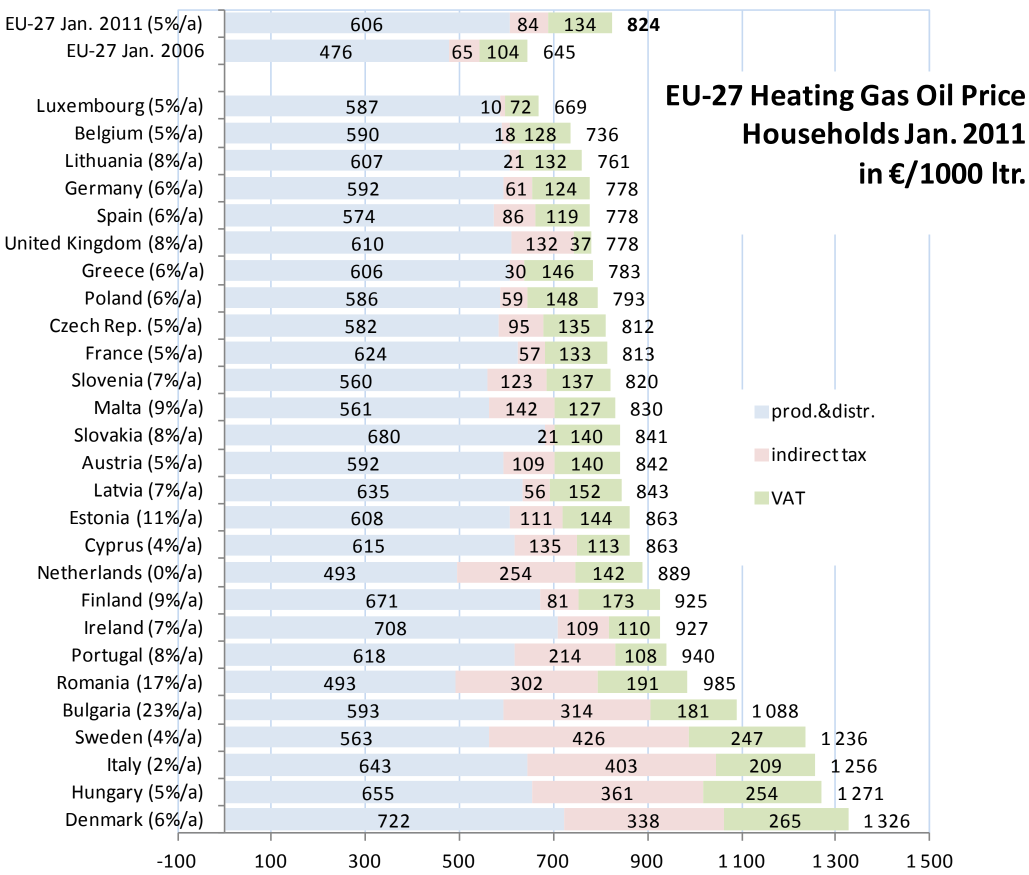

Figure 4 Heating gas oil prices, households, EU-27, Jan. 2011 (annual growth in %/a in brackets

Source: European Community, Oil Bulletin 1538 (3.1.2011) (http://ec.europa.eu/energy/observatory/oil/bulletin_en.htm)
Delivered consumer prices in €/1000 L for deliveries of 2 000 to 5 000 litres;

Annual price growth rates –in brackets, following country name—are averages over the period Jan. 2006 – Jan. 2011. Exceptions are Bulgaria and Romania where the average growth rates relate to the period Jan. 2008-Jan. 2011 (i.e. could be higher than indicated).

Conversions

1 m^3 natural gas (UK, NL) = 35.2 MJ (GCV) = 31.7 MJ (NCV)

1 kg heating gas oil= 42.5 MJ (NCV) = 44.8 MJ (GCV) . Note: NCV varies between 42.2 and 42.8 MJ/kg

1 ltr heating gas oil= 0.85 kg (varies between 0.82 and 0.87) = 36.1 MJ (NCV) = 38 MJ (GCV)

1 kWh = 3.6 MJ

Examples EU-27 average:

Heating gas oil € 824/ 1000 ltr.= € 19.39/ GJ (NCV).

Compare: natural gas € 14.54/GJ. → heating gas oil is 34% more expensive per GJ (NCV) than natural gas.

Compare: electricity € 0.18/kWh = € 50.-/GJ → 2,5 times more than oil and almost 3 times more than gas per GJ (NCV).

2.4 Energy rates for industry

Table 2. Industrial electricity and gas prices, EU-27, Jan. 2008- Jan. 2010 (excl. VAT)

	Electricity prices			Gas prices (per GJ)		
	Industry (1)			**Industry (2)**		
	2008 s1	2009 s1	2010 s1	2008 s1	2009 s1	2010 s1
EU-27	0.10	0.11	0.10	9.42	9.99	8.44
Euro area (EA-16)	0.10	0.11	0.11	9.93	10.55	8.90
Belgium	0.11	0.11	0.11	9.15	9.04	7.93
Bulgaria	0.06	0.06	0.06	5.72	8.74	6.66
Czech Republic	0.11	0.11	0.10	8.87	9.29	8.56
Denmark	0.09	0.09	0.09	:	15.43	15.81
Germany	0.11	0.11	0.11	12.40	11.98	10.10
Estonia	0.06	0.06	0.07	6.97	7.50	8.00
Ireland	0.13	0.12	0.11	11.05	9.30	7.83
Greece	0.09	0.09	0.09	:	:	:
Spain	0.10	0.12	0.12	7.64	8.70	7.70
France	0.07	0.07	0.07	9.23	10.01	9.19
Italy	0.14	0.15	0.14	9.34	11.08	8.24
Cyprus	0.14	0.12	0.15	:	:	:
Latvia	0.07	0.09	0.09	7.92	10.87	7.17
Lithuania	0.08	0.09	0.10	8.79	8.73	8.91
Luxembourg	0.10	0.12	0.10	10.49	11.21	10.26
Hungary	0.11	0.12	:	9.69	10.31	:
Malta	0.12	0.15	:	:	:	:
Netherlands	0.10	0.11	0.10	9.61	10.64	8.96
Austria	0.11	:	:	:	:	:
Poland	0.09	0.09	0.10	8.36	7.73	8.40
Portugal	0.09	0.09	0.09	8.69	9.81	7.62
Romania	0.09	0.08	0.09	7.79	6.52	6.19
Slovenia	0.09	0.10	0.10	10.12	12.13	10.53
Slovakia	0.12	0.14	0.12	8.92	11.30	9.11
Finland	0.06	0.07	0.07	7.90	8.50	8.40
Sweden	0.07	0.07	0.08	14.37	10.96	12.26
United Kingdom	0.10	0.11	0.10	7.73	8.35	5.94

(1) Annual consumption: 500 MWh < consumption < 2.000 MWh
(2) Annual consumption: 10.000 < consumption < 100.000 GJ
:=not available
Source: Eurostat (nrg_pc_205, nrg_pc_203)

Table 3 . Petroleum products prices including and excluding tax, Jan. 2011, EU-27

MS	Euro-super 95 (I), in Euro/1000 L				Automotive gas oil 'Diesel' (I), in Euro/1000 L				LPG motor fuel, in Euro/1000 L				Heavy Fuel Oil (S<=1%) (III), in Euro/ton		
	ex tax	in-direct tax	VAT	incl. tax	ex tax	in-direct tax	VAT	incl. tax	ex tax	in-direct tax	VAT	incl. tax	ex tax	in-direct tax	incl. tax
AT	540	525	213	1 278	585	436	204	1 225					411	68	479
BE	612	614	257	1 483	638	393	216	1 247	599	0	126	725	376	15	391
BG	573	363	187	1 123	605	314	184	1 103	448	94	108	650		0	
CY	613	370	147	1 130	640	341	147	1 128					549	21	570
CZ	606	512	224	1 341	653	436	218	1 307	476	86	112	674	321	19	340
DK	648	571	305	1 523	655	396	263	1 314					428	404	832
EE	572	423	199	1 194	618	393	202	1 213	458	70	106	633		0	
FI	603	611	279	1 493	701	330	237	1 268						0	
FR	592	606	235	1 433	615	428	204	1 247	618	60	133	810	418	19	437
DE	580	655	235	1 469	632	470	209	1 312	502	92	113	707		0	
GR	613	682	298	1 593	706	425	260	1 391					459	26	486
HU	601	443	261	1 305	655	361	254	1 271	520	93	153	766	412	27	438
IE	525	563	229	1 317	573	469	219	1 261					296	82	378
IT	634	564	240	1 438	670	423	219	1 312	499	125	125	750	439	31	470
LV	597	379	215	1 190	635	330	212	1 176	365	127	108	600		0	
LT	607	434	219	1 260	641	302	198	1 141	404	167	120	692		0	
LU	613	462	161	1 236	637	310	142	1 089	573	54	38	665		0	
MT	641	469	200	1 310	643	382	185	1 210					537	30	567
NL	607	720	252	1 579	654	438	207	1 299	629	91	137	857	374	33	407
PL	569	419	227	1 216	620	325	218	1 163	420	116	123	659	456	16	472
PT	620	583	277	1 480	674	364	239	1 277	546	55	138	740	563	15	578
RO	583	359	226	1 168	626	302	223	1 150	419	67	117	603	501	15	516
SK	595	505	220	1 320	643	360	201	1 203	443	-4	88	527	335	27	362
SI	570	482	211	1 263	605	422	206	1 233	575	79	131	785	436	75	511
ES	622	443	192	1 257	660	346	181	1 187	521	32	100	653	410	15	425
SE	571	618	297	1 486	669	486	289	1 443					501	462	964
UK	549	659	242	1 450	591	658	250	1 499						0	
EU	**588**	**588**	**244**	**1 420**	**637**	**424**	**220**	**1 280**	**501**	**78**	**115**	**694**	**437**	**56**	**493**

source: European Commission Oil Bulletin 1538 (3.1.2011) Prices with taxes 3.1.2011 in Euro, 2011 (http://ec.europa.eu/energy/observatory/oil/bulletin_en.htm)

Note 1: Eurosuper and automotive gas oil may be used in mobile machinery. LPG is used in heating and bottled gas applications (e.g. for cooking). Heavy fuel oil (a.k.a. residual fuel oil or HFO) is not used in domestic applications. It can only be used by facilities that have preheating capabilities (power plants, ships, etc.). Table above shows only prices for HFO with sulphur content S<=1%. HFO with S>1% is only available in a few countries, with the following end-prices (in Euro/t, incl. tax) : **BG** 466; **LT**: 395; **PL** 398; **SK** 355.

Note 2: EU averages for LPG are straight averages (no weighting)

Note 3: (I) = pump prices; (III) = Delivered consumer prices for offtakes of less than 2 000 tonnes per month or less than 24 000 tonnes per year (for Ireland, deliveries of 500 to 1 000 tonnes per month)
Empty cells mean that data are not available. '0' means that data are available but the rounded value is zero (value<0.5).

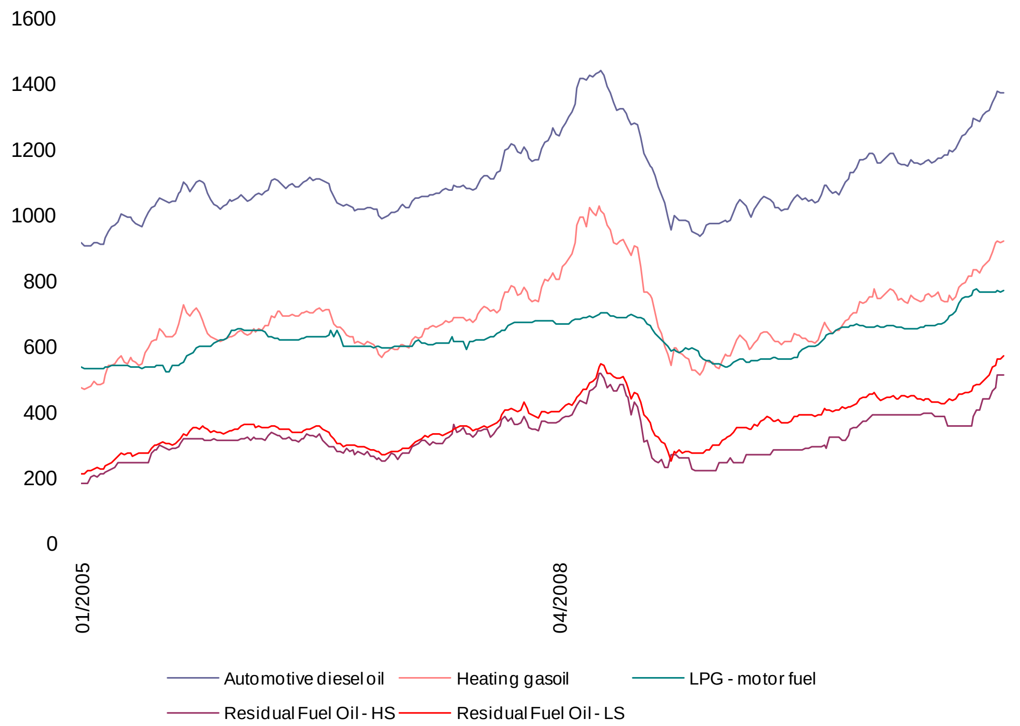

Figure 5 Consumer prices of petroleum products inclusive of duties and taxes - Eurozone weighted average – 2005-2011, in Euro per ton (Residual Fuel Oil) or per 1000 litres (other products).

Source: EC, Oil Bulletin, prices history, 2011

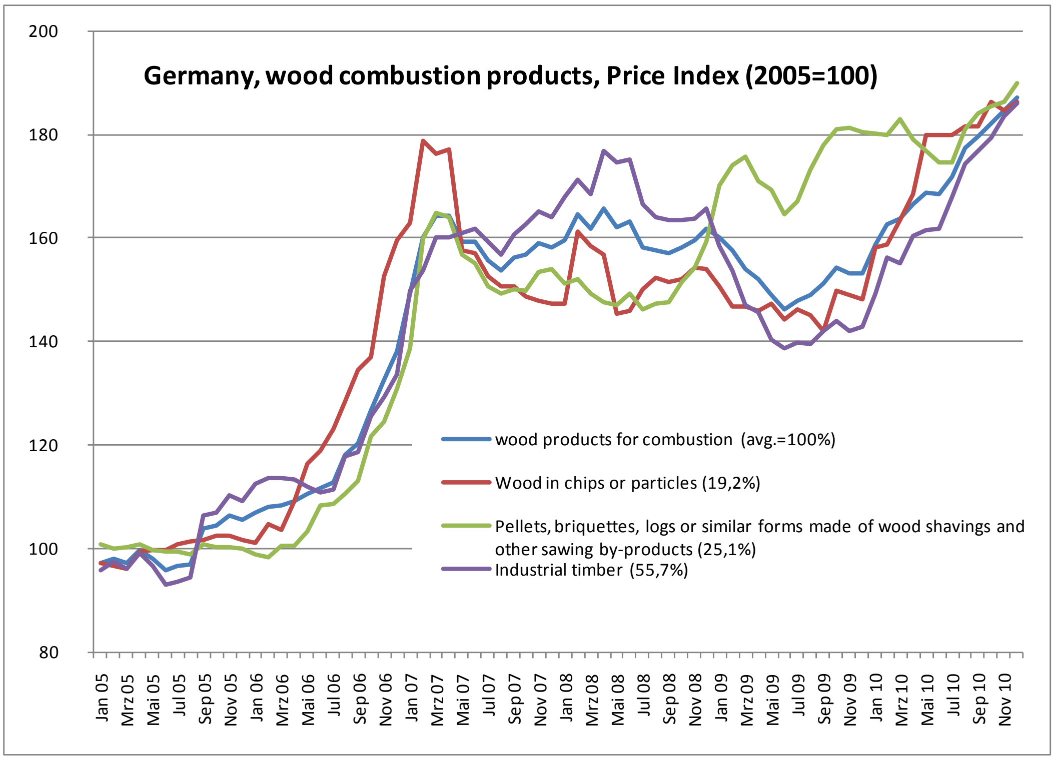

Figure 6 Germany, wood products for energy production, price index (2005=100). Source: Deutsches Statistisches Bundesamt, Preisentwicklung Energie, extract Mar. 2011.

2.5 Water rates

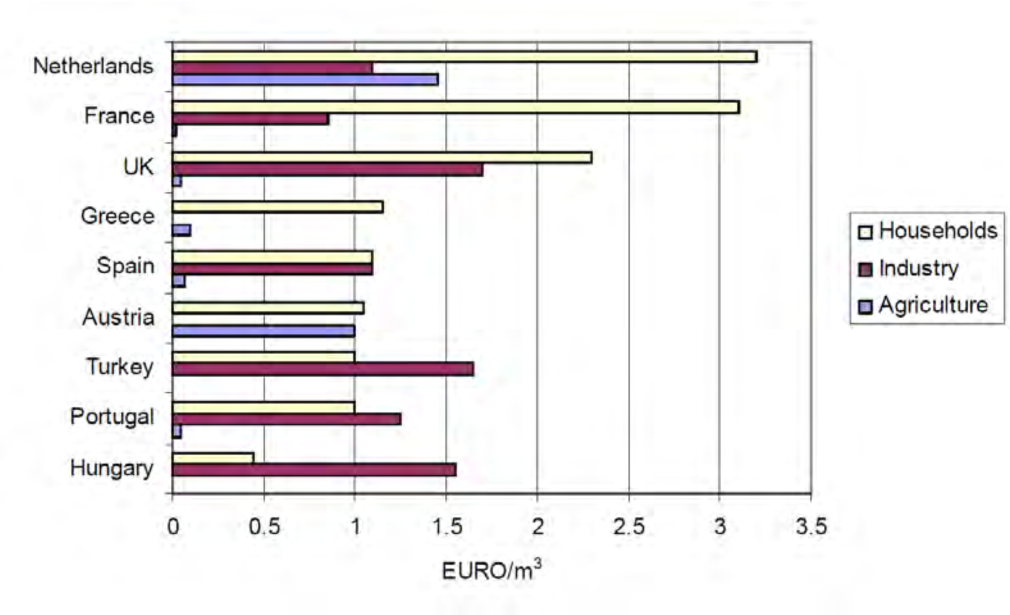

Figure 7 Comparison of agricultural, industrial and household water prices in late 1990s

Comparison of water prices in various sectors and EU Member States in the late 1990s (source: EEA)

Information on water prices is scarce and mostly anecdotal. The above graph is a good basis when supplemented by other data. E.g. in countries with already high water prices like the Netherlands and France, the water price rose with 30% (ca. 2,5%/a) and is now at a level above € 4/m^3 (incl sewage tax). In countries with relatively low water prices like Estonia, Spain, Hungary the water prices rose much more (sources: EEA, preparatory studies ENER Lot 14 on dishwashers and washing machines and ENER Lot 25 on non-tertiary coffee machines)

Currently the average EU water price incl. sewage tax is estimated at € 3.70 / m^3, with an annual nominal growth rate of 2,5% (more or less equal to inflation).

2.6 Interest and inflation rates

Several Ecodesign preparatory studies mention the European Central Bank interest rates. This can be a valuable trend indicator, but for LCC, scenario and sensitivity analysis it is not suitable and the Impact Assessment guidelines of the Commission[17] require that in economic analyses a discount rate of 4% should be used.

The interest rates should be representative of the real-life investment decision, where two situations can be distinguished:

- either the investor has the money available and the net yield ('the interest rate') of the 'eco-investment ' should be substantally higher than the yield of an investment in bonds or low-risk shares or
- the investor does not have the money and in that case he will have to pay an interest rate for the loan.

Figure 8 shows an example of the yield and interest rates that are relevant for large corporate investors. The interest rate for loans > € 1 mln. is around 4-5% in the 2nd half of 2008. This reflects the so-called EMU convergence rate (Maastricht treaty) plus a retail margin for the bank (around 1%). For SME's or smaller loans the retail margin may be slightly (0.5%) higher. The column 'long-term interest rates' in Table 38 gives the EMU convergence rates per Member State (status Dec. 2009).

The yield of bonds and shares is on average 6-7%. As a result, a MEErP interest rate of 6.5% is realistic for corporate buyers.

For the consumer market the interest rate for loans depends very much on the type of loan. The most popular housing loan with >5 year fixed interest has an interest of 5.07%, which would typically apply to energy-relating (construction) products that can be financed through a mortgage. However, as banks are currently more prudent regarding the coverage of the mortgage-sum this may not always be possible. An alternative option, applicable to all sorts of products, is a 'personal' consumer credit. The table shows that for a long-term credit the interest rate is 7.7% (situation Dec. 2009). The table also shows that financing a product purchase through overdrafts, credit cards and bank account overruns is not an advantageous option, with interest rates of on average up to 12,5%.

[17] European Commission, IMPACT ASSESSMENT GUIDELINES, 15 January 2009, SEC(2009) 92.

Figure 8 Interest rate for corporate loans > € 1 mln. and yields of bonds and shares 1996-2008

Source: Austrian National bank OeNB, Financial Stability Report 15, 2009).
Interest rates for smaller corporate loans are around 1% higher.

Table 4 Consumer Interest rates on lending across the EU 27 in %; new business; December 2009

Country	**Lending for house purchase (by initial period of fixation):**			**Consumer credit (by initial rate of fixation):**			**Over-drafts**	**Credit cards**	**Overrun bank account (**)**	**Long-term interest rates (***)**	**Inflation rate (****)**
	<1 yr	**1 - 5 yr**	**>5 yr.**	**<1 yr**	**1 - 5 yr**	**>5 yr.**					
Austria	2.91	2.94	4.9	4.26	4.44	3.74	5.89	5.89	3.29	3.29	0.4
Belgium	2.92			5.27	6.5	5.29	9.81	6.95	3.61	3.61	0
Bulgaria*	13.24	10.67	9.93	15.45	13.94	13.33				6.61	2.5
Cyprus	-	-	-	-	-	-			7.25	4.6	0.2
Czech Republic*	5.96	5.68	5.07	15.05	13.58	14.09				3.98	0.6
Germany	3.36	3.76	4.29	6.38	4.83	7.57	10.38	3.14	0.2	3.14	0.2
Denmark				8.448	6.17	7.036				3.53	1.1
Estonia*	7.59	16	-	11.7	20.73	19.4	16.51				0.2
Greece	3.08	4.6	4.06	8.18	8.95	9.75	14.08	15.17	14.08	5.49	1.3
Spain			7.17	9.72	8.08	9.08	12.34		3.81	3.81	-0.3
Finland	1.92	3.47	4.18	3.04	4.76	4.73	7.83	7.83	3.46	3.46	1.6
France	3.38	3.8	3.74	6.91	6.15	5.74	10.28	10.28	3.48	3.48	0.1
Hungary*	10.27	10.99	15.05	17.77	26.15	30.57	27.52			7.69	4
Ireland		2.61	2.68	3.63	2.61	3.9	12.6	12.6	4.88	4.88	-1.7
Italy	2.24	3.35	4.05	9.85	8.28	6.96			6.6	4.01	0.8
Lithuania	8.55	10.43	9.1	13.85	17.65	8.99	17.02			4.2	
Luxembourg		2.03			5.17	4.76				3.8	0
Latvia*	13.19	7.18	-	21.13	25.04	7.81	24.86		13.75	13.75	3.3
Malta	3.52	4.41	1.8	6.02	5.56	4.41	6.44		6.45		
Netherlands	3.84	4.87	5.26	8.76	-	-	5.76		3.44	3.44	1
Poland*	6.85	7.43	8.53	10.78	13.71	18.88	11.59	16.07		6.22	4
Portugal		2.22		5.53	12.17	6.08	10.64		3.91	3.91	-0.9
Romania*	12.97	11.6	6.65	17.21	18.28	14.53	21.43			8.66	5.6
Sweden	1.52	3.02	4.63	4.2			3.72		3.24	3.24	1.9
Slovenia	3.36	5.17	6.28	4.99	7.35	7.4	8.64		8.64	3.91	0.9
Slovakia	5.92	11.43	14.37	5.26	5.57	8.87			14.35	4.12	0.9
United Kingdom*	3.69	4.84	5.68	2.72	11.78	7.87	7.74	17.76		3.6	2.2
Median EU 27	**3.45**	**5.17**	**5.07**	**7.54**	**8.28**	**7.69**	**10.51**	**12.47**	**7.83**	**3.95**	**0.9**
St. Dev.	3.67	3.92	3.69	5.26	6.97	6.64	6.55	6.68	3.17	2.54	1.76

source: iff/ZEW (2010)– Final Report on interest rate restrictions in the EU, Final Report for the EU Commission DG Internal Market and Services, Project No. ETD/2009/IM/H3/87, Brussels/Hamburg/Mannheim.

Sources used in study: National central bank statistics, unless indicated otherwise. The reported rate is the Annual Agreed Rate (AAR)/Narrowly Defined Effective Rate (NDER), unless indicated otherwise. Missing values indicate that the data is not available. NMS stands for "New Member States". * Interest rates for domestic-currencydenominated loans. ** ECB Statistics: http://www.bundesbank.de/statistik/. *** For convergence assessment purposes, Source: ECB Statistics: http://www.ecb.int/stats/money/. The rates are secondary market yields of government bonds with a remaining maturity close to ten years. ****Source: ECB Statistics: http://epp.eurostat.ec.europa.eu/.
Empty cells and '-' in the table mean that data are not available. '0' means that there is a value but ending up being '0' after rounding to the precision in the rest of the table.

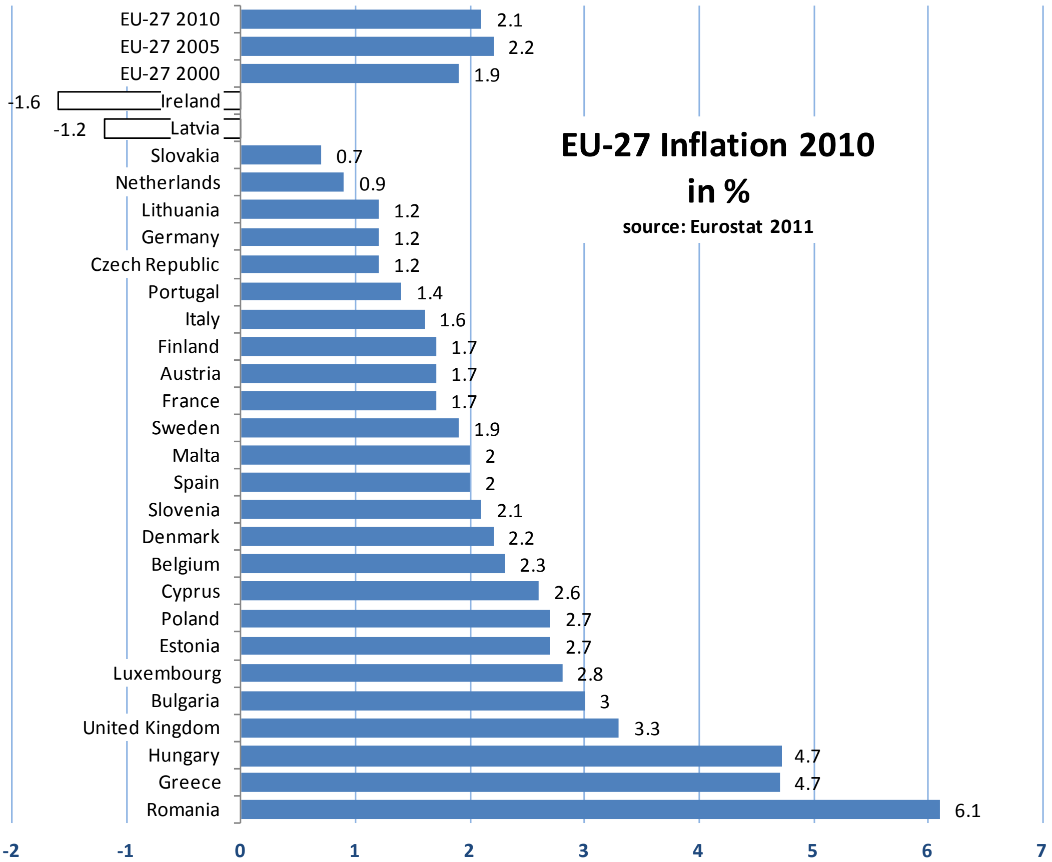

Figure 9 Inflation rate 2010 per EU-27 Member State and EU-27 average 2000, 2005 and 2010.
Current inflation rate is 2,6% (Eurostat, March 2011). MEErP prognosis for LCC and scenarios: 2011-2050: 2.5%

All in all, considering a mix of housing loans and consumer credits, an average MEErP interest rate of 6.5% is realistic for purchases by private consumers and can be used as a uniform MEErP interest rate both for consumers and enterprises.

The inflation rate, as shown in Figure 9, is currently 2,5% and this figure is proposed for MEErP calculations.

In the MEErP sensitivity analysis a variation of the interest rate of ±3 %-points, i.e. between 3.5 and 10% should cover 80-90% of cases. Inflation rate may vary between 1 and 4%, whereby inflation and interest rates are usually linked. This means that the discount rate of 4% may realistically vary between 2,5 and 6%.

2.7 Tax rates

Rates for indirect energy taxes and VAT per country are given in paragraphs 6.6 and 6.7. The table below summarizes tax rates for petroleum products in %.

Other product levies, including levies relating to product disposal, should be assessed on a case-by-case basis.

Table 5 VAT tariffs for petroleum products*, in % (rounded) , EU-27, 3.1.2011**

AT	BE	BG	CY	CZ	DK	EE	FI	FR	DE	GR	HU	IE	IT	LV	LT	LU	MT	NL	PL	PT	RO	SK	SI	ES	SE	UK	**EU**
20	21	20	15	20	25	20	23	20	19	23	25	21	20	22	21	15	18	19	23	23	24	20	20	18	25	20	**21**

* Petroleum products included are: Eurosuper 95, automotive gas oil ('diesel'), liquefied petroleum gas (LPG) heating gas oil, heavy fuel oil with sulphur <= 1% (HFO, S<1%), heavy fuel oil with sulphur >1% (HFO, S>1%)

**=source EC, Oil Bulletin, 3.11. 2011

<u>Exceptions</u> to above VAT tariffs: **CZ:** 19% for HFO(S>1%) / **EE:** 18% for HFO(S<1%) / **GR:** 19% for HFO(S>1%) and LPG / **LU:** 12% for heating gasoil and HFO; 6% for LPG / **PT:** 13% for heating gasoil and HFO(S<1%); 12% for HFO(S>1%) / **RO:** 19% for HFO(S>1%) / **ES:** 16% for HFO(S>1%) / **UK:** 5% for heating gas oil; 18% for HFO; 15% for LPG

2.8 Acquisition costs

The acquisition costs are a vital element of the LCC calculations for the Base Case in MEErP Task 5 and the Design Options in MEErP Task 6 and the economic impact analysis in MEErP Task 7 (see next paragraph on Revenues).

Acquisition costs are the total of purchase price and - if appropriate - installation costs for the end customer. For B2B[18] products this is the costs without VAT and for B2C products the VAT is included. A structural financial incentive for the acquisition costs by governments or energy suppliers can also be taken into account, but very few subsidies have a truly permanent/long-term character. Therefore - as a rule - it is advisable to incorporate the possible effect of subsidies only in the sensitivity analysis (MEErP Task 7) if at all.

<u>*Purchase price*</u>

With the purchase price[19] a distinction can be made between a *'list price'*, the price mentioned by the manufacturer in his/her official pricelist, and a '*street-price*', which is the price actually paid by the clients after commercial discounts. Street-price data are often mentioned in products subject to tests by consumer associations or can be estimated by subtracting a customary discount percentage from the list price. The average discount, which may vary between 0 and 30% depending on the type of product, can be retrieved from interviews with trade-experts and/or prices published on commercial websites.

<u>*Installation costs*</u>

Installation costs can be estimated either from experience (for consultants with a wide expertise in the sector), interviews with installers, from specialised building sector databases specifying time expenditure and hourly rates and/or from specialist publications.

[18] B2B is Business-to-Business; B2C is Business-to-Consumer.

[19] The purchase price for end-users include R&D costs, manufacturing costs, including amortisation of investments, marketing costs and a profit margin.

Especially for installed products (Boilers, HVAC[20], etc.) the product and installation prices may vary widely between EU Member States. In the preparatory study for Lot 1 on Central Heating Boilers the person in charge distinguished the following price multipliers:

- High (SV, DK, AT): 2.6 – 2.2 - 2
- Higher than avg. (DE, FIN): 1.65 – 1.55
- Average (FR, UK/BE/SL, NL/IT): 1.1 – 0.9 – 0.85
- Lower than avg. (IRL/ES/GR/SK/ES/LT/LV, PO): 0.7 – 0.65
- Low (PL/CZ/HU): 0.5

The same study also generated multipliers for installation costs, based on the type of boiler installation:

- Replacement (excl. Chimney renew): boiler street price* 0.6
- New/Replacement incl. chimney renew attic: boiler street price * 0.9
- New/Replacement chimney lateral: boiler street price * 1
- New/Replacement chimney inner liner: boiler street price * 1.2

Another important element is the extent of the installation cost calculation: Do the costs just relate to unit replacement, retrofit with also costs for preparation of the infrastructure (chimney, energy supply) or new installations where there is a choice to limit the costs to strict unit installation or extend the costs also to the whole system, including installation and purchase price of piping or ducting, emitters, etc. In the latter case, for HVAC systems (boilers, air conditioning, ventilation), the total installation costs may well exceed the unit purchase price by a factor 5 to 20.[21]

In principle, all these cost items are relevant for policy makers when judging a possible negative impact on stakeholders and affordability for certain consumer groups and should therefore at least be estimated in MEErP Task 2 or 3. For instance, in ENER Lot 1, the preparatory study identified that for lower-income private apartment owners the necessity –in case of a condensing boiler instead of a non-condensing boiler-- of installing a new chimney for the whole vertical stack could cause problems of affordability for this group.

In the LCC calculations of Base Case and Design Options (MEErP Tasks 5 and 6) as well as the scenario analysis (MEErP Task 7), it would be too complex to consider all installation options and thus here a single installation reference, preferably a sales weighted average, should be used.

[20] HVAC is Heating, Ventilation and Air Conditioning

[21] Based on outcomes of preparatory studies ENER Lot 1 (2007, on boilers) and ENTR Lot 6 (ongoing, for larger air conditioning and ventilation systems)

2.9 Summary EU averages

The table below gives a summary of the average EU-27 rates in this chapter:

Table 6. Summary energy, water & financial rates EU-27 (1.1.2011)

	Unit	domestic incl.VAT	Long term growth per yr	non-domestic excl. VAT
Electricity	€ / kWh	0.18	5%	0.11
Gas	€ / GJ (NCV)	14.54	3-5%	8.90
Oil (gas oil)	€ / 1000 ltr	824	5%	na
Water	€ / m³	3.70	2,50%	
Interest		7.7%		6.5%
Inflation rate		2,1%		
Discount rate (EU default)		4%		
Energy escalation rate*		4%		
VAT		20%		

**= real (inflation-corrected) increase*

3 TASK 3: USERS

3 USERS

3.1 System aspects use phase, for ErP with direct energy consumption

Identify, retrieve and analyse data, report on the environmental & resources impacts during the use phase for ErP with a direct energy consumption effect, with impact levels subdivided in

3.1.1 a strict product/ component scope (e.g. steady state efficiency and emissions at nominal load, as in traditional standards)

3.1.2 an extended product approach: considering that the ErP will be subject to various loads/user demands; the product scope could extend to controllability (flexibility and efficiency to react to different load situations, e.g. modulating burner, variable speed drive,'inverter'), the quality of possible controls (sensors, actuators, central processing unit) and/or the quality of auxiliary devices that may or may not be part of the ErP as placed on the market (e.g. separate heat recovery devices such as PFHRD[22],)

Examples of possibly important factors to consider, depending on the nature of the ErP, are:

- Load efficiency (real load vs. nominal capacity);
- Temperature- and/or timer settings;
- Dosage, quality and consumption of auxiliary inputs (detergents, paper- and toner use, etc.);
- Frequency and characteristic of use (e.g. hours in on, standby or off mode);
- Identification of use of second hand auxiliary inputs during product life (e.g. toner, recycled paper);
- Power management enabling-rate and other user settings;
- Best Practice in sustainable product use, amongst others regarding the items above.

3.1.3 a technical systems approach: considering that the ErP is part of a larger product system and –through certain features of the ErP—can influence the functional performance and/or the resources use and emissions of that of that larger product system. E.g. central heating boiler regulation influencing indoor temperature fluctuation (discomfort), thus increasing heat demand. Other example: combination and possible synergy from combining strict ErP with other ErP (consumer electronics TV/ PC/ phone/ camera; combi-boiler with both space and hot water heating; hybrid boiler combining gas boiler with heat pump, etc.). Note that this still considers solutions of which the ErP is a physical part.

3.2 System aspects use phase, for ErP with indirect energy consumption effect

Identify, retrieve and analyse data, report on the indirect environmental & resources impacts during the use phase for ErP with an indirect [23]energy consumption effect (e.g. windows, insultation material, shower head, water taps), specifically

3.2.1 describe the affected energy system(s), i.e. the systems/products whose energy consumption in the use phase of the ErP is influenced by features of the ErP

3.2.2 repeat Tasks 1.2, 1.3 (relevant standards, legislation) and Task 2 (economic and market analysis) for the affected energy system, but only related to technical parameters that relevant for the aforementioned interaction with the ErP and only in as much as they are not already taken into account in Task 1 and 2 for the ErP.

3.2.3 information retrieval and analysis of the use phase energy consumption of the affected energy system (repeat 3.1 but only for the use phase of the affected energy system).

3.2.4 assess the interaction between the ErP and the affected energy system: describe the basic physical/chemcical or other parameters and mechanisms behind the interaction, possible backed-up by statistical data or field trial or laboratory data.

3.2.5 quantify the energy use and the energy-related resources & environmental impacts during the use phase of the affected energy system(s) that is influenced by the ErP, following the outcomes of the relevant parts of Tasks 4 to 7 for the affected energy system.

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[22] PFHRD= Passive Flue gas Heat Recovery Device (extracts residual heat from central heating boiler flue gas and uses them for sanitary hot water heating with a high energy saving potential)

[23] 'indirect energy consumption effect' means that the physical characteristics of the products/systems cause the energy consumption of other products, e.g. insulation value of a wall influences energy consumption of heating boiler .

3.3 End-of-Life behaviour
Identify, retrieve and analyse data, report on consumer behaviour (avg. EU) regarding end-of-life aspects. This includes:
- 3.3.1 Product use & stock life (=time between purchase and disposal);
- 3.3.2 Repair- and maintenance practice (frequency, spare parts, transportation and other impact parameters);
- 3.3.3 Collection rates, by fraction (consumer perspective);
- 3.3.4 Estimated second hand use, fraction of total and estimated second product life (in practice);
- 3.3.5 Best Practice in sustainable product use, amongst others regarding the items above.

3.4 Local Infra-structure
Identify, retrieve and analyse data, report on barriers and opportunities relating to the local infra-structure regarding
- 3.4.1 Energy: reliability, availability and nature
- 3.4.2 Water (e.g. use of rain water, possibilities for "hot fill" dishwashers);
- 3.4.3 Telecom (e.g. hot spots, WLAN, etc.);
- 3.4.4 Installation, e.g. availability and level of know-how/training of installers;
- 3.4.5 Physical environment, e.g. fraction of shared products, possibilities for shared laundry rooms, etc.

3.5 Recommendations
Make recommendations on
- 3.5.1 refined product scope from the perspective of consumer behaviour and infrastructure
- 3.5.2 barriers and opportunities for Ecodesign from the perspective of consumer behaviour and infrastructure

3.1 Extended product and systems approach

The subtask 3.1 above already describes in detail the differences between

- a strict product approach
- an extended product approach
- a technical system approach and
- a functional systems approach

Basically the approach where a product can be regarded in several levels was the basis for the 'top-down' EU product-related energy use figure in the MEErP 2011, Methodology Report, Part 2. This figure is repeated here on the next page, because it illustrates, especially for the final electricity users, a hierarchy that goes from a basic level of

- motors,
- heat generation (Joule effect),
- generation of electro-magnetic radiation,
- electronics (electrical charges) and
- electrolysis to an intermediate level, where e.g. motors are used in
- fans,
- pumps,
- compressors and
- 'movers'

up to a more detailed level, e.g. for fans used in

- heat exchange devices of all sorts (as convection fans),

- ventilation systems of all sorts (to supply fresh air, possibly in combination with heat/cold transport)
- vacuum cleaners (as a medium to pick up dust particles),
- hoods (as a medium to abduct pollutants in the air)

This is also demonstrated in the example below

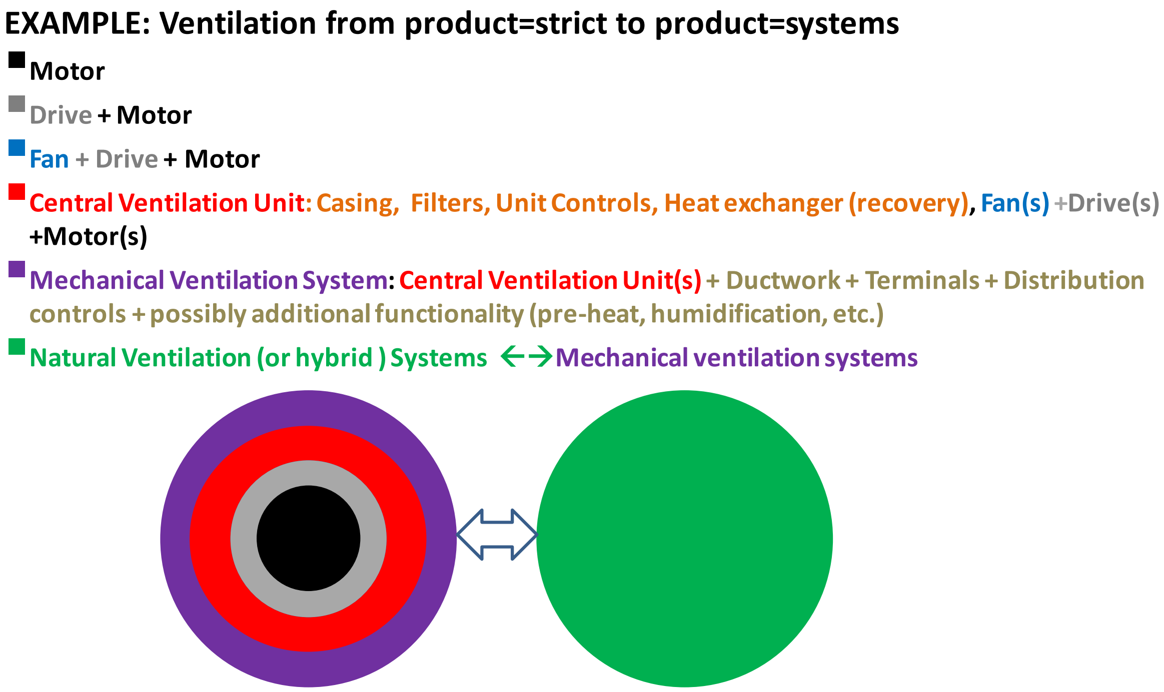


Figure 10 Example extensions of product approach: Ventilation products

The most frequently asked questions in this context are

"If you have already regulated 'motors' (as an example of a product at a basic level) with Ecodesign requirements, why do you have to regulate 'fans' (product at the intermediate level)?" and

"If you have already regulated 'fans' (product at an intermediate level), why do you still need to regulate 'ventilation systems' (product at a detailed level)?".

The answer has both a technical and an economical side. The technical side always seems to win people over, but the economical side is just as important.

On the technical side, every new level of detail adds extra features, e.g. for fans there is a dimension of aerodynamic losses and there is a specific drive issue (e.g. variable speed drive) that makes the combination drive+motor+fan much more efficient in real life. The next step, the fan in a ventilation system, adds again the technical dimension of the air in- and outlet, the pressure drop over the system, the controls and –in balanced systems—the possibilities of heat recovery (heat exchange between ingoing and outgoing air). Overall, it is important to realize that a well-designed product is not an addition of single building blocks. For several reasons, the most efficient and performing products are those with a high level of integration of functions, tailored to the specific need. And every level of detail enhances the possibilities of integration.

On the economical side, every step that tells us more about the actual use of the product, also tells us more about the economical calculations, especially the Life Cycle Costs. In the Ecodesign methodology, as defined in the Directive and made operational in the MEErP 2011, the Least Life Cycle Costs (LLCC) are an important input for the ambition level of the regulator. And the more you know about the application, the more you know about the real LLCC. For example, in case of 'motors' there can be many applications where the motor is run at full load 5% of the time. If you don't want a negative impact for the buyers of these types of 'motors' , the economics for those buyers will eventually determine what the LLCC are. However, if you know that the motors are used in a ventilation system that works at various part loads, that obeys to the so-called fan laws, that runs all year through, etc. the regulatory targets - based on the LLCC - can be much more ambitious.

In that context, it always makes sense for a regulator to look beyond the strict product approach, to look forward to the possible applications of a component, sub-assembly or product in order to avoid sub-optimisation. It may not be always possible to look at the technical system level and it may usually be impossible to look at the functional system level, at least not within the legal scope of the Ecodesign directive, but at the very least the 'extended product approach' should be taken into account.

In that sense, it is usually also no excuse that a component has already been regulated to not tackle the products where the component is used.

Figure 11 EU-27, 2007

Energy consumption by origin

(VHK 2011)

3.2 Extended ErP product scope

The extension of the product-scope from Energy-using to Energy-related Products will lead to new product groups, but is not expected to lead to significant changes in the methodology. In principle, three large groups of products can be distinguished:

- products that are using energy during the use phase (hereafter 'direct ErP'),
- products that - in the use phase - do not use energy but have a significant impact on the energy consumption of products that are using energy (hereafter 'indirect ErP').
- the combination of both.

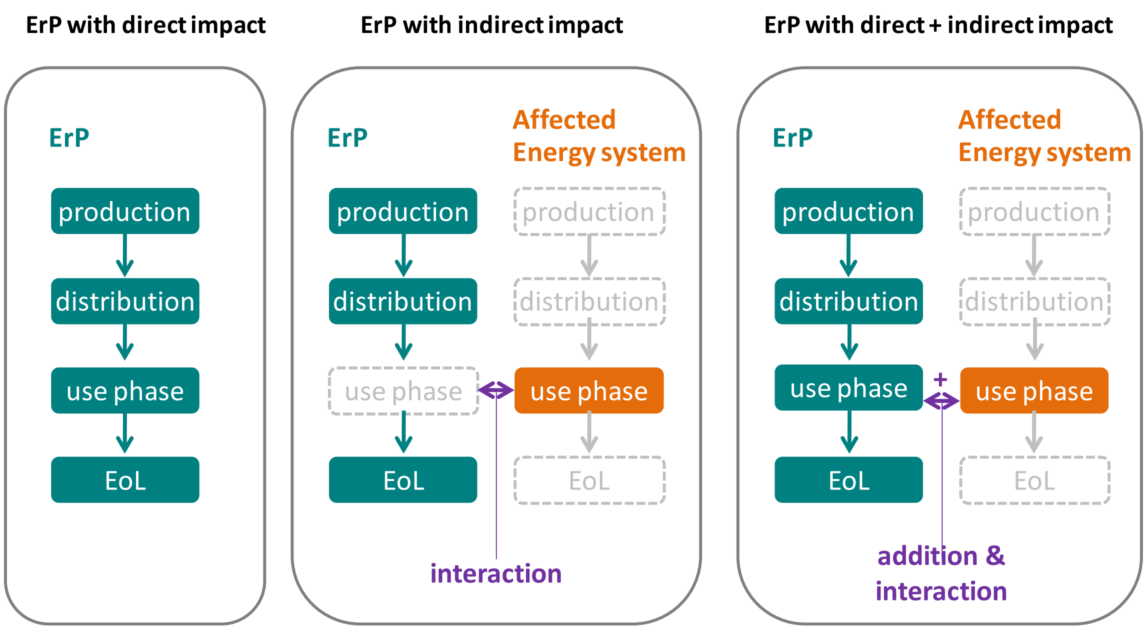


Figure 12 Three groups of ErP

The first and last group were already in the scope of the repealed Ecodesign directive 2005/32/EC. For instance, ventilation products (ENER Lot 10 and ENTR Lot 6) are a clear example of a product where there is both a direct ErP impact - the electricity consumption of the ventilation unit - and an indirect ErP impact - saving on space heating energy (input for the boiler etc.) caused by ventilation losses through better controls and heat recovery. The total impact is simply the sum of the two impacts.

Also in the case of indirect ErP, the impacts can be counted as being caused – indirectly - by the product (e.g. windows, insulation materials).

The main difference between a direct and indirect (ErP) impact is in the reference situation for the saving potential, i.e. the baseline. In the case of products that are only using energy directly it could be enough if the preparatory study compares the improved direct ErP with the existing direct ErP, with relatively less attention to the physical environment or other energy-related aspects, i.e. assuming all other factors being equal (c.p.).

For an indirect ErP this is different, because the presumed saving potential very much depends on these other factors and --more specifically-- depends on the characteristics of ’affected *energy system’* where the actual savings take place.

For instance, many indirect ErP, and a substantial part of the ErP affected by them, are building-related. And in many cases, the analysis of what would be the baseline characteristics of the buildings takes as much or even more time and effort than the analysis of the product itself. Information on EU building characteristics is far from complete. On basic parameters, such as the total number of ‘buildings’ (however defined), the accumulative floor area, building volume, etc., there is little consensus at EU-level and the estimates vary, depending on the (interest of) the source, by up to a factor 2. This may lead to highly unrealistic saving claims –positive or negative—and a huge distortion of the analysis.

The best a MEErP methodology can do, is to supply a common set of building-, climate- and occupancy data that can be used as a basis for any building-related product. The source for these data are the preparatory studies that have already been conducted and on which measures have been or will be based. This data-set cannot be complete and will require additional analysis in each of the preparatory studies for ErP, but at least it provides a framework that will avoid exaggerated or minimalised saving potentials. Available data are shown in the last chapters of the Methodology Report Part 2, Chapters 6 and 7. For aspects not handled there, the past and ongoing Ecodesign preparatory studies, after a reality and quality check, should be the alternative choice.

3.3 Method indirect ErP effect

To deal with the indirect ErP effect, the structure proposed in MEErP 2011 is that of subtasks 3.2:

1. identification of the energy system affected by the ErP and general description of the important parameters
2. information retrieval on the standards, legislation and the cost side of the affected energy system, only in as much as it relates to impacts and running costs during the use phase and the interaction with the ErP (repeat Task 1 and 2 for these aspects).
3. information retrieval and analysis of the use phase energy consumption of the affected energy system (subtask 3.1, but now for the affected energy system)
4. description of the interaction between ErP and affected energy system, in physical/chemical or other parameters, in general terms and
5. in terms of data that are retrieved from studying the use phase of the affected system as part of –relevant parts—of MEErP Tasks 4 to 7.

Key factor in this subtask 3.2 is that the preparatory study has to describe the basic physical, chemical or other parameters and mechanisms involved in the interaction between, possibly backed up by statistical data, field trial reports and/or laboratory test reports.

This requires the person in charge of the study, with the aid of the individual stakeholder-experts, to have sufficient engineering/technical knowledge of the subject at hand. Although the analysis should be proportional and does not have to capture small effects (e.g. thermal mass calculations in a heat balance), it does require intimate knowledge of e.g. buildings heat balances, lighting engineering formulas, basic thermodynamics, etc. to be comprehensive.

In a second instance and probably one of the hardest tasks for a person in charge in a preparatory study, the interaction should be described in a relatively simple, concise manner that can be communicated to non-expert policy makers and stakeholders. Experience from past Ecodesign studies have shown that it is not acceptable for the decision makers to rely on technical experts only.

This part will be illustrated in subsequent examples on insulation, windows, shower heads & taps and other products.

Note that the product scope of the affected energy system, once it has been identified based on technical considerations about the interaction, needs to be firmed up by repeating –for this system— some parts of MEErP 2011 Task 1 and 2, i.e. to make an exact description of the affected system (subtask 1.1.2), find and compare EN standards describing the interaction between the ErP and the affected system, and to make an inventory of the current and imminent EU and Member State legislation that will influence the future development of resources use and environmental impacts (subtasks 1.3.1 and 1.3.2), to assess the Market and stock data (subtask 2.2) and identify trends (subtask 2.3.1), to assess the relevant prices and rates, including external environmental damage, that relate to the running costs (part of subtask 2.4).

Repeating subtask 3.1, especially task 3.1.3 (technical systems), gives an insight in the total energy demand by the user in functional units (kWh space heat, litres of hot water at the desired characteristics (flow, temperature, etc., ultimately also resulting in a kWh hot water demand), lumen.hour (lmh) of light, kg of washed laundry or number of settings in a dishwasher, etc..

In all the subsequent Tasks 4 to 7, wherever it reads 'products' and it concerns the (variable part of) the impacts and costs during the use-phase influenced by the ErP, the person in charge should perform the tasks for the affected energy system. For the impacts/costs in the other stages of the life cycle (production, distribution and end-of-life) and the ErP-related direct costs/impacts in the use phase (e.g. repair, maintenance, auxiliary inputs, etc.) the 'product' should be the ErP.

Note that the Tasks 4 to 7 for the affected energy system do not have to be as comprehensive as for a direct ErP, because e.g. the design options do not come from an improvement of the affected system, but from the improved ErP characteristics.

More specifically:

Subtask 4.1, especially 4.1.4 (working towards basecases), gives general information about the efficiency of the affected system to fill in the user demand in terms of resources (incl. energy) use and environmental impacts. It also indicates e.g. which part of the energy use is fixed (stand-by, off-mode, etc. losses) and which part is variable, i.e. depending on the user demand. Finally it should give the (approximate) efficiency degradation or upgrade at lower user demand.[24] This part requires

[24] E.g. for on-off controlled space heating generators there is a degradation at lower demand/'load'/' output'/'part load'; with modulating heat generators (or those with an inverter) efficiency tends to increase up to the turn-down ratio (e.g. 30% of nominal) and then decrease. Also, the current average operating point/range is relevant as a starting point; most heat generators operate at a fraction of their nominal output, partially because they have to (to be able to meet extreme weather consitions) and partially because they are oversized ('just to be sure' or due to lack of installer knowledge/training or they are combined with an instantaneous sanitary hot water function).   If the product supplies batch-type services, like a

the person in charge to have technical/engineering knowledge of the affected energy system. Main information source will be the past and ongoing Ecodesign preparatory studies for a ‘bottom-up’ approach and the data in the Methodology Report part 2 for a ‘top-down’ approach (reality check on ‘bottom up’ numbers). Note that the ‘top down’ approach, even though it is approximate and simplified, is a very important element, because it is void of any stakeholder or other bias.

In Task 5, the economic (LCC) and environmental (LCA) assessment of the base case, should be based on the ErP and only for the monetary running costs (the Operating Expense ‘OE’ in the LCC formula) and the environmental impacts in the use phase (as in EcoReport 2011) it should be based on the affected system characteristics and more specifically only for the costs and impacts that are influenced by the ErP characteristics. For all the other aspects it should be based on ErP.

This is the part where the outcomes of subtasks 3.1 and 4.1.1 meet the interaction mechanisms found in subtask 3.2.2, to determine which part of the energy use and related impacts of the affected system - and to which degree - is affected by the ErP. This part, with forward-looking links to outcomes of tasks 4 to 7 in the reporting, should be prepared in subtask 3.2.4. It prepares how to analysis should be done, also on an operational level. E.g. it could be based on a ‘manual’ (not in EcoReport) assessment of the use phase or - in Excel - with EcoReport(s) of the affected energy system feeding into the use phase indicator cells of the EcoReport 2011.

As mentioned, it is difficult to give general guidance on this issue because it is very product specific. The examples in the following paragraph should give an idea.

In task 6, describing the impact of design options, the analysis of the impact of the affected system in the use phase can be simple if there is a linear relationship between a single determining ErP parameter (e.g. a flow limiter in a shower head or tap) and the energy use of the affected system (e.g. sanitary hot water generation). It becomes slightly more complicated if the relationship is not linear (as with most space heating energy generators) and even more complex if there is not one interaction but there are several interactions on a different level (e.g. windows, affecting both the heat balance and the lighting balance in a building, with partially opposite effects).

In task 7, especially in the scenario analysis (subtask 7.2), it is important to consider that - apart from being influenced by the ErP - the affected energy system is also affected by several other measures and trends that may be totally unrelated to trends in ErP markets. In that sense, it is important - at least approximately - to take into account the scenarios in the Ecodesign studies and the foreseen (or introduced) measures because they may have a significant influence on long-term (2030, 2050) outcomes of the savings/abatement effect of the ErP.

3.4 Example shower head or water tap

Water saving shower heads and water taps, i.e. equipped with an appropriate flow-limiter, are mentioned in the Ecodesign directive as an example of an (indirect) ErP.[25] The characteristic parameter of shower heads and taps that influences the water demand is the flow limiter. The concept is that by using this device, flow rate of showers can be limited by 30%. The micro-bubbles

washing or dishwashing machine, the effect of lower demand will have to be split over a) more part-load per batch (efficiency decrease) and b) less batches (i.e. less washing machine cycles, with no efficiency effect).

[25] Note that inclusion in the methodology report does not mean that these product groups will automatically be included in the coming Ecodesign Working Plan.

that are brought in the water-stream are enough to guarantee showering comfort and hand/ food washing comfort without prolonging the time-of-use.

The Affected Energy systems are the energy-using components of the public water grid and the sanitary water heaters[26], where the water saving from the ErP affects the energy use. For the latter, it should be taken into account that the reduced water consumption does not influence the standing losses in storage-type water heaters and that the water heating reduction does not apply to volume applications such as filling a bath or a bucket. Also cold water volume applications (e.g. filling toilets, washing machines, dishwashers, kettles, pots and pans) will not be affected.

Finally, it should be taken into account –e.g. in the flow rate index-- that flow-limiters are already installed in a significant part of the market, especially in the Northern part of Europe.

The energy-effect of the ErP on the public water grid will be small and –although it will probably be taken into account in a preparatory study to assess e.g. the water resource saving—for the purpose of this example it will be neglected.

The Affected Energy (AE, in TWh or PJ primary energy for EU totals) thus takes only into account the sanitary hot water and can be expressed by a simple formula, assuming a linear relationship between the relevant part of the energy system (right hand side of formula) and the characteristic of the ErP (f, flow rate index):

$$AE = f * (Q_{WHtot} – Q_{WHvolume} - Q_{WHstandby})$$

where

f is the flow rate index (Base Case reference year, f=100%)

Q_{WHtot} is the total primary energy consumption of the water heaters in the EU-27

$Q_{WHvolume}$ is the primary energy consumption of the water heaters for volume applications

$Q_{WHstandby}$ is the total primary energy consumption of the water heaters caused by standing losses

The problem is in the availability of data. Water heaters have been subject of one of the first extensive Ecodesign preparatory studies (ENER Lot 2, report 2007) and an extensive research by AEAT for JRC-IPTS (‘Ecotapware’ , report 2010). Still, the differences between both studies are remarkable and therefore it is not possible, e.g. in the ongoing Study on Amended Working Plan[27] , to make more than a rough estimate.

For 2010 the ENER Lot 2 preparatory study on (domestic) water heaters projected 4 000 PJ/a energy use, 500 kt SO_2 eq. acidification potential and 230 Mt CO_2 eq. carbon emissions for this product group. Of this, 99% was in the use phase. Around 10% is fixed (standing losses of hot water tanks) and 90% is variable. There are no hard data on volume applications, but in the ‘average’ (Medium) tapping pattern[28] they play only a modest role; for this we assume a share of 10% of total energy use.

The variable energy use related to the remaining 80% (3 200 PJ/a) is linearly dependent on the hot water quantity= hot water energy content (no degradation). To this we have to add 33% (1 100 PJ) for non-domestic use, bringing the total Affected Energy to AE= 4 300 PJ/a in 2010.

[26] Dedicated water heaters and combi-boilers

[27] Van Elburg, M. et al., Study on Amended Working Plan under the Ecodesign Directive, VHK for EC DG ENTR, draft 14 July 2011.

[28] Tapping patterns as defined in EN 13203 and as proposed in the Commission’s draft working documents for dedicated water heaters.

The population growth (extra 12%), the increased comfort (extra 10% due to longer showers etc.), the autonomous water heater efficiency increase (minus 7%) would cause an increase of 15% over the 2010-2030. Hence, in 2030 the AE≈ 5 000 PJ/a.

At a normal replacement rate of 16 (domestic) and 10 years (non-domestic) the market penetration of flow limiting devices in 2030 can be close to 100%. The savings depend on the technical saving and the penetration of flow-limiters already in the market, but it is assumed to be around 20%. In other words, in 2030 there would be a saving of around 1000 PJ/a with respect of the baseline. [29]

3.5 Example: Building insulation materials

Building insulation materials are mentioned in the Ecodesign directive as another example of an (indirect) ErP. The Affected Energy system is the part of the building space heating/cooling energy in the EU-27 and more specifically the part related to transmission heat losses of the building, which influences the heat demand. This is the part influenced[30] by the ErP functional unit, i.e. the insulation value (U-value in W/m2.K). The basic (simplified) formula describing the interaction between the ErP and the AE system is

$$AE = \frac{U \text{ x } A \text{ x } T \text{ x } season}{\eta}$$

where

AE is affected energy consumption in PJ/a or TWh/a

U is the average insulation value in W/m².K

A is the non-transparent building shell surface in m²

T is average temperature difference indoor-outdoor over the season in degree Kelvin (K)

season is time period of heating/cooling season in h

η is efficiency central heating system

More sophisticated formulas can be found in several EN standards, e.g. EN-ISO 13790 (energy calculation) or EN 12831 (heat balance), but at least for an initial assessment of AE it is enough to know that there is a linear relationship between de ErP functional parameter (*U*) and a part of the heating/cooling energy *(A x T x season)/η*.

The problem, again, is the availability of reliable data. In a ‘bottum up’ approach, a preparatory study could find the environmental impacts in the use phase for space heating by summing the results of preparatory studies on boilers, room air conditioners, solid fuel boilers, local heaters and air heating

[29] Not taking into account that in 2030 also the electric power generation (half of water heaters are electric) has become 80% (assumed) more efficient and emits less carbon.
[30] Mainly influenced, because the U-values of the walls, thermal bridges, etc. also play a role

systems (ENER Lots 1, 10, 15, 20, 21). A rough estimate of the environmental profile of district heating can be added. This would describe the affected system as a whole.

In a 'top down' approach (see Figure 11), the fossil fuel space heating (13.225 PJ GCV= 12.432 PJ NCV) and the electric space heating devices (total ca. 280-300 TWh for space heating = 2.700 PJ NCV) give a total of around 15.000 PJ/a.

With a system-efficiency of space heat supply of 70%[31], this results in 10.500 PJ/a actual heat demand.

Following the characteristics of the EU 'average existing dwelling' in ENER Lot 1, it is assumed that the net heat demand is made up of 105% transmission (insulation) losses, 15% losses through thermal bridges and 70% ventilation & infiltration losses, with a reduction of 35% for solar gains and 55% for internal gains. The heat demand due to transmission losses –the Affected Energy-- is around 105% of 10.500 PJ/a = 11 025 PJ/a = 3 062TWh/a.

The transmission losses depend on the outer surface of the buildings A (in m^2) and the U value (in $W/m^2.K$). The MEErP Methodology Report, Part 2 suggests a total heated volume (@18 ^oC) of all EU-27 buildings of around 100 bln. m^3. At an AV-ratio (ratio between outer surface and volume) of 0.5 the outer surface is thus around 50 bln. m^2. It has to be taken into account that ca. 10% of the surface is taken by windows and doors (15% of outer wall plus 5% of roof surface), with an insulation value 3 times worse than the rest, i.e. taking up 30% of transmission losses. This means a) that the surface that could be equipped with insulation materials is 45 mln. m^2 and b) that the annual transmission loss through that surface is 0.7 * 3 062 TWh= 2 143 TWh.

At an indoor-outdoor temperature difference of 11,5 degrees (18 ^oC inside, 6.5 ^oC outside) over a 5.000 h heating season, the average U-value (in $W/m^2.K$) can be calculated:

U = 2 143/(5 kh x 11,5 degrees x 45 bln. m^2)= 0.83 W/ m^2.K

This is reasonably in line with Ecofys/Eurima figures for buildings built around 1990 (i.e. circa the average age of the residential building stock). [32]

For buildings realized after 2006 the same source mentions <u>average</u> U-values of 0.23 (roof), 0.38 (façade) and 0.41 $W/m^2.K$ (floor), suggesting an average of around 0.35 $W/m^2.K$ and a long-term saving potential of over 55 %. Knowing that the relationship of the space heat generator (e.g. boiler) also degrades at lower load (we assume 10% over the full 0-100% range), the actual saving will be closer to 50%.

The 'long-term' may easily be 30-40 years (depending on incentives), during which time the space heating system may also have increased to on average 80% over that period, but still it would mean a **saving** of 50%*(70%/80%)*2 143 TWh= 937 TWh/a or 3 373 PJ/a primary energy (GCV) on heating. The cooling side may add another 25%, resulting in a total saving potential of around 4 000 PJ/a. This is a saving at complete stock change to the target value. In 2030, i.e. 15 years after more measures, only 30-50% may be realized (around 1000 – 1500 PJ/a).

Compared to the <u>Best Available Technology</u> in nearZeroEnergy Buildings, the theoretical saving potential could be much more (>70% of current average), but it will depend on measures in how much this can be realized.

[31] Estimated value, update from ENER Lot 1 data and additional preparatory studies

[32] Average age of the building stock is 45-50 years. Ecofys/Eurima indicate for dwellings 1975-1990 U-values of 0.5 for the roof, 1 for the façade and 0.8 $W/m^2.K$ for the floor. At a weighting of 25/55/20% this comes down to an average of 0.77, which is 6% lower than 0.82. For dwellings 1990-2000 the values indicated by the authors are 0.4 (roof), 0.5 (façade) and 0.5 $W/m^2.K$ (floor).

Note that this is a saving calculated both from an increased retrofit of insulation in general and an improvement in the insulation material technologies. It uses very approximate numbers. In a preparatory study, this analysis should be refined/differentiated, also in the light of the total policy mix for BIM; this could be Ecodesign requirements, energy labeling but possibly also other support measures in the context of GPP, EPBD, etc..

Furthermore the analysis should be extended to cover also space cooling (similar analysis, different figures) and to other emissions/indicators (GWP, AP, etc.).

As regards the accuracy of the estimate, the above is intended to illustrate the approach. Depending on the position of stakeholders, a more detailed approach may be followed.

3.6 Example: Windows

Windows are a complex subject for LCA, because they affect both the 'lighting balance', i.e. the contribution of daylight to reduce the electricity consumption of artificial lighting, and the space heating/cooling balance, i.e. contributing to solar heat gains versus the extended heat loss through an insulation value that is worse than for 'non-transparent' surface elements like walls, roof and ground-floor. So, this means that there are (at least) two Affected Energy systems.[33]

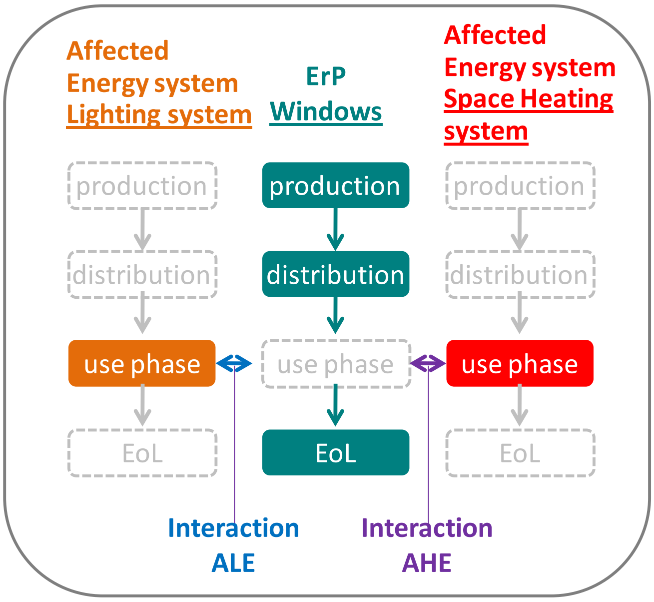


Figure 13 Windows: 1 ErP and 2 Affected Energy systems

[33] That is: if we do not consider the air leakage ('infiltration') rate, which is assumed to be negligible in modern window frames. This is to be confirmed in a preparatory study; if it turns out that infiltration and/or specific ventilation provisions in the frame are to be taken into account then the ventilation energy requirement of buildings becomes a third AE system. Also, in the lighting system we consider 'transparency' (unperturbed vision) to be equivalent to 'translucency' (transmittance of visible light). In reality, there is a difference which could/should be taken into account through categorization.

Primary function of windows is to let sunlight in the building (for lighting) and let people look out (well-being, safety). Possible secondary functionality relates to regulation of thermal radiation, optimisiation of anti-glare (shading, coatings), ventilation (opening/closing windows, integrated grids, etc.) and even the addition of (semi-)transparent solar PV cells/coatings. As far as strictly lighting is concerned, windows are energy saving devices because the daylight diminishes the need (and energy use) for artificial lighting. Side-effect of windows –as compared to non-transparent parts of the building shell—is that its insulation value is worse, but it also captures solar heat inside the building, which is good for energy saving in the space heating season and bad for energy saving in the cooling season.

For space heating/ cooling systems the interaction between the ErP and the AE system can be expressed by the following simplified expressions:

$$\textit{Affected Heating Energy } \boldsymbol{AHE} = \frac{\textit{transmission losses windows } \boldsymbol{QTw} - \textit{solar gains } \boldsymbol{Qsol}}{\textit{efficiency heating system } \boldsymbol{\eta_H}}$$

$$\textit{Affected Cooling Energy } \boldsymbol{ACE} = \frac{\textit{transmission losses windows } \boldsymbol{QTw} + \textit{solar gains } \boldsymbol{Qsol}}{\textit{efficiency cooling system } \boldsymbol{\eta_C}}$$

with

AHE or ***ACE*** Affected Heating or Cooling Energy in TWh/a or PJ/a primary energy

Q_{trans} transmission losses for transparent shell components in TWh/a or PJ/a

Q_{sol} solar gains in TWh/a or PJ/a

η_H or η_C efficiency of heating system (-)

where the relevant ErP-parameters influencing the AHE and ACE are

U_w the insulation value of the window including glazing and frame[34] in $W/m^2.K$;

g_w the solar energy transmittance factor, i.e. the fraction of incident solar radiation on the façade opening for glazing+window frame that is transmitted indoors in the form of heat[35], which in turn depends on

g_g the solar energy energy transmittance factor of the glazing;

α the glazing-to-window surface ratio (A_g/A_w);

integrated external shading features. If applicable these features could lead to a reduced g_w value in the cooling season.

[34] the U-value of glazing+window frame (Uwindow) is probably most appropriate, but separate U-values of glazing (Uglazing) and frame (Uframe) may be added for analysis. For certain types of glazing/frames it may be appropriate to distinguish between directional U-values (from cold to hot and from hot to cold).

[35] Relates to the strict window-dependent transmission parameter(s), i.e. without deduction for building- and site-dependent parameters such as shading (from trees, overhangs, etc.), average dirt-level and utilization factor for heating. (see ISO 13790 and ISO 18292)

For lighting the total Lighting system Energy LE can be expressed by the following simplified expression:

$$\textit{Lighting Energy } \boldsymbol{LE} = \frac{\textit{total lighting need } \boldsymbol{\Phi tot} - \textit{daylight contribution } \boldsymbol{\Phi day}}{\textit{efficacy artificial lighting } \boldsymbol{\eta_L}}$$

The Affected Lighting Energy is only in the right hand part of the equation:

$$\textit{Affected Lighting Energy } \boldsymbol{ALE} = \frac{-\textit{daylight contribution } \boldsymbol{\Phi day}}{\textit{efficacy artificial lighting } \boldsymbol{\eta_L}}$$

with

Φtot and ***Φday*** in Tlmh (Tera lumen hour = 10^{12} lumen hour)

η in lm/W primary energy

where the relevant ErP-parameters influencing the ALE are

τ_{vis} the visible light transmittance of the glazing of the window;

a the glazing-to-window surface ratio (A_g/A_w);

light guidance features (anti-glare + increase utility of incident solar light also at the back of the room).

More sophisticated parameters and equations for modelling and testing can be found in several harmonised standards. The above equations only serve to illustrate the principles and need to be revisited if windows are selected for a preparatory study. The latest comprehensive standard on *'fenestration systems'* is EN-ISO 18292 : 2011[36] .

<u>Calculation of the EU baseline</u>

Data availability for buildings in the EU-27 is fragmented (often only available at national level), of scarce quality and often subject to heated debate, as it has a large effect on the estimated energy use and saving potential. The MEErP report - especially Part 2 - has therefore summarized the best quality data on buildings from preparatory studies, in order to streamline the preparatory studies in this respect and avoid most of the debates.

Nonetheless, the MEErP report does not supply all the necessary answers. It may provide overall U-values, but for the analysis the preparatory study still has to establish a further split-up by type. Also there may be more recent data on the timing and type of insulation measures that were taken in the existing building stock; in such a case the tables in the MEErP, which predominantly relate to the EU-2005 and stem from 2005 or earlier may at least serve as a starting point and a reality check.

For the underlying example, the simplest possible data sets and equations will be used.

[36] EN ISO 18292: 2011, Energy performance of fenestration systems for residential buildings -- Calculation procedure

Heating data (AHE)

The "top down" approach on heating and cooling is initially identical to that used for building insulation materials (see earlier).

It results in an EU energy use for space heating of 15.000 PJ/a (GCV, is 14.270 PJ/a NCV). At a heating system efficiency of 70%, this comes down to a building heat demand of 10.500 PJ/a, of which 105% (11 025 PJ = 3 062TWh/a) are transmission losses and 35% are solar gains (3 675 PJ/a = 1020 TWh/a). Around 30% of the transmission losses (3 307 PJ/a= 919 TWh/a) can be attributed to windows[37] . The total surface for window façade openings is estimated at around 4-5 billion m^2 and , with otherwise the same equation as for insulation materials, the average U_{window} value can now be calculated

U_w = 919/(5 kh x 11,5 degrees x 5 bln. m^2)= 3,2 W/ m^2.K

This is slightly (10-20%) higher than what is found in some other studies[38], but for the purpose of the underlying illustration it is close enough. Hence the values of 3 000 TWh/a transmission losses and an U_w value of 3,2 W/ m^2.K are used in the rest of the calculation.

The solar gains ***Qsol*** are 35% of the heat demand and are assumed to be fully attributable to the windows, thus resulting in 3 675 PJ/a ≈ 1000 TWh/a. As the related transmittance value (for all radiation, not just visible light) a value of ***g***=0.8 is assumed (typical for basic double glazing). The glazing-to-window surface area ratio a_w is set at around 0.7. The multiplication of these two (0.8 x 0.7=0.56) is used to create a solar gains index $G_{ndx} = (t_{vis} \times A_g/A_w) / 0.56$ with starting value 1. Likewise, an insulation index $U_{ndx}= U_{window} /3,2$ is created from the U-value.

With the heating system efficiency of 0.7 (70%) the affected energy for heating can now be calculated

AHE = (U_{ndx} *3000 – G_{ndx} * 1000) / 0.7 = U_{ndx} *4285 – G_{ndx} * 1428 = 2857 TWh/a = 10 350 PJ/a

The total EU energy consumption for cooling is 11% of that of heating, so for the sake of simplicitly it is assumed that the relevant AE for cooling is 11% of 2857 TWh = ca. 320 TWh.[39] In the formula, the solar gains now have a negative effect and –for an average climate—have even a bigger influence than the transmission losses in the cooling season. The COP of the cooling system is set at 2.5. In primary energy this is a primary COP of 1.

ACE = (U_{ndx} *120 + G_{ndx} * 200) / 1 = 320 TWh/a = 1152 PJ/a

The Affected Heating and Cooling energy AHCE for an average climate can now be expressed as

AHCE = AHE + ACE = U_{ndx} *4405 - G_{ndx} *1228

Lighting data (ALE)

For lighting the various standards give ample room for very extensive modelling and calculations. But fortunately the ISO 18292 also gives simple examples of the daylight-factors, i.e. the contribution of daylight to the total lighting need, for various locations. From these examples it can be seen that in an average climate (e.g. Lyon, France) the average daylight factor is 0.7-0.8 (say 0.75). For a colder climate (Helsinki, FI) it is closer to 0.6 and in a warmer climate it is closer to 0.9. These are calculated

[37] Transparent building shell elements.

[38] Studies by Eurima and others indicate values of around 3 W/m2.K

[39] EU consumption is 185 TWh electricity per annum for space cooling, which equals 1.665 PJ/a (NCV, ca. 1.781 PJ/a GCV), which is 11% of that for heating.

(theoretical values), which assume ideal human behaviour (no light when it is not needed) and/or ideally controlled artificial lighting systems. In practice, and for the purpose of calculating savings in this particular case, it is assumed that the daylight factor is more modest, i.e. around 50%. Or rather, in average buildings without windows the artificial lighting energy consumption is double as high as in the same buildings with windows.

In the various Ecodesign preparatory studies on lighting it was found that the total electricity consumption for artificial lighting is 340 TWh_e/a. In primary energy (primary energy factor/conversion coefficient 2.5) this is 850 TWh/a or around 3000 PJ/a. This is also the daylight energy contribution at the current window designs.

Common values relating to this situation are $t_{vis} = 0.8$ and $A_g/A_w = 0.7$. The multiplied value of these two (0.56) is taken as a basis to create a lighting index $L_{ndx} = (t_{vis} \times A_g/A_w) / 0.56$ with an initial value of 1 (100%). Thus the full equation for ALE (in TWh/a) is

ALE = - L_{ndx} * 850

Total Affected Energy

Summing the previous elements

$AE = AHCE + ALE = U_{ndx} * 4405 - G_{ndx} * 1228 - L_{ndx} * 850 = 2\,327$ TWh/a = 8 377 PJ/a

with starting values $U_{ndx} = G_{ndx} = L_{ndx} = 1$

Example: Saving potential

To calculate a saving potential, i.e. taking low-e double glazing with U-value 1,6 W/m2.K and a lower transmittance of 0.7, it is enough to change the indexes. U_{ndx} becomes 0.5 (1.6/3.2) and G_{ndx} becomes 0.875 (0.49/0.56). The new value for *AE* is

AE= 0.5*4 405 – 0.875 * 1228 – 0.875*850 = 2 202 – 330 = 384 TWh/a = 1 382 PJ/a

The primary energy saving, if the target is reached for the complete stock, is 1 943 TWh (6 995 PJ/a) or more than 80%.

This may look unusual: An improvement of a performance parameter of 50% with even a negative effect on the other performance parameters (reduction of the transmittance) that leads to a saving of more than 80%. But it is the consequence of the formula which is in fact the difference between a large positive number and two also fairly large negative numbers.

Having said that, the above simple formula and its inputs should be revisited and possibly refined in a preparatory study, because –due to its nature-- it is very sensitive to small changes.

Furthermore, the calculation was done for the EU as a whole. With the design of measures, not only the average climate but also the colder and warmer climate should be taken into account and will look different (compare Ecodesign measures for Room Air Conditioners). Also if the calculation is applied to e.g. a commercial building with full space cooling the equation will look very different than for a residential dwelling without air conditioning.

When setting out the saving potential in time, it should also be taken into account that the saving will be reached only at complete stock change. In 2030 only 30-40% of the target may have been reached, resulting in a saving of 2 500 to 3 000 PJ/a for that year.

3.7 Example: Detergents

Another subject that is frequently mentioned as a 'typical ErP' are washing machine detergents. Methodologically this is a relatively less complex subject. The wash performance of a (dish)washing machine depends on 4 elements:

- Mechanical Action
- Time
- Chemistry and
- Temperature

Of these 4 elements, the temperature is the one that is responsible for most of the energy consumption, i.e. for heating of the sud. Following the energy labelling actions in the 1990's the washing machine designers have by now optimised the role of the mechanical action and the time, within the boundary conditions of washing machine space requirements and the limits of what consumers accept as a washing time. This optimisation has already led to a significant energy saving, because it allowed lowering of the temperature[40]. What is left, and where the detergent industry has been working on for a few decades[41], is the lowering of the wash temperature with better chemistry.

Today, most detergent manufacturers claim that their A-brand detergents can achieve a good wash performance --comparable to the 40°C programme of a decade ago-- for most applications at a wash-temperature of 20-25°C. Of course, this is in part also due to the increase in mechanical action and wash time, but still…

EU energy calculation

To determine the affected energy use of detergents the data from the Ecodesign preparatory study on domestic (dish)washing machines can be used, which set the electricity consumption at 24 TWh/a for washing laundry at standard test conditions (see also figure 10). In primary energy --using a *pef* of 2.5[42] -- this results in 60 TWh/a (216 PJ/a).

To determine the real-life baseline heating energy, the following parameters were assumed:

- average wash frequency of 234 cycles/year.household for 200 million EU households of which 90% own a washing machines → 234 x 200 x 0.9 ≈ 42 billion cycles/year;
- an average wash temperature of around 40°C and an average cold water temperature of 10°C, which means that the water needs to be heated by 30 degrees K;

[40] In most modern washing machines the "60 °C cotton" program only runs at 50 °C, but with the same wash performance as the old "60 °C cotton" programs.
[41] E.g. compare the A.I.S.E. voluntary programmes.
[42] Primary energy factor for electric power generation and distribution

- sud volume of 2.5 litres/kg laundry[43] with an average real-life load of 3,5 kg → ca. 9 litres sud (water) volume;
- the specific heat of water is 1,16 Wh/ltr. K (assuming an electric heating efficiency of 100%).

The equation for the affected (primary) energy AE for detergents is thus

AE = 2.5 pef * 42 billion cycles/a * **30 K** * 9 litres * 1,16 Wh/ltr.K = 32 885 GWh≈ 33 TWh/a (120 PJ/a)

The interaction depends linearly on the temperature difference between cold water and the wash water, i.e. 30 K.

The affected energy at e.g. a lower sud temperature of 25 °C instead of 40°C is thus

AE = 2.5 pef * 42 billion cycles/a * **15 K** * 9 litres * 1,16 Wh/ltr.K = 16 443 GWh≈ 16.4 TWh/a (60 PJ/a)

Note that this concerns only the use phase, as a demonstration of the extension of the methodology. Significant savings could also be expected in the other life cycle phases (production, distribution, end-of-life), calculated in the 'traditional' way.

Also in this case, the values that were used in this example need to be revisited for accuracy in a preparatory study if this product group is deemed eligible for such a study.

[43] At standard conditions a 5 kg machine uses 12,5 litres heated water for the wash and then 25-30 litres litres of cold water for the subsequent rinsing; total 38-42,5 litres for the whole cycle .

4 TASK 4: TECHNOLOGIES

4	**TECHNOLOGIES**	
	Identify, retrieve and analyse data, report on	
4.1	**Technical product description**, illustrated with data on performance, price, resources/emissions impact of	
	4.1.1	Existing products (working towards definition of BaseCases)
	4.1.2	Products with standard improvement (design) options
	4.1.3	Best Available Technology BAT (best of products on the market)
	4.1.4	Best Not yet Available Technology BNAT (best of products in field tests, labs, etc.)
4.2	**Production, distribution and end-of-life**, specifically regarding	
	4.2.1	Product weight and Bills-of-Materials (BOMs), preferably in EcoReport format (see Task 5)
	4.2.2	Assessment of the primary scrap production during sheet metal manufacturing
	4.2.3	Packaging materials
	4.2.4	Volume and weight of the packaged product
	4.2.5	Actual means of transport employed in shipment of components, sub-assemblies and finished products[44]
	4.2.6	Materials flow and collection effort at end-of-life (secondary waste), to landfill/ incineration/ recycling/ re-use (industry perspective)
	4.2.7	Technical product life (time-to-failure of critical parts)
4.3	**Recommendations** for	
	4.3.1	refined product scope from the technical perspective (e.g. exclude special applications for niche markets)
	4.3.2	barriers and opportunities for Ecodesign from a technical perspective
	4.3.3	the typical design cycle for this product and thus approximately appropriate timing of measures

4.1 Technical product description (Task 4.1)

Task 4.1 has a dual purpose: capacity building for the policy makers/ stakeholders and a first assessment, as a predecessor of the modelling work in Task 6, of a number of anchor points:

- Base case (BC), representing the average product on the market in terms of resources efficiency, emissions and functional performance (see par. 5.1.2);
- Least Life Cycle Cost point (LLCC), representing the product with lower resources use and emissions than the Base case at the lowest life cycle costs (see par. 5.1.3);
- A ‘break-even’ point (BE), representing a product with lower resources use and emissions than the Base case but at the same life cycle costs (see par. 5.1.4);
- Best Available Technology point (BAT), representing the best commercially available product with the lowest resources use and/or emissions (see par. 5.1.5);
- Best Not yet Available Technology point (BNAT), representing an experimentally proven technology that is not yet brought to market, e.g. it is still at the stage of field-tests or official approval.(see par. 5.1.6)

[44] Note that the EcoReport 2011 software tool uses average mix of transport modes by type of product. If the ErP deviates substantially from the average transport mix, this can be corrected ex-post. This would give the industry sectors with an environmentally-friendly transport policy (local suppliers, ship instead of airplane) an option to take their effort into account

4.1.1 Capacity building

The first aim, capacity building, means that the analysts performing the preparatory study have to explain in easy-to-understand wording for non-experts what physical/ chemical processes are involved in the functional performance of the product, in particular where such processes are responsible for resources use and emissions. This is necessary because the policy makers, at the stage of actually designing the (draft) legislation, have to be able to have at least a basic understanding of the underlying technologies when discussing with the stakeholders.

At the same time the explanation is also directed at the technical experts, presumably the designers and developers of the industry that is placing the products on the market. This means that it should be identified and reported what the latest research findings say and what they would imply for the future functional and environmental performance.

To do each of these two capacity building tasks in a proper way is not easy; to combine these two is definitely difficult. One of the possible ways to do this, is to keep the general body text simple and easy to follow and summarize all specialist knowledge in footnotes, pictures (with explanations) and tables. Another way is to keep the explanations simple at the beginning, when discussing the technologies that are already on the market, and raise the complexity where the report needs to convince a usually sceptic expert-audience of BAT and especially BNAT. Note that these are merely suggestions, any preparatory study team can have its own reporting style as long as the main messages get across.

4.1.2 Base Case

As regards the assessment of the 5 anchor points, it should be remembered how these points are used. The Base Case (BC) is the basis for all remaining tasks 5, 6 and 7. These are all modelling tasks and ideally the definition of the BC should facilitate this:

- The use-phase impact of the BC, when multiplied with the total number of products in use, should result in the total impacts during the use phase;
- The production and distribution impacts of the BC, when multiplied with the total number of products sold, should give the total production and distribution impact of those products;
- The end-of-life impacts of the BC, when multiplied with the total number of products discarded, should give give the total end-of-life impact for that product.

Naturally, in case the product group is subdivided in categories, the sum of the aggregated Base Cases (one per category) should meet these requirements.

These impacts are not just environmental, but also the commercial and economical parameters established in Task 2 should fit with the average product features established for the Base Case. In that sense, the technical analyst looking through catalogues and consumer association tests should take into account that prices may differ widely between the EU Member States (see Chapter 2.8, Acquisition costs).

The BC may or may not be a real product that one can buy on the market. Especially when the market is made up of different technologies, the BC will be a virtual (non-existing) product with the average sales-weighted characteristics of all technologies around. On the other hand, e.g. if the market and technical information is incomplete, the analysts of the preparatory study, in consultation with stakeholders and the Commission services may decide to choose a real product for which there is a consensus that this would represent ‘the average’.

Some stakeholders have argued that the methodology should also identify the 'worst case'. The reason for this would be that the Base Case, as a basis for a possible target, is already quite ambitious. Assuming the likely case that the average product is also more or less the median product, taking the BC as a target level woukd already 'cut off' 50% of all the products on the market. From a standpoint of 'removing the worst-performing products of the market' this would imply already quite an ambitious target according to these stakeholders.

Fortunately, the Ecodesign directive is very clear about this: The technical-economic analysis should aim at identifying the Least Life Cycle Costs point, which almost by definition would be beyond the 'Business-as-Usual' scenario. Should the analysts find, by some theoretical chance, that the average product (the BC) is already performing better than the LLCC then it will be very hard to sustain that there is a 'regulatory or market failure' and thus it will be difficult to implement any measure at all.

Also from a practical point of view, in the past Ecodesign studies the current definition of the Base Case has never led to a large dispute during the preparatory study. Also the time-factor plays a role: The preparatory study is performed at least 3 years (sometimes 4, sometimes 5 years) before the Commission finalizes the legislation. In those 3-5 years most manufacturers have changed their catalogues already 2 times and –being aware of the assessments in the preparatory study—usually in a direction of new products with substantially less environmental impact.

Hence, there can be no doubt that the average product, and not a worse-than-average product should be the Base Case in the preparatory study.

4.1.3 Least Life Cycle Costs (LLCC)

The LLCC is the designated target level for Ecodesign measures, as indicated in the Ecodesign directive. Assessment of the LLCC point involves not only an evaluation of the technical features but also an evaluation of the economics, especially concerning how much the improved product should cost. In this respect, loosely based on the experience in the past Ecodesign studies, three partially complementary approaches can be distinguished:

a product approach,

a design option approach based on a disaggregation of product prices and

an engineering approach that is based on a 'bottom-up' cost calculation.

Product approach

For the LLCC it is already more likely than for the Base Case that this would be a real product that can be found on the market. Even if there are widely different technogies in the product group, it will often be clear that one technology, i.e. one model that is actually available on the market, represents the product with the highest savings against the lowest price increase (if indeed there is a price increase) vis-à-vis the Base Case.

The fact that the LLCC relates to real products and therefore the prices relate to real prices from catalogues is definitely an advantage for the accuracy and credibility of the results. On the other hand there are also a few problems:

- It becomes even more important than with the base case, which could benefit also from a 'top-down' approach in the data retrieval, that the local or national prices established are corrected to the average EU-level (see Chapter 2.8, Acquisition costs).
- Also it will be crucial that the margins and distribution structure of the LLCC are representative of the EU-average (and if they are not, to apply a correction factor). Cionsumer association test data could be a good source, e.g. to assess "street price" against "list price". For instance, it

would be highly misleading to compare prices of a low-price internet seller with the prices of a highstreet-retailer.

- In terms of quality/ durability the LLCC product should be comparable to the EU-average. Again the tests of consumer associations could be a good source for B2C products.
- It needs to be assessed how much of the product price is determined by features that are unrelated to the resources efficiency and the emissions

These problems almost always necessitate to complement or substitute this 'product approach' by the following 'design option approach'. conditions are often not easy to assess and also the disaggregation of complete products into individual design options, excluding features that are unrelated to resources use and emissions, requires technical expertise.

Design option approach

The preferred, but not binding, approach is that the analysts in the preparatory study shouldnot only look at catalogue/street prices but try to break down the product price in individual design options. Very often it is much more easy to establish that –looking at a large sample of products from different origins—that an extra design option X results in a price increase of Y % (c.p.) than to try to establish absolute values. Here it is already much more likely to find consistent numbers for the analysts in the preparatory study.

An important problem arises when certain features are new and there is a commercial bonus (extra margin) involved. In these first few years, the price reflects what the market is willing to pay and not what the new feature would actually cost in a competitive market arising from mandatory measures.

In principle, this bonus will disappear when policy measures force the market to upgrade their products and therefore the share of this bonus needs to be eliminated from the assessment. This subject is also discussed in Chapter 8 (par 8.2).

In order to establish the long-term price increase of a design option there are two alternatives:

- for new product features that have already reached the stage of component mass-production a 'bottom-up' engineering approach is appropriate. This requires, even if only at an approximate level, a detailed cost split-up of the new OEM components, extra assembly hours, capital write-off, etc. to arrive at the *strict manufacturing cost increase*. Subsequently, the manufacturing overhead and industry margin is applied to arrive at the manufacturer's selling price (msp). Finally, the sector-specific wholesale and retail margins and --for consumer products-- VAT and levies are applied to arrive at the consumer street-price. See Table 32 for an example of msp split-up that is fairly typical for the EU durable consumer goods industry. Wholesale margin (30%) and retail margin (20%) are typical for this particular boiler product. For e.g. whitegoods, retail margins are higher (50-150%)
- for parts and features that have not yet reached the final stage of development and mass-production, the 'bottom-up' engineering approach will either have to 'dig deeper', i.e. analyzing prices of component materials and processing, or - more likely - has to rely on long-term projections by authorative and unbiased sources. For instance, in the case of OLED and LED lighting the ultimate price level can only be assessed in the latter way.

Several stakeholders suggest that the Preparatory Study teams assess the potential for developing "Learning Curve" product pricing to apply to the product, meaning establishing some historical trend in price and efficiency over time, to try and develop a historical trend in technology and price evolution, and then conduct a sensitivity analysis at the expected learning curve (lower) price point. There are three discrete factors at play that all impact price after a regulation has taken effect: (1)

the price may increase because manufacturers are now incorporating better components, more material, more expensive parts; (2) the price may decrease because companies generally get better at manufacturing, they may redesign to reduce the number of components, they may have a programme focused on substituting parts designed to reduce costs; any OEM supplied parts such as high-efficiency compressors may get less expensive since a larger volume is being ordered (economies of scale); and (3) the price may decrease because energy efficient models tend to command a higher profit margin in the market, which will be eroded when that level becomes the minimum regulated standard that everyone makes. When presenting price projections, these three factors should be distinguished, if available data allows.

Additional problems may arise when the product life of the various optons is an important variable. This is discussed in Chapter 6 (Task 6 on the modelling of design options). In principle, the merits of a longer product life may be taken into account but only in as much as the longer product life is likely to occur in practice and –related to this—only if the product life extension is not likely to block future innovation. For instance, in 'workhorse' applications like lighting and for products that represent the current best, or close to the best in terms of environmental impact (example LED) the longer product life can be taken into account.[45]

However, 'workhorse' applications are rare and possibilities for a major innovation in terms of environmental impact are also not at the horizon for every product group. Since the very beginning of 'Design for Longevity' in the late 1970s it is well known that for most applications the technical life far exceeds the economical (service) life. Already in 1978 van den Kroonenberg established that most of the discarded refrigerators at that time could have been easily and economically repaired. Washing machine manufacturers in the 1990s concluded the same about their products in a large waste study. In 2011 the ERM-report mentioned that 33% of the discarded consumer electronics are still in perfect working order.

Most consumers throw products away because they no longer fit their needs: They have changed themselves (higher income, moving house) and/or the products have changed (new options with step-wise improvement of performance, more fashionable). Prolonging technical product life for those products, if it involves spending extra resources to do so, may actually have a negative effect.

For other products, like means of transport and industrial products, one might argue that the current product life is actually too long. One might dispute the value of car take-back incentive schemes for the environment, but it is the best known example of policy makers understanding the mechanism. For industrial products, however, there can be little doubt that most >30 year old "cash cow" production lines, carefully groomed by a dedicated maintenance and repair staff, are highly detrimental to the environment, because the emission-levels and resources use of these production lines has not evolved to the current state-of-the-art.

In short, claims of a longer technical product life for an LLCC should be evaluated very carefully by the analysts in a preparatory study, taking into account how they would relate to the actual consumer behaviour and the overall environmental impact.

More guidance on the subject of product life extension can be obtained from the recent ERM-study commissioned by DEFRA.

[45] It is tempting to propose a general rule in MEErP that would calculate 'how good' a product should be to qualify as 'close to the best' . For instance, in lighting and space heating –in past studies—a general rule that the product should be at least twice as efficient as the Base Case could be such a rule. But the product sectors are so different that there is no guarantee that such a general rule would result in the best decisions. Therefore an ad-hoc decision needs to be taken in the preparatory study.

Engineering approach

The engineering approach entails a conventional product cost assessment as it is done in industry for new products or –e.g. in preparing for new product development—as is customary in a product analysis of existing products. This approach requires that the analysts have the right engineering and costing background in performing such a task and is very familiar with the OEM-structure in the sector and at least has some general idea –possibly to be firmed up by asking specific offers-- about real component prices, tooling costs, mark-ups, etc..

In MEErP this approach should be seen as complementary to the design option and/or product approach, i.e. in cases where there is a dispute with the stakeholders over specific design option costs or the partitioning of a product price change to the various options and/or in cases where it is needed to eliminate the effect of the commercial bonus (see below).

Demanding a fully-fledged engineering approach in MEErP, apart from the budgetary consequences, is not recommended for a number of reasons:

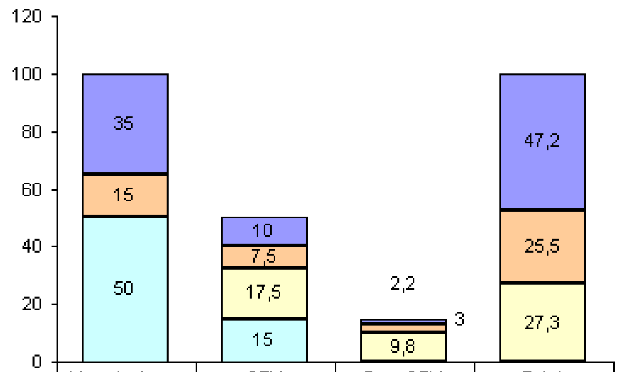
- Analysts with the required skills are very rare, especially when the Commission services require analysts involved in preparatory studies to be be independent, i.e. there should be no possibility of a 'conflict-of-interest'.
- The number of variables are huge and –even for an experienced analyst—the differences in e.g. individual component costs can be a factor 2 or more. An important reason for this is, that most of the EU-industry has evolved from a manufacturing industry –where costs could be derived from integrated machine+labour tariffs, machine and handling times, etc..—to an industry of traders, assemblers and –sometimes—developers. This means that they buy most components on the global market, especially Asia, where labour costs and the available know-how are determining factors. For some labour-intensive components India may be twice as cheap as China. The tooling for these components may require to first develop the tools closer to home, in Europe, for the first production series and then have the final tools made in China, with India out of the picture for reasons of insufficient know-how and machinery. On the other hand, there are still some OEMs with their own tool shop and production lines left in Europe. And there the cost calculation looks looks very different. This means that the analyst would have to make several cost calculations and then determine a sales-weighted average. Practically speaking this is, at some level of accuracy, close to impossible.

What is more realistic, is to give an estimate of the relative change in production costs for a limited amount of product features/deisgn options in one particular cost model which is acceptable to all stakeholders. As mentioned in the previous section, this is actually the preferred approach for new features, in order to eliminate the commercial bonus. In that case, a 'classic' in-house cost calculation for an EU based manufacturer can be followed. This would entail a detailed cost split-up of the new OEM components, extra assembly hours, capital write-off, etc. to arrive at the *strict manufacturing cost increase*. Subsequently, the manufacturing overhead and industry margin is applied to arrive at the manufacturer's selling price (msp). Finally, the sector-specific wholesale and retail margins and --for consumer products-- VAT and levies are applied to arrive at the consumer street-price. The following table gives an example of msp split-up that is fairly typical for the EU durable consumer goods industry. Wholesale margin (30%) and retail margin (20%) are typical for this particular boiler product. For e.g. whitegoods, retail margins are higher (50-150%).

Table 7. MSP (manufacturer selling price) of CH boiler, split up (source: ENER Lot 1, VHK, 2007)

MSP (manufacturer selling price)	100%	
Overhead (marketing, admin, margin)	35%	
Labour (finishing, assembly, testing, packaging)	15%	
Subassemblies & components (OEM)	50%	
of which		
OEM: Overhead		
OEM: Labour		15% (=7.5% * msp)
OEM: Raw materials		35% (=17.5% * msp)
OEM: Secondary OEMs		30% (= 15% * msp)
of which		
Sec. OEM: Overhead		15% (=2.2% * msp)
Sec. OEM: Labour		20% (=3% * msp)
Sec. OEM: Raw materials		65% (=9.8% *msp)

Overall: Overhead 47.2%, labour 25.5%, materials 27.3%



	Manufacturer	OEM	Sec. OEM	Total
overhead	35	10	2,2	47,2
labour	15	7,5	3	25,5
raw material		17,5	9,8	27,3
OEM	50	15		

Additional remarks

On the use of questionnaires

In several past preparatory studies an attempt was made to obtain data on the performance and costs of design options through a questionnaire. This is definitely **not** the recommended approach for this subject. Price information of this nature is typically very sensitive and no manufacturer will reveal its cost structure to the competition for the sake of a preparatory study. This is a futile exercise in which analysts should not engage and from which they cannot draw any meaningful conclusions.

The proper approach is to present industrial stakeholders with a cost structure and individual design option costs using the approaches in the previous sections and look for general acceptance with stakeholders that this, possibly with some amendments, is a reasonable and plausible basis for further modelling of LLCC, BE, BAT and BNAT points.

On the split-up of design option costs

Several stakeholders suggest that the Preparatory Study teams assess the potential for developing "Learning Curve" product pricing to apply to the product, meaning establishing some historical trend in price and efficiency over time, to try and develop a historical trend in technology and price evolution, and then conduct a sensitivity analysis at the expected learning curve (lower) price point. There are three discrete factors at play that all impact price after a regulation has taken effect: (1) the price may increase because manufacturers are now incorporating better components, more material, more expensive parts; (2) the price may decrease because companies generally get better at manufacturing, they may redesign to reduce the number of components, they may have a programme focused on substituting parts designed to reduce costs; any OEM supplied parts such as high-efficiency compressors may get less expensive since a larger volume is being ordered (economies of scale); and (3) the price may decrease because energy efficient models tend to command a higher profit margin in the market, which will be eroded when that level becomes the minimum regulated standard that everyone makes.

When presenting price projections, these three factors could be distinguished, if available data allows.

On the role of the analyst as a designer

The analyst in preparatory study should not take on the role of the designer. It would be highly presumptious to expect that within the time and resources of a preparatory study the analyst could realistically propose new design options or even new combinations of design options. This doesn't mean that the analyst cannot be creative in its data-retrieval and question why certain (combinations of) options were not considered by industry or why certain research findings were never applied. And the answers to those questions can be part of the MEErP reporting.

4.1.4 Break-even point (BE)

Several stakeholders have suggested that the technical-economic analysis should also incorporate a brake even point where the Life Cycle Costs of the improved product equal those of the Base Case. Financially speaking this would be the point where there is still 'no negative impact' on the consumer

This could be helpful in assessing the absolute margin for target levels, possibly to be proposed by the Commission services in their later Working Documents, that go beyond the LLCC point.

In principle, for the assessment of the BE the same rules apply as for the LLCC.

4.1.5 Best Available Technology (BAT)

The Best Available Technology benchmark should be a robust benchmark for market pull measures, e.g. the 'A' energy class and/or the level for public procurement, Eco-labels, etc..

The assessment of the BAT takes place on purely technical grounds, i.e. the product with the lowest environmental impact, but it should be clear that in terms of functional performance, quality and durability it should be a product that is at least equivalent to the Base Case. This is an important condition, because very often new products suffer from a subpar longevity and from subpar quality for certain aspects of their performance.

Some examples where longevity of the products would not qualify them as BAT (but instead as BNAT) are fossil-fuel fed fuel cells for cars and large OLED displays for TVs. Both have been in the news for years, have been shown to the public at all trade fairs, have been produced in small series, etc. but still are not ready for mass-production. Instead, to show how thin the definition lines run, a hydrogen-fed fuel cell, e.g. as used for power packs and battery replacements, can be regarded as BAT. Likewise, small OLED displays –e.g. for camera displays and some cell phones—can be considered to be BAT.

Another example from current practice (Oct. 2011) is the performance of LED light sources, where the Commission is working on functional performance requirements to avoid quality issues.

4.1.6 Best Not (yet) Available Technology (BNAT)

The BNAT point indicates the space for future innovation and product-differentiation after the introduction of measures. Should the measures be too ambitious, i.e. allow only the BAT products with no long-term perspective on new improved products, the conclusion can be that indeed there is a negative impact for the consumer (no freedom-of-choice) and for business (only one product type with necessarily a large focus on low-cost production).

Furthermore, it is not excluded that BNAT technologies can be taken up in certain incentive programs once they have been evaluated as such in the Eciodesign preparatory study.

Finally, the BNAT-level can be an indicator for future new energy classes ('A+', 'A++', 'A+++').

Several stakeholders have expressed concerns on the assessment of BNAT-levels. Some are afraid that analysts in preparatory studies will propose speculative, immature and commercially unattractive product concepts as being BNAT. Others would like to see a more pro-active and ambitious role of the analysts proposing all possible new (combinations of) design options.

In the past preparatory studies, neither of these approaches was found. The analysts have restricted themselves to technologies that were technically proven, where there is some idea of the costs and that are already at the stage of at least product field tests with pilot-series. In short, at that stage at least 5-10 years of R&D work had gone into the product. From that stage onwards, considering that production and marketing development still has to start, it will be at least some 3 to 5 years before these products are actually on the market. And sometimes, e.g. with fuel-fed fuel cells, it may be much longer before they are actually being marketed in significant numbers.

This is, for outsiders, a cautious approach, but it is the approach recommended by the MEErP in order to avoid speculation on the part of the legislator. In general, most people outside R&D

dramatically underestimate the lead times for putting even the simplest new (not restyled, but actually technically new) product on the market. It is not unusual that 5-15 years pass between the first success in the labs and commercial production in any significant numbers. It is also not unusual that, once the first company brings a product on the market there is at least a period of 5 years of copy&improve by the competitors before the market arrives at a stable technical and commercial level. This very much depends on the sector.

4.2 Other subtasks

The other subtasks involve relatively straightforward data retrieval and recommendations on technical barriers and opportunities and timing issues for which no further guidance is deemed necessary.

5 TASK 5/6: ENVIRONMENT

5 ENVIRONMENT & ECONOMICS

5.1 Product-specific inputs

Choose from the previous tasks the most appropriate information

From all tasks 1 to 4:

Definition of the base case(s) (from all previous Tasks 1 to 4)
with per Base Case

Task 1: The most appropriate test standard for performance and consumption data

Task 2: EU-27 annual unit sales 2010
EU-27 unit stock 2010
Purchase price. the installation costs (specify end-of-life disposal costs comprised in product price)
Repair and maintenance costs
Unitary rates for energy, water and/or other consumables
Discount, inflation, interest rates to be applied
Product service life

Task 3 Annual resources consumption (energy, water, consumables, from Task 3.1) and emissions caused during product life (from Task 3.2);
Product use&stock life, if appropriate (i.e. if deviates substantially from product service life)
As appropriate, multiplier(s) to transform standard test data to real-life consumption data
Average user demand/ load
Collection rate at end-of-life (per fraction if applicable)

Task4 Product weight and Bill-of-Materials (BOM), preferably in EcoReport format (from Task 4)
Primary scrap production during sheet metal manufacturing (avg. EU);[12]
Volume and weight of the packaged product avg. EU;
Selected EU scenario at end-of-life of materials flow for:

- Disposal (landfill, pyrolytic incineration);
- Thermal Recycling (non-hazardous incineration optimised for energy recovery);
- Re-use or materials recycling scenario.

5.2 Base-Case Environmental Impact Assessment.

Using the EcoReport and the above inputs calculate emission/resources categories in MEErP format for

Raw Materials Use and Manufacturing;
Distribution;
Use phase (real life);
End-of-Life Phase.

Furthermore, if more than one type of resource is used in the use phase, make a split-up between resources and their individual impacts.

5.3 Base-Case Life Cycle Costs for consumer [see Chapter 6]

5.4 EU Totals

Aggregate the Real-Life Base-Case environmental impact data and the Life Cycle Cost data (subtask 5.3 and 5.4) to EU-27 level, using stock and market data from task 2, indicating

5.4.1. The life cycle environmental impact and total LCC of the new products designed in 2010 or most recent year for which there are reliable date (this relates to a period of 2010 up to 2010+product life);

5.4.2 The annual (2010) impact of production, use and (estimated) disposal of the product group, both in terms of the annual environmental impacts and the annual monetary costs for consumers.

6 DESIGN OPTIONS

6.1 Options
Identify and describe (aggregated clusters of) design options to be taken into account (from Task 4, typically 4 to 8 design options are appropriate)

6.2 Impacts
Assess quantitatively the environmental improvement per option using the EcoReport tool. Compare the outcomes and report only on impacts that change significantly with the design options

6.3 Costs [see Chapter 6]

6.4 Analysis LLCC and BAT

6.4.1 Rank the individual design options by LCC (e.g. option 1, option 2, option 3);;

6.4.2 Determine/ estimate possible positive or negative ('rebound') side effects of the individual design measures;

6.4.3 Estimate the accumulative improvement and cost effect of implementing the ranked options simultaneously (e.g. option 1, option 1+2, option 1+2+3, etc.), also taking into account the above side-effects;

6.4.4 Rank the accumulative design options; draw LCC-curves (1st Y-axis= LLCC, 2nd Y-axis= impact (e.g. energy), X-axis= options); identify the Least Life Cycle Cost (LLCC) point and the point with the Best Available Technology (BAT);

6.5 Long-term targets (BNAT) and systems analysis
Discussion of long-term technical potential on the basis of outcomes of applied and fundamental research, but still in the context of the present product archetype;
Discussion of long-term potential on the basis of changes of the total system to which the present archetype product belongs: Societal transitions, product-services substitution, dematerialisation, etc.

5.1 Introduction

As discussed in the previous chapter on general methodology, Task 5 (Base Case) and 6 (Design Options) require an environmental impact assessment a.k.a. as Life Cycle Assessment (LCA) of the product and its improvement options. Task 7 involves a projection of the most important impacts in a scenario analysis. The 'cradle-to-grave' LCA shall describe the production, distribution, use and end-of-life phase (including recycling and re-use) of the product in terms of its impact on resources use and environment.

Hereafter follows a brief summary.

In general, an LCA involves three stages:

1. **Life Cycle Inventory (LCI)** assessment. This is the assessment of emissions and resources use from all individual processes at the lowest possible aggregation level. It involves the assessment of many possible emissions and resources types per process and –in order to establish a full LCA of a significant number of different ErP— more than 20.000 individual processes. The emissions and resources are usually partitioned to the output of the process, which are then used as input in subsequent processes within one life cycle stage. Where this chain stops depends on the purpose of the LCA, i.e. it is tuned to the decision maker. If the decision maker is a mining company, it will be interested in the list of emissions and resources involved in producing the ore. If the decision maker is a product designer in a manufacturing industry, he or she has no vote in how the individual mining operations are run but will be interested in the emissions and resources involved in e.g. 'steel sheet' as compared to e.g. 'aluminium sheet'.

The principle is illustrated in the underlying graph

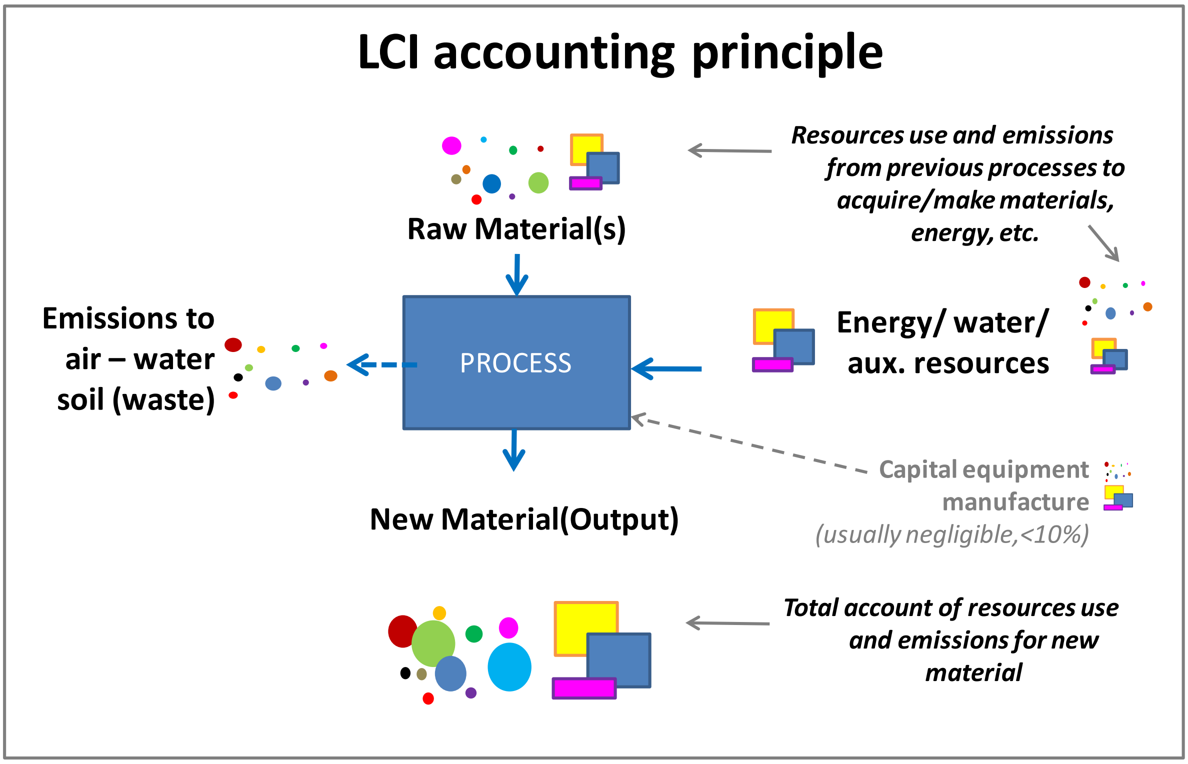


Figure 14. LCI accounting principle

2. **Life Cycle Impact Analysis (LCIA).** This stage 'translates' the emissions and resources into the impacts. For example, if the production of a material (calculated from the subsequent individual processes) causes –amongst others-- the effect of x kg of NO_x, y kg of SO_2 and z kg of NH_3 then the LCIA establishes multipliers for each of these emissions to translate/aggregate them into one measurement unit of acidification (e.g. "SO_2 equivalent"). This translation/ aggregation is based on the state-of-the-art insights into the effect of these emissions on ecosystems and/or the scarcity of the resources, but - for lack of insight (no data), lack of scientific consensus, time horizon employed or other reasons - also involves several political choices. It allows the user of the LCA to interpret the relative importance in a limited, manageable amount of impact values per unit of the material or process performance that he or she has to choose from.

3. **Life Cycle Assessment (LCA)** is, apart from a denominator for the process as a whole, also the name of the final analysis where the unit indicators from the LCIA are multiplied with the amount of materials use/disposal and the amounts of performance units required.

The environmental analysis data structure is given in figures

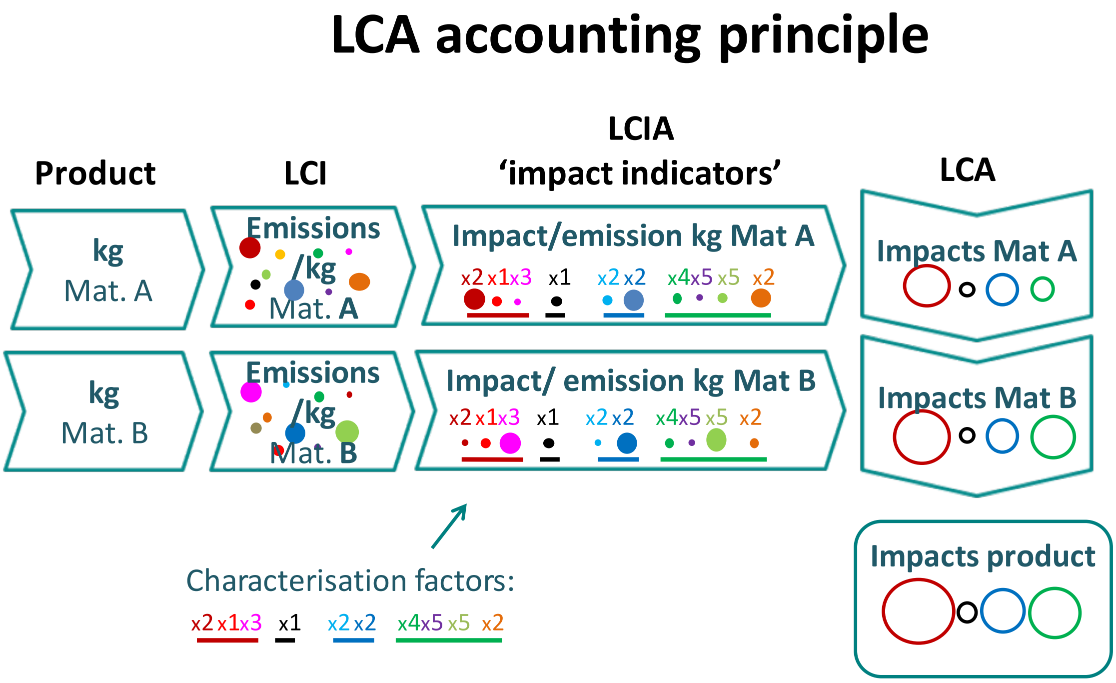


Figure 15. Environmental analysis data structure

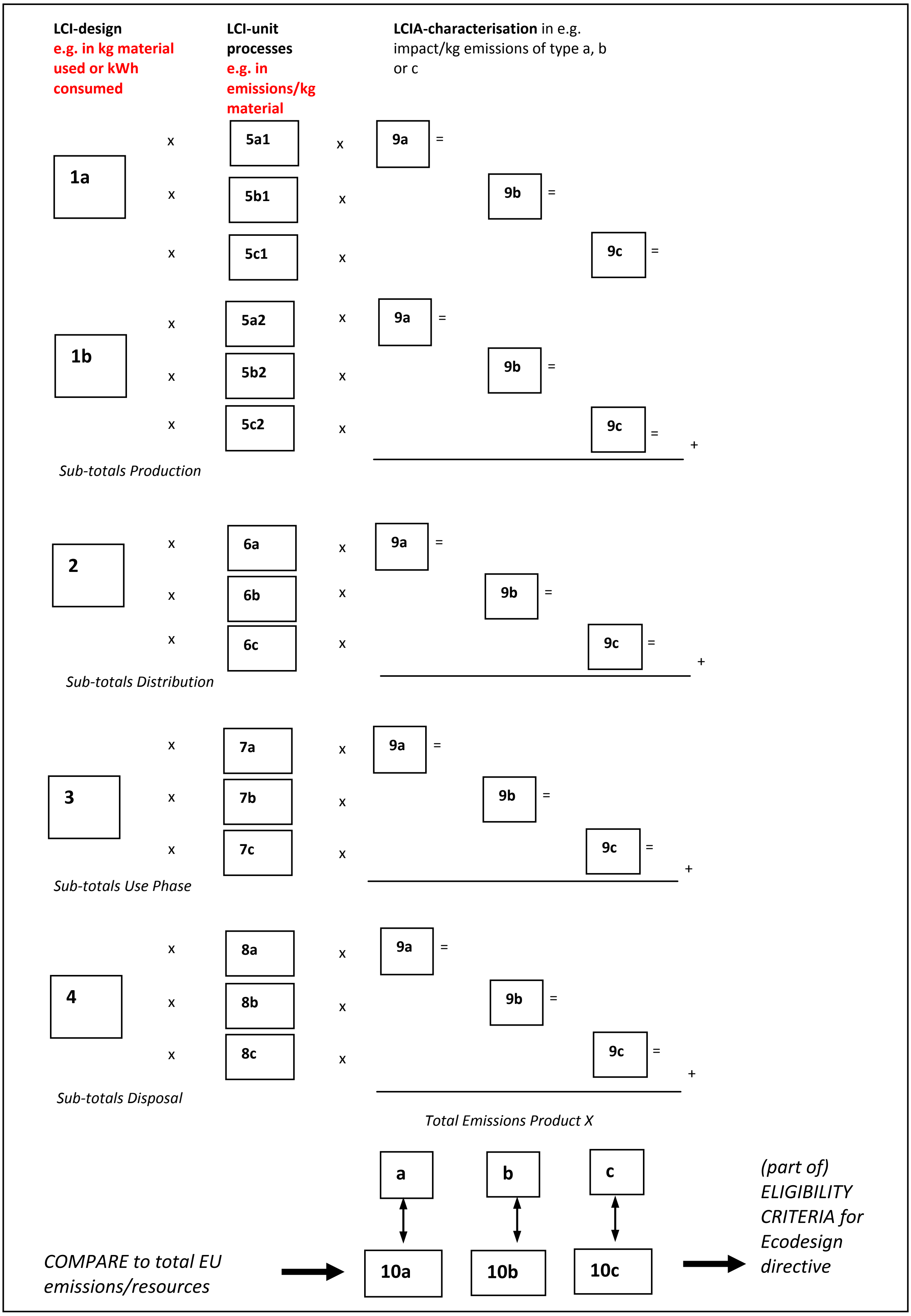


Figure 16. Environmental analysis data structure

In the EU, there are several LCA tools and databases available, that allow LCA-analysis for a wide variety of applications, including possibly an application in Ecodesign preparatory studies. Nonetheless, the former MEEuP 2005 and –for the same reasons-- the MEErP 2011 have proposed to use an alternative tool as a basis for the LCA to try to avoid some of the problems:

1. Most LCA tools are not in the public domain and require acquisition at a sizeable sum. For generally applicable legislation this is not suitable.

2. There are significant differences in the LCI-data between the available tools/ databases. Possible causes are differences in methodology, lack of data, data bias and use of data that are not up-to-date. Should the LCA in the preparatory studies be based on available LCA tools there would be significant differences depending on the tool/database, which in a legislative context is not suitable.

3. There are significant differences in some LCIA multipliers between the available LCA tools/ databases, both in nature/definition of the impacts and in the multiplier values used. And none of the currently available LCIA multipliers exactly meets the requirements established in the Ecodesign directive, nor are they specifically designed for the realisation of specific policy goals.

4. The available LCA-tools/ databases are directed towards LCA-practitioners. Their proper use requires training, experience and background knowledge both in LCA-science and industrial process technologies. Without that, the use of the tools may lead to highly debatable choices and incoherence between the various Ecodesign preparatory studies.

For these reasons the MEErP 2011 study, such as the former MEEuP 2005 study

1. lays down the ground rules for methodological issues in LCI assessment[46], as given in the next paragraph 6.2;

2. determines the LCIA impact indicators, based on the EU Ecodesign and other environmental legislation regarding the set of indicators. Its values are directly derived from emission limit values in the legislation (updated for MEErP 2011) and the aggregation level of the data is tuned to the domain of Ecodesign;

3. retrieved the available LCI data to built a compact set of unit indicators for the public domain and

4. developed a user-friendly, easy-to-use ***EcoReport 2011*** spreadsheet tool for the LCA (see paragraph 6. and separate .xls file).

Note that the EcoReport tool and dataset was specifically developed for use in Ecodesign preparatory studies and is in many ways complementary to existing LCA tools.

Another important difference is in the fact that the EcoReport tool is only tuned to product-design decisions in the manufacturing industry, regarding the 4 decision domains: materials selection, selection of production technique (from half-products), geometry and the way the product should be used (the 'user manual'). It is not equipped e.g. for process optimisation in any of the preceeding steps, like most LCA tools. This makes EcoReport compact and easy-to-use, but for LCA-practitioners outside the realm of product design, it also makes it rigid for daily practice.

[46] e.g. regarding partitioning rules in case of multi-product processes, multi-process products, system level to which emissions and resources use should be traced, accounting units, end-of-life and recycling

Having said that, the LCIA data in the EcoReport are traceable (source mentioned) and most LCA-practitioners that have been working with EcoReport had little complaints (if any, it was about certain materials not being in the list). Furthermore, compared to outcomes of most LCA tools in SIMAPRO the results were fairly consistent[47]. The EcoReport tool is now one of the set of LCA tools in SIMAPRO.

5.2 LCI accounting rules

5.2.1 Introduction

The MEErP 2011 accounting rules for a 'cradle-to-grave' environmental analysis for policy purposes tries to follow as much as possible well established principles which were first introduced in the context of energy analysis and then mirrored in the LCA practice and the ISO 14040 standards. As the energy analysis uses only one input, instead of all types of resources use (materials, water) and emission outputs, it is easier to explain. Having said that, in the following section on LCI accounting in general, wherever 'energy' is mentioned also 'materials', 'water' or any of the emissions to air and water can be read.

The formula for the LCI of a material that is used in a certain quantity in a product system can be given by:

$$S_s = \sum_{i=0}^{n} (\mu_i \cdot m_i)$$

where,

- S_s is the resources input or emission output for the mass of material s used in a product (e.g. in mg I per product);
- n is the number of processes taken into account;
- μ_i is a mass multiplier, implying the mass of resources or emissions from process i per mass unit of material s produced from this process (e.g. in mg i/kg s);
- m_i is the mass of material output from process i needed to (eventually) produce the total amount of material s used in the product system.

[47] pers. comm.. Mark Goedkoop, Pré Consultants, Amersfoort (NL). 2007

The guiding accounting rules for performing an LCA in a policy context, stem from energy analysis . They have been well established some 30 years ago through the IFIAS Workshops in 1974[48] and 1975[49]. In 1978 they were firmed up in a NATO/CCMS[50] report and a comprehensive methodology to use them in the energy-conscious design was introduced as early as 1980 at Delft University (NL)[51]. Furthermore, energy analysis has played an important role in the development of the first ecodesign methodology in the 1980s by Delft University and Leiden University CML.

The roots of energy analysis go back to the 1950s when energy analysis, i.e. the assessment of energy carriers set apart in terms of their enthalpy rather than in money units or kg of different types of fuel, was used in the process and energy industry to optimise the economy of a specific process. The notion that energy analysis could be used in ecology stems from the Odum brothers in the 1960s[52] and became known more broadly in 1971 through publication of "Environment, Power and Society" by Howard T. Odum[53] , often cited as the founding father of modern ecology.

5.2.2 Accounting Unit and Auxiliary Parameters

The accounting unit to be used in energy analysis practice, according to IFIAS conventions, is the combustion value of the fuels used in Mega Joules (MJ, million Joules). This combustion value varies according to the type and the quality of the fuel used, but also depends on whether one takes into account the potential energy of the water content of the flue gases (upper heating value or gross calorific value) or not (lower heating value or net calorific value). For solid fuels the upper and lower heating values are roughly the same, but for liquid fuels there is a difference of 5-6% and for gaseous fuels there is a difference of typically 11%.

IFIAS recommends taking the upper heating value as a basis, because it illustrates most clearly the maximum energy to be extracted from the fuel and the energy efficiency of a combustion process can thereby never be higher than 100%. However, in policy documents and product-related legislation like e.g. the Boiler Directive, the lower heating value has now become the most popular. Also the default combustion values used by the Intergovernmental Panel on Climate Change (IPCC) are the lower heating values. Therefore, in order to comply with existing legislation, we also propose to use the lower heating value. As a consequence, however, this may lead for condensing appliances to efficiencies higher than 100%. For gas appliances the maximum achievable is around 111% and for oil appliances it is 106%.

In the data retrieval process for the production phase (materials production) it is not always clear if authors have used the upper or lower heating values. In those cases we have always tried to maintain the original energy data, giving priority to transparency over a possible error of usually (in industrial processes) no more than 5%.

The main energy parameter is the Gross Energy Requirement (GER), which is the primary energy set apart in the various stages of the product-life. An auxiliary parameter - contained in the tender

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48 **IFIAS***, Energy Analysis Workshop on Methodology and Conventions*, no. 6, Guldsmedshyttan, Sweden, International Federation of Institutes for Advanced Studies, Aug. **1974**.

49 **IFIAS***, Workshop on Energy Analysis and Economics*, no. 9, Guldsmedshyttan, Sweden, International Federation of Institutes for Advanced Studies, **1975**

50 **NATO/ CCMS**, *Energy Analysis Methodology*, Industrial International Data Base, Report No. 75 by the Committee on the Challenges of Modern Society, Long, T.V. (ed.), Technical Information Center US Dept. of Energy, **1978**

51 **Kemna, R.B.J.,** *Toepassing van Energie Analyse in het Ontwerpproces* (application of energy analysis in the design process), Thesis with prof. Dr. J.M. Dirken, other mentors: Eekels, J., den Buurman, R., van Gool, W., Delft University of Technology, Faculty Industrial Design Engineering, **1980**

52 **Odum, Eugene P.**, *Fundamentals of ecology,* Philadelphia, Saunders, **1959**

53 **Odum, Howard T**., *Environment, power, and society,* New York, Wiley-Interscience [1970, c **1971**]

document but also recommended by IFIAS - is the part of the GER that is used in form of electricity. This could have been given in kWh electric energy (kWh_e), but in the Unit Indicator table we use the electricity already converted to MJ primary energy. This allows us to use for some processes, like plastic production, electricity from CHP (Combined Heat and Power), which has a different power generation efficiency (7.35 MJ/kWh_e) than the electricity from the public grid (10.5 MJ/kWh_e).

The electricity use is an auxiliary parameter; it should not be perceived as a form of energy that in itself would have a higher or lower reduction priority than the GER. However, it is an important auxiliary parameter, as it not only creates the link with efficiency of power generation but also with a host of other parameters (emissions, waste, water use) that are relevant at this second system level. Should one of these parameters in the energy industry change, the consequences for the Unit Indicators “across-the-board” would become immediately clear.

Another auxiliary parameter, with a much more limited scope, is the combustion value of the material, usually some 5-10% less than the value of the feedstock. These feedstock values, as given by the various sources[54], are only relevant for the energy recovery of plastics and plastic coatings.

Process vs. I/O Analysis

IFIAS distinguishes between process analysis and input/output analysis. IFIAS prefers the former, as it is based on physical parameters, but sees the utility of I/O energy analysis, that uses converted money-to-energy parameters for sectors of the economy, in cases where there is no other information available and/or a quick way to addresses the energy requirement of process at the so-called 3rd system level of process analysis, i.e. the energy requirement for capital goods and buildings needed to make a product. At this point the EIPRO study has to be mentioned, which is complementary to the underlying project as far as environmental impact assessment is concerned.

EIPRO uses ‘I/O analysis’ for all economic sectors, supplemented by ‘process analysis’ data (e.g. from ECCP) for the use phase of direct ErP.[55]

5.2.3 System boundaries

The figure below shows the system levels in an energy analysis, which is also mirrored in the ISO 14040 standard on LCA. The first level is the direct energy input into the process. The 2nd level is the primary energy needed to produce this direct energy input (e.g. power plants) and the energy needed to produce the raw and auxiliary materials. At the 3rd level there is energy requirement of the capital goods, as mentioned, but also the energy requirement to produce the energy to produce the materials (again power plants, steam generation, etc.).

In theory, the system levels of energy analysis could go on indefinitely. But as a practical restriction IFIAS proposes to limit the analysis to a level (usually the third) whereby the addition of an extra level would not add more than 10% to the total energy requirement. The reasoning was that already the error in the previous levels would be higher than the extra information from this additional level.

[54] APME for plastics, IPPC BREFs for coatings

[55] The EIPRO stays at a higher aggregation level (product groups), making it less suitable to conclude to implementing measures. On the other hand, EIPRO is very useful in giving policy makers a first insight in the relative environmental impact of EuP versus e.g. food production/ consumption, transportation and the building sector..

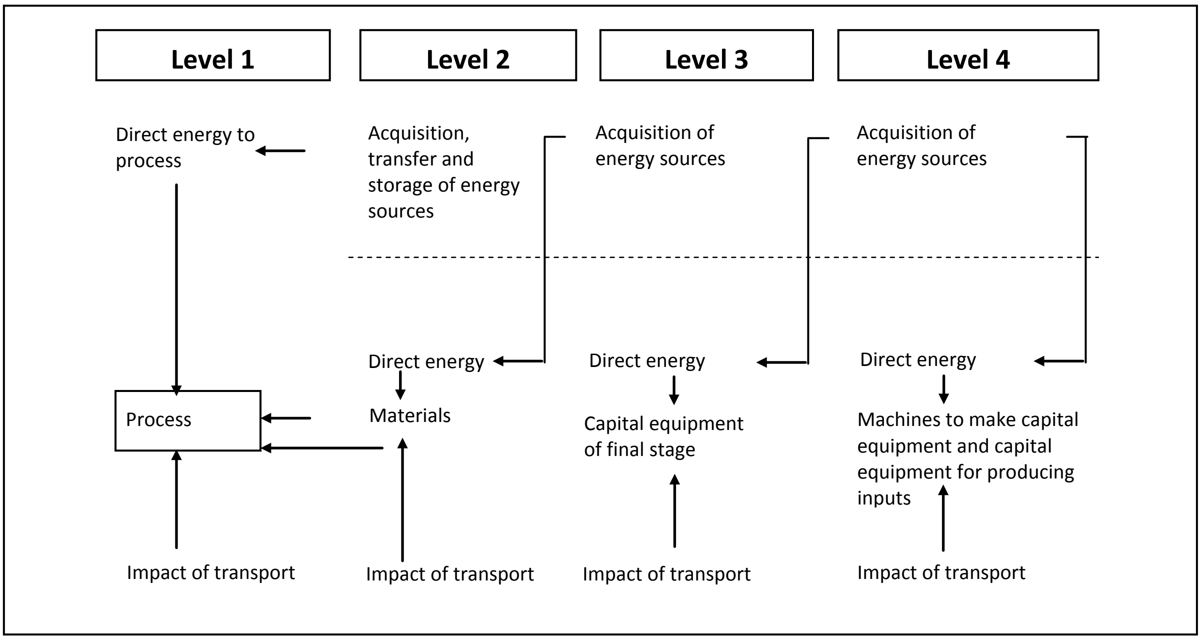

Figure 17. System levels in LCA , illustrated by resources use only (source: IFIAS, 1975)

In terms of ***geographical boundaries*** the underlying study tries to use average values for the resources consumption and emissions in the EU whenever possible and global figures when unavoidable (e.g. when there is no process in the EU). The Life Cycle Analysis does not refer to the actual geographical origin of materials, processes, etc. In the sense of the ISO 14040-series it would therefore not be called a "Full LCA", but a "Streamlined LCA". The reason for this choice is evident from the designer's perspective, which will have no influence on where the components and materials for the future product will be purchased, nor where it is used, nor where it is disposed off.

5.2.4 Multi-product processes and multi-process products

IFIAS and NATO/CCMS also address the problem of partitioning energy in multi-product processes, i.e. processes producing more than one useful product, and the problem of assessing the societal energy expenditure for multi-process products, i.e. products/materials that can be produced by different process-routes. The proposal for the multi-product processes is to use physical parameters, usually the product weight, to partition the energy and stay clear from partitioning on a money value basis. For equally useful products from one process this is easy, but there are situations where it is not clear whether a product from a process should be regarded as a product or a by-product/waste. A case in point is the production of sulphur compounds from metals processing. The origin of the sulphur is from the sulphuric ore and in old ore processing plants this sulphur would simply be combusted and be emitted into air as SO_2, clearly a pollutant. In a modern plant the sulphur is 'captured' in the form of considerable quantities of sulphur and/or sulphuric acid, which is then sold to the processing industry. Environmentally speaking this is of course a Good Thing, but it leaves the problem of partitioning. Should the sulphuric acid be seen as a product and therefore responsible for a part of the input energy or should it be seen as by-product/ waste with no energy attributed?

The actual answer usually comes from using very strict boundaries for the processes in question. For instance in this case the only energy attributed to sulphuric acid production is the energy needed for the process that converts "waste" sulphur compounds into the useful product "sulphuric acid". Or -

in this case - the difference between the process energy emitting SO_2 in the ambient and the process energy with the sulphuric acid as a by-product. This principle not only applies to relatively low-grade by-products, but also to high-grade by-products. For instance, the copper production produces not only copper and nickel, but also a sludge containing small quantities of precious metals (gold, PGM). Not everywhere, but in Europe this sludge is further processed to extract these precious metals from the sludge. However, the partitioning of the energy starts with the extra effort to process the sludge; the main energy input for the copper processing is still attributed to the copper.

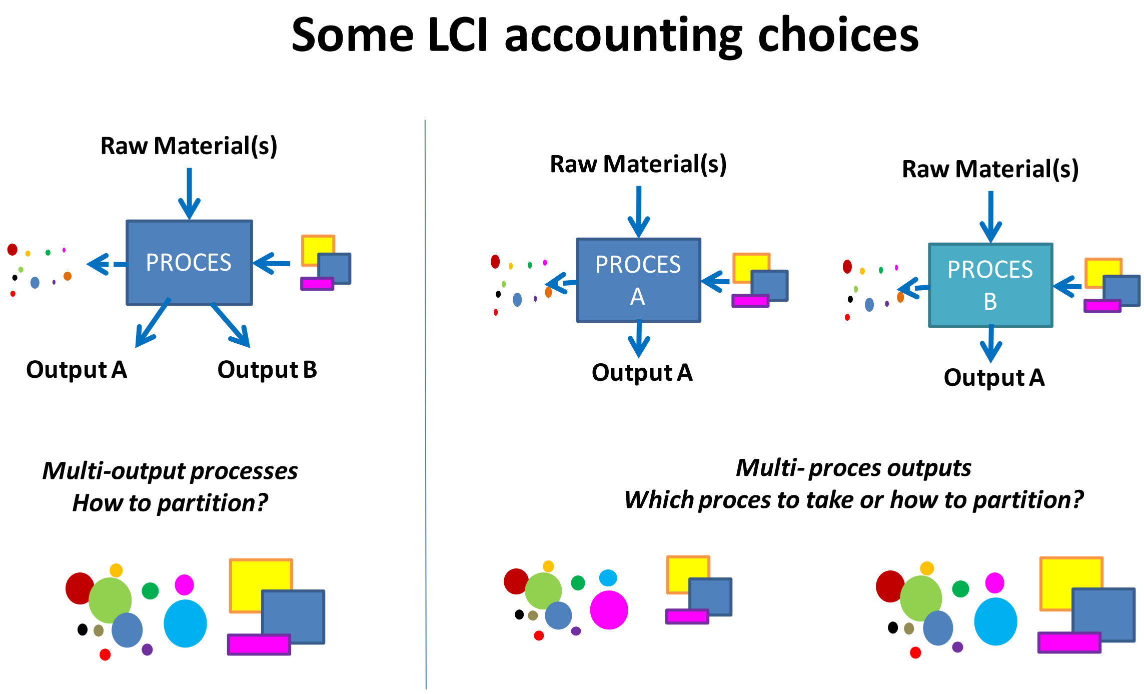

Figure 18. Some LCI accounting choices

Which brings us to the problem of <u>multi-process products</u>. Gold can come from gold/PGM mines but can also (ca. 10% of total) come from processing the "waste" of the copper production, as mentioned above, with a significantly lower energy consumption. Which one to choose? The convention here is not to take some weighted average of the different process routes, but to take the energy requirement of the main process, staying clear of multi-product processes as much as possible. This is of course an abstraction of reality that would lead to an exaggeration if the process analysis were to be used in some sort of global energy accounting. But it is a methodology that is robust and it is consistent with the objective of using energy accounting in Ecodesign, namely energy conservation through influencing the demand of certain less energy-intensive materials per functional unit over more energy-intensive materials per functional unit (c.p.). The reasoning is that when e.g. a metal is faced with a falling or rising demand the main processes will be the first to react: e.g. closing of gold mines (not copper mines) in case of falling demand (=lower gold price) or the exploration/ mining of lower-grade gold deposits in case of a rising demand (=higher gold price). Of course there will be an extra effort to recuperate gold as a by-product from copper processing, but there the effect will be limited because the supply is dictated not by the gold demand but by the copper demand.

As an ultimate consequence even in the case that a metal or chemical is produced only as a by-product of other processes, the energy requirement of a no longer existing or theoretical main process route should be taken as the basis. And this still makes sense, because should the demand for these chemicals or metals rise it would lead to specific mining and production of the main process.

In our data-retrieval we are looking for analyses using the above conventions, also for the broader environmental analysis. But it must be added that the methodological debate on multi-product processes and multi-process products continues, also because there are some vested interests to calculate one way or the other. For instance, for copper producers it would be definitely advantageous to draw the process system boundaries much wider than the individual processes and discount the full credit of gold production - calculated from the main gold producing route - in the copper production. Another – legitimate - reason is when energy analysis is not used in the context of Ecodesign (e.g. materials or resources selection), but in the context of a nation-wide or global energy accounting exercise. In the latter case, in order to make the sums add up, there is no choice but to take a snapshot of the current averages of the different process routes.

5.2.5 Recycling

A related methodological problem occurs with recycling, which is a special case of a multi-process product. In the 1970s, with the aim of stimulating the demand for less energy-intensive over more energy-intensive materials (c.p.), there was a consensus that the energy requirements of secondary materials (post-consumer) and primary (virgin) materials should be made visible from the start and that —depending on the use of the energy analysis— the user of these data should determine the actual use. And in fact there are quite a few studies —e.g. on packaging— that incorporated the current global (thermal) recycling percentage right from the start when comparing alternative materials. By doing so, the actual role of the designer in realizing materials recycling would appear to be limited[56]. Around 1980 the school of recycling-conscious design (D. *Recyclinggerechtes Konstruieren*) started to change this point-of-view and the designer could only gain recycling-credits if he/she took all precautions to “Design for Disassembly”. The mental model of recycling-conscious design was that of a so-called closed loop: If the designer would succeed in having all the materials recycled, there would be no materials depletion at all.

Both these schools represent extremes. In recent years, there are several authors that have painted a more differentiated picture of the recycling process in an economic reality. For instance, the Danish LCA-expert Bo Weidema has rightfully argued that recycling answers to economic laws of supply and demand and that it is not sufficient to stimulate just the supply-side of post-consumer secondary materials, e.g. through recycling-conscious design, without doing something about the demand-side, i.e. the use of recycled materials in new products.

A classic case in point is the recycling of plastics, e.g. plastic bottles that are now collected in many countries as separate waste. At the outset the concept was that this waste fraction could be recycled into new plastic bottles. In reality, this type of closed-loop recycling did hardly occur as the price of the secondary material was not attractive (comparable to the virgin material) and there were several health concerns, etc. E.g. if recycled plastics are (re-)used in food packaging it is usually with an inner liner of virgin material. Basically the only real closed-loop recycling occurs if the whole product - and not the materials alone - is being cleaned and re-used. Instead of substituting virgin material, the recycled plastics are often used in new low-grade applications that require substantial weight or

[56] Note that we are only referring to materials recycling. Most of these studies would recognize the role of designer’s materials selection in re-use of the product. In that sense there are several studies comparing plastic cups to (re-usable) ceramic mugs or using one-way packaging with multi-trip glass bottles.

volume, like outdoor benches, scaffolding materials, etc., where they substitute not plastics but wood. Also recycled plastics are used as road-beddings where they substitute other waste products like nut-shells. But the most popular use of plastics still remains incineration. If the plastics fractions are reasonably pure, like in packaging, this incineration can be effective and if the combustion enthalpy is 30 MJ/kg or higher (see MEErP Part 2 report, chapter on Waste) they would fall under the non-hazardous incineration. The generated heat can then be used for e.g. district heating. Apart from packaging, large housings of ErP that are not contaminated with flame-retardants could follow the same routes as the packaging materials.

This is the situation for relatively clean plastics (from packaging, casings, etc.). However - and also Jaco Huisman's QWERTY approach is making this point - for the multi-type and "contaminated" plastics from ErP the situation is quite different. Both from an economical but also from an environmental point he claims that the costs of recycling exceed the benefits. Huisman says that in this case incineration with energy recovery is the only environmentally sensible thing to do. However, because of the possible contamination, these plastic fractions would have to be earmarked for treatment as hazardous waste. The enthalpy of these fractions is useful, but on the other hand the energy requirement of the hazardous waste incineration itself (with higher temperatures and post-processing of flue gases and residues) is much higher.

In the MEErP 2011 methodology the analysts are required to give the materials flows to re-use (including closed loop recycling whereby a part of the original plastics can indeed be re-used), materials recycling, energy recover (a.k.a. 'thermal recycling') and disposal. The credits for recycling fractions are based on down-cycling/ open loop recycling.

Whereas plastics recycling is suffering from deficiencies both at the demand and the supply side, with metals recycling there are no problems on the supply side. Apart from some simple rules of not mixing certain "enemy" metals, the post-consumer recovery of metals from ErP does not pose too much of a problem from the design point-of-view. According to Huisman and others even shredder-based recycling would recover over 95% of the different metal fractions in a fairly pure state. This could be done in Europe and there would be no need to send the discarded ErP to China or India for largely uncontrolled disassembly activities. This secondary metal, with primary scrap and virgin metal mixed in, can consequently be processed economically into rods and profiles for the construction industry and die-casts that in principle can be re-used in ErP and other consumer goods (cars, etc.). The subject of metals recycling is discussed extensively in the 'Resources' chapter of the MEErP 2011 Methodology Report, Part 2. For the accounting it is enough to say that the MEErP takes into account the 'recycled content' (ratio of secondary scrap to semi-product weight) from the start and thus avoids potential problems of partitioning and system boundaries.

5.2.6 Role of product life and number of users

ErP differ from non-ErP regarding the optimisation of the parameter Product Life. With shoes, clothes, furniture, etc. it is obvious that - both from the economical and the environmental point of view - the longer the Product Life, the better. There is no limit.

With many ErP this is different. Especially with larger ErP (heating appliances, water heaters, white goods, etc.) the energy efficiency of the new models has improved significantly over the old models. So much so, that the *average new* refrigerator, washing machine or dishwasher is 30-40% more efficient than the *average new* appliance 10 years ago. And the *best new* white goods today are some 50 to 75% more efficient with energy resources than their *average new* equivalent 10-15 years ago. This progress becomes visible in the EU's energy balance only very slowly, mainly because the adoption of the new efficient appliances is 'blocked' by the long product life of the old models in the market.[57] In other words, for these ErP a longer product life - also taking into account the impact of production and disposal - would not be advantageous for the environment. Depending on the dynamics in product improvement, a design strategy aiming at a longer product life should be treated with caution: There is more likely to be an optimum and with some products and over certain time periods we may have already passed this optimum (see box: simplified example[58]).

Simplified example: Product Life

2 consumers are buying a new ErP in year 0. Let's assume —very pessimistically— that the materials extraction & production phase for this appliance causes 150 kg of CO_2-emissions. The electricity consumption of this ErP is 400 kWh/year and thereby causes some 200 kg CO_2-emissions per year (0.5 kg CO_2/kWh_e).

After 8 years of the initial purchase the *first consumer* decides to replace the ErP with another average new model. This model is 25% more efficient and uses only 300 kWh/year (150 kg CO_2/year). Its production again causes 150 kg of CO_2-emissions. The first consumer continues to use it for another 8 years. After 16 years, he will have caused 2 x 150 kg= 300 kg CO_2 emissions for production and (8 x 200) + (8x150)= 2.800 kg CO_2 emissions for the use of the fridge. In total this is 3100 kg CO_2 emissions.

The *second consumer* tries to preserve the appliance as long as possible and succeeds in keeping the refrigerator in use for a full 16 years. After this time, he will have caused 150 kg CO_2 emissions for production and 16 x 200= 3.200 kg CO_2 emissions for the use of the ErP. In total this is 3.350 kg CO_2 emissions. So, instead of saving on CO_2-emissions, this second consumer has actually caused 250 kg or 8% <u>more</u> CO_2-emissions than the first consumer.

Please note that with a non-ErP the second consumer would have always been by far the most environmentally friendly.

Due to the uncertainty of Product Life prolongation in general and the specific uncertainty in the trade-off between - on one hand - longer Product Life hindering resources-efficient innovation during product life and - on the other hand - the conservation of resources and emissions in the materials loop, it is proposed that for ErP where the environmental impact of the use phase is dominant the Product Life should be treated with extreme caution. So far, only in the case of light sources where there is a step-change in both resources efficiency and product life (e.g.LED), product life minimum requirements have been included in measures. For small appliances, mobile ICT equipment and some other products where the production stage is dominant, the Product Life prolongation is already a more likely strategy to be included in measures, but in these cases the disposal is not necessarily a result of technical product failure but the product being out-of-date.

If we take the national and EU Eco-label criteria as a yardstick, there seems to be consensus on this issue. Most label-criteria would involve the guaranteed delivery of spare parts over a minimum period, but nowhere is the longevity of the product - beyond the current average - an eco-label reward criterion.

[57] CECED 2001 has calculated in a stock model, that decreasing the average product life from 12 to 10 years for these appliances would immediately result in a significant saving of 1 Mt CO2 emissions

[58] The simplification regards e.g. on one hand that we don't take into account the efficiency improvement in electricity production and on the other hand we don't take into account that —through wear and tear— many appliances use more energy the older they become. Also the figures are of course fictitious.

Nonetheless, as the case of lighting demonstrates, product life prolongation may play a role. A recent study by ERM, commissioned by DEFRA, may provide more guidance.[59]

The same goes for a possible design-criterion regarding the increase of the number of users per product. In theory this design-strategy makes sense as most products are discarded long before their technical product life and sharing a product would increase the chance that the real (economical) product life comes closer to the technical life. Furthermore, using robust and state-of-the-art machines at maximum capacity would create a whole new dimension to saving resources. As indicated by Kemna 1981[60], the number of users per product N, could have the same importance as the product-life L in describing the energy efficiency of a product per functional unit $E_{function}$ (in MJ/year.user)

$$E_{function} = (E_{production} + E_{use} + E_{disposal} – E_{recycling}) \ / \ (L * N),$$

Where $E_{production}$, E_{use}, $E_{disposal}$ are the energy requirements of respectively producing, using and disposal of the product and $E_{recycling}$ constitutes the energy credits for recycling (all in MJ).

Having said that, there have been several studies, e.g. on shared laundry washing[61] or car-pooling[62], showing that there are quite a few social, cultural and health barriers to be expected that have very little to do with the actual product design. Also in the various Eco-label studies of ErP and non-ErP the number of users is never used as a criterion.

Therefore it is proposed to also not reward an increase of the number of users, but instead take the number of users as a given (constant) for the specific product group.

The number of different LCI input and output flows can be hundreds. More details on the LCI methodology are given in the Annex.

For strategic policy goals, like fighting climate change, acidification, toxic and ecotoxic pollutants, the LCI data are not easily manageable. For that reason, the Commission –in its brief—and the Ecodesign Directive give indicators of impacts that are of strategic interest.

59

http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17047&FromSearch=Y&Publisher=1&SearchText=product%20life&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description

60 Kemna, R.B.J., "Energiebewust Ontwerpen" (energy-conscious design), Delft University of Technology, syllabus 1981-1997.

61 Thesis Robert Den Hoed, Delft University

62 Ph. D thesis Rens Meykamp, Delft University

5.3 LCIA, impact indicators

The following list gives an overview of the impact indicators, that are either

- calculated automatically in the EcoReport 2011 tool from the LCI look-up table, the Bill-of-Materials or other inputs [marked with symbol 💻] or
- that must be assessed separately with subsequent 'manual input' in EcoReport 2011 tool [marked with symbol ✋].

Note that for most 'manual input' indicators, the EcoReport 2011 gives defaults to cover the most common situations but they are <u>not prescriptive</u>. The list specifically also mentions the inputs to arrive at the indicators (outputs in EcoReport 2011), because - especially if the a certain aspect turns out to be critical - they may become very relevant 'operational indicators' for setting Ecodesign requirements (e.g. mercury in lamps).

Material Resources

<u>indicators</u> of the materials inputs for ErP life cycle[63] [💻]:

- bulkplastics (in g per product)
- technical plastics (in g per product)
- ferrous metals (in g per product)
- non-ferrous metals (in g per product)
- electronics (in g per product)
- miscellaneous (in g per product)

specified for each materials group and each stages of the life cycle (including totals) [💻]:

- production (total in g per product)
- distribution (total in g per product)
- use phase (total in g per product)
- end-of-life re-use & recycling (in g per product)
- end-of-life disposal (in g per product)

with <u>inputs</u>

relating to production phase:

- bill-of-materials (in g per component, per specific material fraction) [64][✋]
- (new) scrap from metal parts manufacturing (in % of mass metal input)[65] [✋]

relating to use phase:

- auxiliary materials (in kg/year per specific material fraction) [✋]
- product (service) life (in years, used as a multiplier for the above) [✋]
- spare parts (in g, fixed 1% fraction) [💻]

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[63] materials in final product including packaging plus consumables during use phase
[64] materials in final product including packaging
[65] Currently assumed at 100% recycling, so it does not influence the materials balance. It does influence resources use o energy, water and emissions from new scrap recycling.

relating to the end-of-life, with mass flow fractions <u>based on sector or overall EU data</u> [✋]

for metals and glass:

- materials recycling (post-consumer) at fixed, EU future-oriented rates per half-product (in % of product mass) [💻]

for plastics:

- re-use (in % of product plastics fraction) [✋]
- materials recycling (in % of product plastics fraction) [✋]
- thermal recycling/ energy recovery (in % of product plastics fraction) [✋]

for electronics (PWB), <u>individual product</u> features influencing recyclability

- disassembly time for printed wiring board (PWB) (meets target yes/no) [✋]

with intermediate calculation of:

- landfill (fraction product mass not recovered, in g and % of total product mass) [💻]
- incineration (fraction plastics and PWB not re-used/recycled, in g and % of total product mass) [💻]
- resources use and environmental impact of plastics recovery & recycling, as well as (internal calculaton in EcoReport) the impacts of landfill (waste collection and site) and incineration [💻]

<u>Specific materials of interest</u>

Inputs relating to flows of specific materials of interest (not affecting previous materials balance totals, but are highlighting specific impacts like GWP, toxicity or EU scarcity)

specific materials of interest [✋]

- refrigerants in the product (in g, with specification of refrigerant type)[66]
- mercury (Hg) in the product (in g)[67]

fugitive (=during product life) and end-of-life ('dumped') emissions of specific materials of interest

- refrigerants (in % of original input as above, with specification of refrigerant type)
- mercury (Hg) (in % of original input as above)

<u>NEW in MEErP 2011</u>

The following indicators were added to MEErP 2011 as compared to former MEEuP 2005

a separate indicator for *specific materials of interests*:[68]

[66] This is a further specification of the 'miscellaneous' category. It does not influence the materials mass balance, but it does very specifically take into account the extra GWP from refrigerant production and it is the calculation basis for fugitive and dumped refrigerant during use phase and end-of-life, which also add on to the GWP indicator.

[67] This is a further specification of the 'miscellaneous' category. It does not influence the materials mass balance, but it does very specifically target Hg-input and it is the calculation basis for fugitive and dumped mercury during use phase and end-of-life, adding on to the Heavy Metals indicator.

- ‘critical raw materials’ input (in kg antimony (Sb) equivalent) [✋]

with inputs:

- materials fractions (in g per product) of antimony, beryllium, cobalt, fluorspar, gallium, germanium, graphite, indium, magnesium, niobium, platinum group metals, rare earths, tantalum, tungsten. [69]
- characterisation factors for above materials, taking into account EU import dependence, post-consumer recycling rate and substitutability (in g antimony equivalent, see table).[70]

Table 2. Critical Raw Material index

Critical Raw material	Ge	Be	Ta	In	PGM*	Ga	**Sb**	W	Nb	REM**	Co	C	CaF2	Mg
index in Sb mass eq.* **	**18**	**12**	**9**	**9**	**8**	**8**	**1**	**0.2**	**0.04**	**0.03**	**0.02**	**0.01**	**0.001**	**0.0005**

* PMG= Platinum Materials Group= Pt, Pd, Rh, Ru, Os, Ir ; **REM= Rare Earth Metals= fifteen lanthanoids, scandium, yttrium
***= kg antimony equivalent per kg of critical raw material

a new indicator ‘recycmax$_t$’ for mass-flow at End-of-Life, taking into account

- ‘stock effect’ due to the mass of materials in use (in products) in growth markets, defined as the ratio between total mass of products/materials sold and mass of products/materials discarded in year t (sets maximum recycling %) [✋]

with inputs

- product stock life L (time between purchase and disposal, in years)
- annual average growth rate r of the physical sales of the product group (in %/a)
- correlation formula: recycmax$_t$= 1 / $(1+r)^L$, with recycmax$_t$ always ≤ 1 (maximum 100%)

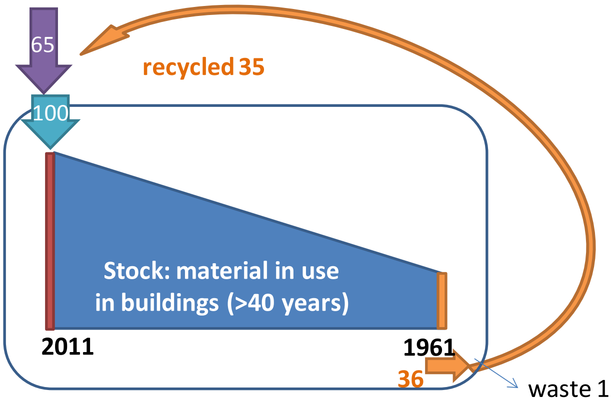

Figure 19. Visualisation stock-effect

[68] Based on the Commission’s Raw Material Communication. COM(2011)25
[69] Materials selected as ‘critical’ on the basis of EU import dependence, post-consumer recycling rate, substitutability, global ultimate reserves, characterization of extra-EU supplier countries.
[70] list provided

Energy Resources

with indicators for

- total primary energy (Gross Energy Requirement, GER, in MJ)
- electricity (in MJ primary energy)
- heating energy (fossil fuels, Net Calorific Value)

with inputs as for ‘Materials’ and additionally

- energy use during use phase (waste from electricity generation in g/GWh and ashes from solid fuel combustion, in g/GJ heat output), calculated from:
  - product (service) life (in years)

  for products using electricity:
  - specific electricity consumption (kWh per hour/cycle/setting) in on mode, standby-mode, off-mode
  - annual frequency of use (number of hours/cycles/settings/etc. per year) in on mode, standby-mode, off-mode
  - total electricity consumption over product life (MWh), multiplying product life, specific electricity consumption, annual frequency of use per mode and making a total of all modes

  for products producing heat from fossil fuels:
  - average/nominal heat power output (in kW)
  - annual frequency of heat use at average/ nominal heat power output (number of hours)
  - efficiency (in Net Calorific Value NCV) of heat generator (in %) at specific fuel type (gas, oil, wood pellets, logs ; other) and characteristic efficiency range (4 steps for gas, 2 steps for other fuels)[71]
- number of km for maintenance/repair/ service over product life (km/life)

with intermediate calculations of manufacturing impacts.

Water Resources

with indicators for

- process water (fraction disposed to sewage) and
- cooling water (temperature change)

subdivided into life cycle stages (see ‘Materials’)

with inputs as for ‘Materials’ and additionally

- water consumption per year (in m^3/a)

[71] Exact efficiency number can be set in EcoReport within the range selected

Waste from production/ distribution/ use phase, with indicators for

- hazardous waste (in kg)[72] and
- non-hazardous waste (in kg);

subdivided into life cycle stages (see 'Materials')

with inputs as for 'Materials' and 'Energy'.

Emissions

All emission parameters are subdivided into the life cycle stages (see 'Materials')

[72] As defined in the Waste Framework Directive 2008/98/EC (values in LCI look-up table in EcoReport tool). DEFINITION UPDATED with respect of MEEuP 2005.

GWP

Global Warming Potential

indicator

- GWP-100 (in kg CO_2 equivalent per product)

with characterisation factors as given by IPPC 2007 (UPDATED since MEEuP 2005)

Table 8. **Greenhouse gases Global Warming Potential, scope 100 years (GWP-100)**

Source: IPCC Fourth Assessment report: Climate Change 2007

Greenhouse gases under Kyoto protocol (Annex A)			Other greenhouse gases		
ASHRAE nr.	Name	GWP-	ASHRAE nr.	Name	GWP-100
			CFC	chlorofluorocarbon	
R-744	Carbon dioxide CO_2	1	CFC-10	tetrafluoromethane	1800
R-50	Methane CH_4	25	CFC-11	CFCl3 (trichlorofluoromethane)	4750
R-744a	Dinitrogen monoxide N_2O	298	CFC-12	CF2Cl2 (dichlorodifluoromethane)	10900
	Sulfur hexafluoride SF_6	22800	CFC-13	CF3Cl (chlorotrifluoromethane)	14400
			CFC-14	Methane, tetrafluoro-	5700
			CFC-113	CF2ClCFCl2 (trichlorotrifluoroethane)	6130
PFC	perfluorocarbon		CFC-114	Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-	10000
C2F6	perfluoroethane (10% van CF4)	9200	CFC-115	Ethane, chloropentafluoro-	7370
C3F8	perfluoropropane	8600			
C4F10	perfluorobutane	8600		Halons	
C4F8	perfluorocyclobutane	10000	Halon 1001	bromomethane	5
C5F12	perfluoropentane	8900	Halon 1201	bromodifluoromethane	470
C6F14	perfluorohexane	9000	Halon 1211	bromochlorodifluoromethane	1300
CF4	perfluoromethane	6500	Halon 1301	bromotrifluoromethane	6900
HFC	hydrofluorocarbon		HCFC	hydrochlorofluorocarbon	
HFC-23	CHF3 (Methane, trifluoro-)	14800	HCFC-123	Ethane, 2,2-dichloro-1,1,1-trifluoro-	77
HFC-32	CH2F2 (Methane, difluoro-)	675	HCFC-124	Ethane, 2-chloro-1,1,1,2-tetrafluoro-	609
HFC-41	CH3F (Methane, fluoro-)	97	HCFC-141b	Ethane, 1,1-dichloro-1-fluoro-	725
HFC-43-10mee	CF3CHFCHFCF2CF3	1640	HCFC-141b	CH3CFCl2	725
HFC-116	hexafluoroethane	11900	HCFC-142	Ethane, 1-chloro-1,1-difluoro-	2310
HFC-125	CHF2CF3 (Ethane, pentafluoro-)	3500	HCFC-142b	CH3CF2Cl	2310
HFC-134	CHF2CHF2 (Ethane, 1,1,2,2-tetrafluoro-)	1100	HCFC-22	Methane, chlorodifluoro-	1810
HFC-134a	CF3CH2F (Ethane, 1,1,1,2-tetrafluoro-)	1430	HCFC-225ca	Propane, 3,3-dichloro-1,1,1,2,2-pentafluoro-	180
HFC-140	Ethane, 1,1,1-trichloro-	140	HCFC-225ca	CF3CF2CHCl2	122
HFC-143	CH2F CHF2	330	HCFC-225cb	Propane, 1,3-dichloro-1,1,2,2,3-pentafluoro-	620
HFC-143a	CH3CF3 (Ethane, 1,1,2-trifluoro-)	4300	HCFC-225cb	CClF2CF2CHClF	595
HFC-152a	CH3CHF2 (Ethane, 1,1-difluoro-)	124	HCFE-235da2	CF3CHClOCHF2	
HFC-227ea	CF3CHFCF3	3220			
	(Propane, 1,1,1,2,3,3,3-heptafluoro-)			chlorinated hydrocarbons	
HFC-236fa	CF3CH2CF3	9810	R-20	Chloroform CHCl3	30
	(Propane, 1,1,1,3,3,3-hexafluoro-)		R-40	Methane, monochloro-	16
HFC-245ca	CH2FCF2CHF2	640			
	(Propane, 1,1,2,2,3-pentafluoro-)			miscellaneous	
			CO	Carbon monoxide CO	1,57

Notes

Anthropogenic (human origin) emissions of CO_2, CO, N_2O and CH_4 occur mostly at combustion processes. CO_2 occurs also at cement production and in some chemical industry applications.

SF_6, PFCs and HFCs are also known as "fluorinated greenhouse gases", regulated under the F-gas Regulation. SF_6 typically occurs with magnesium casting as cover gas. The most well known PFCs are CF_4 and C_2F_6 that are emitted e.g. at the anodes of primary aluminum production. PFCs are also used in the semi-conductor industry and as cleaning solvents. HFCs are used as refrigerants, cleaning solvents and foam blowing agents.

HFCs and PFCs are groups of gases, each with their own specific characterisation factor in GWP100 CO_2 equivalent. IPPC 2007 gives characterisation factors relating to the gas emissions only. To this the emissions of their production have to be added. This can be done by adding a specific percentage or by using production-specific emission-data.

with inputs as for 'Materials' and 'Energy', especially (as already mentioned with 'Materials'),

Inputs relating to flows of specific materials of interest for GWP:

- refrigerants in the product (in g, with specification of refrigerant type)[73] [✋]
- refrigerants (in % of original input as above, with specification of refrigerant type) [✋]

The GWP values can be taken from the table above [✋] in a manual procedure. Or the EcoReport has incorporated some refrigerants to choose from: R134a (GWP-100=1300), R404a (3260), R410a (1730), R152a (140) and R744 (=CO_2=1) [💻].

For regulatory purposes, where a policy maker might prefer not to require a full LCA, the parameter TEWI may be useful with cooling devices.

TEWI stands for Total Equivalent Warming Impact and is defined in EN 378:2008 as

$$TEWI = GWP \cdot L \cdot n + [GWP \cdot m \cdot (1- \alpha_{recovery})] + n \cdot E_{annual} \cdot \beta$$

where

$GWP \cdot L \cdot n$ is the impact of leakage losses;
$GWP \cdot m \cdot (1- \alpha_{recovery})$ is the impact of recovery losses;
$n \cdot E_{annual} \cdot \beta$ is the impact of energy consumption.

where
TEWI is the total equivalent warming impact, in kilogrammes of CO_2;
GWP is the global warming potential, in CO_2-equivalents;
L is the leakage, in kilogrammes per year;
n is the system operating time, in years;
m is the refrigerant charge, in kilogrammes;
$\alpha_{recovery}$ is the recovery/recycling factor, 0 to 1;
E_{annual} is the energy consumption, in kilowatt-hour per year;
β is the CO_2-emission, in kilogrammes per kilowatt-hour.

The first term of the equation describes the GWP-100 impact of leakage losses ('fugitive emissions'), the second term the impact of recovery losses (end-of-life refrigerant fraction not recovered) and the third term describes the impact of the energy consumption. Default for β is 0.384 kg CO_2 eq./kWh. The end-of-life recovery rate $\alpha_{recovery}$ for professional installations may be in the range of 70-80%; for domestic appliances perhaps a bit lower. Apart from the GWP, the parameter ***L*** is usually the most important and subject of most disputes. It can vary between 1-2% of ***m*** for a pre-sealed refrigerator or room air conditioner and 50% of ***m*** for a commercial cooling system with a suboptimal installation on site.

[73] This is a further specification of the 'miscellaneous' category. It does not influence the materials mass balance, but it does very specifically take into account the extra GWP from refrigerant production and it is the calculation basis for fugitive and dumped refrigerant during use phase and end-of-life, which also add on to the GWP indicator.

AP

Acidification Potential

indicator

- acidification impact (in g SO_2 equivalent per product) [🖳]

using the following characterisation factors from an international treaty

Table 9. MEErP Characterisation Factors for Emissions of Acidifying Agents to Air

Acidifying agent	characterisation factor g SO_2 eq./ g	Acidifying agent	characterisation factor g SO_2 eq./ g
Ammonia NH_3	**1.88**	Nitric oxide NO	**1.07**
Ammonium carbonate H_2CO_3 x NH_3	**0.67**	Nitrogen dioxide NO_2	**0.7**
Ammonium nitrate NH_4NO_3	**0.4**	**Nitrogen oxides NO_x**	**0.7**
Dinitrogen monoxide N_2O	**1.78**	Sulphate SO_4	**0.98**
Hydrogen chloride HCl	**0.88**	Sulphur dioxide SO_2	**1**
Hydrogen fluoride HF	**1.6**	**Sulphur oxides SOx**	**1**
Hydrogen sulphide H_2S	**1.88**	Sulphur trioxide SO_3	**0.8**
Nitric acid HNO_3	**0.51**	Sulphuric acid H_2SO_4	**0.65**

Source: 'acid equivalents' from the UNECE 1999 CLRTAP protocol (Gothenburg), reset for kg SO_2 equivalent.

NMVOC

Non-Methane Volatile Organic Compounds)

indicator

- VOC-content (in g VOC per product, no characterization factor) [🖳]

with inputs as for 'Materials' and 'Energy'.

POP

Persistent Organic Pollutants

indicator (for dioxins and furans)

- Total concentration equivalent (Teq) of Tetrachlorodibenzodioxin (TCDD) (in ng Teq per product) [🖳]

with inputs as for 'Materials' and 'Energy'.

using the following characterisation factors from EU legislation

Table 10. Equivalence factors for dibenzo-p-dioxins and dibenzofurans (source:)

Dioxin	factor	Furan	factor
2,3,7,8 -Tetrachlorodibenzodioxin (TCDD)	**1**	2,3,7,8 -Tetrachlorodibenzofuran (TCDF)	**0.1**
1,2,3,7,8 -Pentachlorodibenzodioxin (PeCDD)	**0.5**	2,3,4,7,8 -Pentachlorodibenzofuran (PeCDF)	**0.5**
1,2,3,4,7,8 -Hexachlorodibenzodioxin (HxCDD)	**0.1**	1,2,3,7,8 -Pentachlorodibenzofuran (PeCDF)	**0.05**
1,2,3,6,7,8 -Hexachlorodibenzodioxin (HxCDD)	**0.1**	1,2,3,4,7,8 -Hexachlorodibenzofuran (HxCDF)	**0.1**
1,2,3,7,8,9 -Hexachlorodibenzodioxin (HxCDD)	**0.1**	1,2,3,6,7,8 -Hexachlorodibenzofuran (HxCDF)	**0.1**
1,2,3,4,6,7,8 -Heptachlorodibenzodioxin (HpCDD)	**0.01**	1,2,3,7,8,9 -Hexachlorodibenzofuran (HxCDF)	**0.1**
-Octachlorodibenzodioxin (OCDD)	**0.001**	2,3,4,6,7,8 -Hexachlorodibenzofuran (HxCDF)	**0.1**
		1,2,3,4,6,7,8 -Heptachlorodibenzofuran (HpCDF)	**0.01**
		1,2,3,4,7,8,9 -Heptachlorodibenzofuran (HpCDF)	**0.01**
		-Octachlorodibenzofuran (OCDF)	**0.001**

Source: Industrial Emissions directive 2010/75/EU[74]. For the determination of the total concentration (TE) of dioxins and furans, the mass concentrations of the above dibenzo-p-dioxins and dibenzofurans shall be multiplied by the following equivalence factors before summing, following the directive.
Note that pesticides etc. POP were not included as they are rare in ErP. Should they occur, their effect must be listed separately.

HMa

Heavy Metal emissions to air

indicator

- Nickel equivalent (in mg Ni equivalent per product) [🖳]

with inputs as for 'Materials' and 'Energy'.

using the following characterisation factors from EU legislation

Table 11. MEErP characterisation factors for Heavy Metals to Air, in Ni equivalent

Heavy Metals (air)	**Cd**	**Hg**	**As**	HMU	**Ni**	Cr	Cu	**Pb**	Zn	MU
HM characterisation --> Ni eq.	**5**	**5**	**3.33**	2	**1**	0.5	0.5	**0.04**	0.04	0.01

MU= Metals Unspecified; HMU= Heavy Metals Unspecified.
Sources: emission limit values from Directives 2008/50/EC (AQD): Pb (0.5 mg/m^3) and 2004/107/EC: Cd (5 ng/m^3), As (6 ng/m^3), Ni (20 ng/m^3). Characterisation values are calculated from the inverse of these values, using the inverse of Ni mass equivalent (20 ng/m^3) as the reference accounting unit. The values for Cr(III), Cu, Zn are derived from Reporting Treshold Values under the E-PRTR Regulation 166/2006[75] in relation to Ni (50 kg/a), i.e. Cr(100 kg/a), Cu (100 kg/a), Zn (200 kg/a). Values for HMU and MU are defaults to be used only in case LCI data provide no more specific indications.

[74] Reference is updated, but values in the new reference (recast) are identical to the previous values
[75] Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC.

PAHa

Polycyclic Aromatic Hydrocarbons emissions to air

indicator

- Nickel equivalent (in mg Ni equivalent per product) [💻]

with inputs as for 'Materials' and 'Energy'.

using the following characterisation factors from EU legislation

Table 12. **MEErP characterisation factors for PAHs, in Ni equivalent**

PAHs (air)	PAHs*	C_6H_6 (benzene)	CO
HM characterisation -> Ni eq.	**20**	**0.004**	**0.000002**

**=benzo(a)pyrene [B(a)P], benzo(a)anthracene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene;*

Sources: emission limit values from Directives 2008/50/EC (on AAQ): C6H6 (5 µg/m³), CO (10 mg/m³) and 2004/107/EC : PAH (1 ng/m³ BaP). Characterisation values are calculated from the inverse of these values, using the inverse of Ni mass equivalent (20 ng/m³) as the reference accounting unit.

PM

particulate matter

indicator

- PM10 equivalent (in mg PM10 equivalent per product) [💻]

inputs as for 'Materials' and 'Energy'.

characterisation factors from EU legislation:

Table 13. **MEErP characterisation factors for PM, in PM10 equivalent**

PM	PM2,5	PM10	PM
PM characterisation -> PM10 eq.	**2**	**1**	**1**

**= data with unspecified PM particle size usually refer to toal mass, with equal weight of particles.*
Source: emission limit values from Directive 2008/50/EC (Ambient Air Quality Directive): PM2.5 (25 µg/m³), PM10 (50 µg/m³). Characterisation values are calculated from the invers of these values, using the inverse of PM10 as the reference accounting unit.

NEW in MEErP 2011: Specific emission limit values in 2008/50/EC on ambient air quality prompted different characterisation (in former MEEuP 2005 there was only PM10 or total PM mass)

HMw

Heavy Metal and PAH emissions to water

indicator

- Hg/20 equivalent (in mg (Hg/20) equivalent per product) []

with inputs as for 'Materials' and 'Energy'.

using the following characterisation factors from EU legislation

Table 14. MEErP characterisation factors for emissions of heavy metal emissions to water

Heavy Metals (water)	Hg	PAH	Cd	Pb	Ni
HM characterisation factor--> Hg/20 eq.	**20**	**20**	**11.1**	**0.14**	**0.05**

Source: annual average concentration limit values AA-EQS from Directive 2008/150/EC (Water Quality Directive): Hg (0.05 µg/l); PAH (0.05 µg/l); Cd (0.2 µg/l); Pb (7.2 µg/l); Ni (20 µg/l). Characterisation values are calculated from the inverse of these values, using (Hg/20) mass equivalent as the reference accounting unit.

NEW in MEErP 2011:

The new Water Quality Directive specifies, for the first time in EU legislation, emission limit values for 4 heavy metals and PAHs to water. With respect of former MEEuP 2005, which used limits from LCA-literature and also contained characterisation factors for As (3), Cu (2.8), Cr(0.4), Zn(0.2) and unspecified heavy metals (HMU; 3) the data set is more limited as regards heavy metals. The addition of PAH is new. The limits for Cd (was 7), Pb (was 0.5) and Ni (was 7) changed.

EP

Eutrophication Potential of emissions to water

indicator

- PO4 equivalent (in mg PO4 (phosphate) equivalent per product) []

with inputs as for 'Materials' and 'Energy'.

using the following characterisation factors from EU legislation

Table 15. MEErP characterisation factors for eutrophication

Eutrophication (water)	P	P2O5	PO4	N	NH4+	NO3-	BOD	Suspended Solids	DOC	TOC	COD
EP characterisation--> PO4 equivalent	**3.07**	**1.34**	**1**	**0.42**	**0.33**	**0.1**	**0.11**	**0.08**	**0.066**	**0.066**	**0.05**

Source: concentration limit values from Directive 91/271/EC (Urban Waste Water Treatment Directive UWWTD, including amendments up to 2008)[76]: biochemical oxygen demand BOD (25 mg/l O2), chemical oxygen demand COD (125 mg/l O2), suspended solids (35 mg/l), total phosphorus P (2 mg/l) and total nitrogen N[77] (15 mg/l). Characterisation values are calculated from these values, using PO4 mass equivalent (P content by atomic weight 31,57%) as the reference accounting unit.

HS/SVHC

Indicators for hazardous substances (HS) and Substances of Very High Concern (SVHC) in products

The use of cadmium (Cd), lead (Pb), mercury (Hg), hexavalent chromium (Cr VI), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) in products is banned under the RoHS Directive 2011/65/EU[78] if above 0.1% concentration in homogeneous materials (0.01% for Cd), but there are exemptions that may be addressed under Ecodesign.

Indicators are (if the product and/or its components is part of the exemptions):

- mass of Hg in product (in mg per product) [✋]
- mass of Cd in product (in mg per product) [✋]
- mass of Pb in product (in mg per product) [✋]
- mass of Cr VI in product (in mg per product) [✋]
- PBB concentration (in %, for component of homogeneous material) [✋]
- PBDE concentration (in %, for component of homogeneous material) [✋]

Under the REACH regulation No 1907/2006, manufacturers have to notify clients of a >0.1% concentration of SVHC in their products and –at the sunset date for a particular SVHC—the substance is banned unless a special authorisation is obtained. Currently, there are 6 substances on the SVHC Candidate list for which a sunset date is set:

Table 16. **REACH Subtances of Very High Concern**

Name	**Chemical name**	**CAS No.**	**Sunset date**	**Main application**
Musk xylene	5-tert-butyl-2,4,6-trinitro-m-xylene	81-15-2;	21.8.2014	fragrance
MDA	4,4'-Diaminodiphenylmethane	101-77-9	21.8.2014	hardener epoxy coating
HBCDD	Hexabromocyclododecane	3194-55-6; 25637-99-4	21.8.2015	brominated flame retardant (in EPS)
DEHP	Bis(2-ethylhexyl) phthalate	117-81-7	21.2.2015	PVC plasticizer
BPP	Benzyl butyl phthalate	85-68-7	21.2.2015	plasticizer vinyl foams
DBP	Dibutyl phthalate	84-74-2	21.2.2015	plasticizer

[76] COUNCIL DIRECTIVE of 21 May 1991 concerning urban waste water treatment (91/271/EEC)
(OJ L 135, 30.5.1991, p. 40) Amended by: Commission Directive 98/15/EC of 27 February 1998 L 67 29 7.3.1998 ,Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 L 284 1 31.10.2003;Regulation (EC) No 1137/2008 of the European Parliament and of the Council of 22 October 2008, L 311 1 21.11.2008 and corrected by: Corrigendum, OJ L 139, 2.6.1999, p. 34 (91/271/EEC) 1991L0271 —EN —11.12.2008— 003.001— 1.

[77] Kjeldahl nitrogen (organic and ammoniacal nitrogen) nitrate-nitrogen and nitrite-nitrogen.

[78] Note that RoHS was designed to "approximate the laws of the Member States [..art. 95 TEC] and to contribute to the protection of human health and the environmentally sound recovery and disposal of waste electrical and electronic equipment." It can be seen as a part of the Waste strategy or as part of a strategy to protect human health

In October 2011, the full Candidate list contains 53 substances, as given in the table below. The substances for which a sunset date has been established are indicated in a red, italic font.

Table 17**. REACH Candidate list for Substances of Very High Concern (source: ECHA, extract 5 Oct. 2011)**

1	1,2,3-Trichloropropane	**28**	Cobalt(II) carbonate
2	1,2-Benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich	**29**	Cobalt(II) diacetate
3	1,2-Benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters	**30**	Cobalt(II) dinitrate
4	1-Methyl-2-pyrrolidone	**31**	Cobalt(II) sulphate
5	2,4-Dinitrotoluene	**32**	Diarsenic pentaoxide
6	2-Ethoxyethanol	**33**	Diarsenic trioxide
7	2-Ethoxyethyl acetate	**34**	***Dibutyl phthalate (DBP)***
8	2-Methoxyethanol	**35**	Diisobutyl phthalate
9	***4,4'- Diaminodiphenylmethane (MDA)***	**36**	Disodium tetraborate, anhydrous
10	***5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene)***	**37**	***Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified:***
11	Acrylamide		***- Alpha-hexabromocyclododecane***
12	Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins)		***- Beta-hexabromocyclododecane***
13	Aluminosilicate Refractory Ceramic Fibres***		***- Gamma-hexabromocyclododecane***
14	Ammonium dichromate	**38**	Hydrazine
15	Anthracene	**39**	Lead chromate
16	Anthracene oil	**40**	Lead chromate molybdate sulphate red (C.I. Pigment Red 104)
17	Anthracene oil, anthracene paste	**41**	Lead hydrogen arsenate
18	Anthracene oil, anthracene paste, anthracene fraction	**42**	Lead sulfochromate yellow (C.I. Pigment Yellow 34)
19	Anthracene oil, anthracene paste,distn. lights	**43**	Pitch, coal tar, high temp.
20	Anthracene oil, anthracene-low	**44**	Potassium chromate
21	***Benzyl butyl phthalate (BBP)***	**45**	Potassium dichromate
22	***Bis (2-ethylhexyl)phthalate (DEHP)***	**46**	Sodium chromate
23	Bis(tributyltin)oxide (TBTO)	**47**	Sodium dichromate
24	Boric acid	**48**	Strontium chromate
25	Chromic acid, Oligomers of chromic acid and dichromic acid, Dichromic acid	**49**	Tetraboron disodium heptaoxide, hydrate
		50	Trichloroethylene
		51	Triethyl arsenate
26	Chromium trioxide	**52**	Tris(2-chloroethyl)phosphate
27	Cobalt dichloride	**53**	Zirconia Aluminosilicate Refractory Ceramic Fibres***(ZARCF)

***)are fibres covered by index number 650-017-00-8 in Annex VI, part 3, table 3.2 of Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, and fulfil the two following conditions:

a) for ZARCF: Al_2O_3, SiO_2 and ZrO_2 are present within the following concentration ranges: Al_2O_3: 35 – 36 % w/w, and SiO_2: 47.5 – 50 % w/w, and ZrO_2: 15 - 17 % w/w |||

for ARCF: Al_2O_3 and SiO_2 are present within the following concentration ranges: Al_2O_3: 43.5 – 47 % w/w, and SiO_2: 49.5 – 53.5 % w/w, or Al_2O_3: 45.5 – 50.5 % w/w, and SiO_2: 48.5 – 54 % w/w,

b) fibres have a length weighted geometric mean diameter less two standard geometric errors of 6 or less micrometres (µm).

More details on REACH, the EU and CAS numbers of substances on the candidate list, as well as the impacts per substance are given in the Methodology Report Part 2.

The SVHC indicator in the MEErP is a direct mass count in mg/product of the total mass of SVHC on the Candidate list; the Commission has not established specific characterisation factors that would allow weighting. The SVHC indicator has to be established 'manually' [✋], i.e. there are no provisions in the EcoReport tool to aid the assessment. One reason is that the Candidate list will change/expand frequently and the analysts conducting the preparatory studies are to tak into account the latest status of the candidate list at the time of the analysis (see REACH website[79] and EHCA Candidate list webpages[80]).

Currently (Oct. 2011) there are over 3500 pre-registered substances, large part of which are expected to enter the Candidate list in the coming years. For reasons mentioned in the Methodology Report Part 2, analysts are not required to conduct there chemical laboratory work, nor are they required to retrieve data that are not in the public domain. They are required to make their assessment on the basis of data from centralised bodies (industry associations, governmental agencies, EHCA, etc.) and if such information is not available they are to assume that SVHC do not occur in the product, or at least not in quantities exceeding the established limits.

Physical impacts

Indicators for physical impacts in the use phase as defined in Annex I of the Ecodesign directive:

- Sound power level, possibly subdivided in indoor and outdoor [81][✋]
- Radiation (Radon, UV, medical)[82] [83] [84] [85] [86][✋]
- Vibration (e.g. with machine tools)[87] [✋]
- Electromagnetic Fields EMF (e.g. from cell phone) [✋]

Possibly this list may be extended in the future with new subjects like e.g. nano-materials.

Not on the list of impact indicators

Note that indicators of emissions with **Ozone Depletion Potential (ODP)** and water **emissions of POPs** are no longer part of the list, as explained in the former MEEuP 2005 report: The ODP-emissions are now practically non-existing, due to the Montreal agreement and on water-emissions of POPs no data can be found. **Pesticides** are expected to have little bearing on ErP and were therefore not included. **Land use and biodiversity** are as yet not sufficiently developed to be included as indicators. Finally, as explained earlier **Product Life** and **Number of Users** (collective use) are important parameters to be assessed and may be subject to measures for certain products, but they are not considered appropriate generic environmental indicators for ErP.

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[79] http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

[80] http://www.echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp

[81] The Environmental Noise Directive (2002/49/EC) is one of the main instruments to identify noise pollution levels and to trigger the necessary action at Member State level. The Commission has recently published a first implementation report (COM(2011) 321 final of 1 June 2011) which summarises the implementation progress to date and outlines possible ways forward to improve implementation and enhance effectiveness of EU's environmental noise policy.

[82] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation

[83] Commission Recommendation of 21 February 1990 on the protection of the public against indoor exposure to radon (90/143/Euratom) laying down reference and design levels for indoor radon.

[84] Radon in drinking water is addressed by a Commission Recommendation on the protection of the public against exposure to radon in drinking water supplies (notified under document number C(2001) 4580, 2001/928/Euratom, 20 December 2001)

[85] Directive 97/43/Euratom provides for a high level of health protection to ionising radiation in medical exposure (dental and other X-ray applications).Relevant technical standards are (a.o.) the IEC 60601-series

[86] Effects of UV radiation from artificial light is currently under investigation by SCENIHR (Scientific Committee on Emerging and Newly Identified Health Risks)

[87] Directive 2002/44/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration) (sixteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

The tables below give a summary of the impacts, main characterisation and accounting rules.

Table 18. RESOURCES USE, summary MEErP characterisation

Impacts	*Units*	*Accounting*
MATERIALS totals mass	kg	**Stages: Production - Distribution - Use - EoL recycling - EoL disposal** Fractions: Bulkplastics- Tech. Plastics - Ferro - Non Ferro - Electronics - Misc.
production	kg	**Primary scrap manufacturing:** Direct credit to metal/plastic input
use phase	kg	**Consumables use phase**: input required, added to Totals (refrig. separate)
EoL metals & glass	kg	***Fixed:*** **5% landfill**; **95%** of (post consumer) waste **recycled** (fixed %) --> credit **X** % of new (ex ante) input. In line with current practice per half-product. *Max. dissassembly time large parts --> **10% recyclability credit** for fractions where this is applicable (product-specific)*
EoL plastics & PWB's	kg	***Indicate:*** **reuse-recycling-energy recovery-haz. incineration fractions** only defaults given, but to be changed as necessary --> ex post credits:

Re-use	Recycling	Recovery Energy
75% of all impacts of plastics used	27 MJ + 50% of feedstock energy & GWP of plastics	75% of feedstock energy & GWP of plastics

*Max. disassembly time PWB/**displays/batteries** --> 20% recyclability credit for these fractions*

recycling maximum	%	cannot recycle more than is disposed --> **$recycmaxt = 1 / (1+r)^L$** with L=product life in years, r=average annual growth rate over life (units, %)
refrigerants & mercury	g	*indicate:* Refrigerant type (GWP), Refrig. & Hg mass in products (to EoL), mass in fugitive emissions (to Use phase) *[report also gives TEWI sample]*
Critical Raw Materials (CRM)	g W eq.	

Ge	Be	Ta	In	PGM	Ga	Sb	W	Nb	REM	Co	C	CaF2	Mg
90	60	45	45	40	40	5	1	0.2	0.15	0.1	0.05	0.005	0.0025

kg tungsten (W) equivalent per kg; PMG= Platinum Materials Group= Pt, Pd, Rh, Ru, Os, Ir ; REM= Rare Earth Metals= fifteen lanthanoids, scandium, yttrium; C=graphite; CaF2=fluorspar.

ENERGY	MJ	***Stages: Production - Distribution - Use - EoL recycling - EoL disposal*** 1 assessment for ErP direct impact; **1 for ErP indirect impact (Affected Energy)**

Total	Electricity	Heating energy
GER: Gross Energy Requirement	primary energy (9 MJ primair= 1 kWh e)	Net Calorific Value (conversion as in Part 2)

Add: energy in feedstock

WATER	m^3	

Process water	Cooling Water
m^3	m^3

WASTE	kg	

Hazardous	Non-hazardous
kg	kg

Table 19. EMISSIONS, HAZARDOUS SUBSTANCES & PHYSICAL IMPACTS (MEErP characterisation)

Emissions	*Units*	*Relevant emissions and their characterisation factors (EcoReport tool)*									
GWP-100	kg CO2 eq.	**CO2**	**CO**	**CH4**	**N2O**	**CF4**	**C2F6**	**SF6**	**R134a**	**other**	
		1	1,57	25	298	6500	9200	22800	1430	IPPC'07	
AP	g SO2 eq.	**SOx**	**NOx**	**N2O**	**NH3**	**HF**	**HCl**	**H2S**	**H2SO4**	**other**	
		1	0.7	1.78	1.88	1.6	0.88	1.88	0.65	CLRTAP	
NMVOC	kg NMVOC	**direct mass count for all Non-Methane VOC**									
POP	ng Teq eq.	**dioxin and furan TCCD eq. factors** from IE directive (recast. no change 2005)									
HMa	mg Ni eq.	**Cd**	**Hg**	**As**	HMU	**Ni**	Cr III	Cu	**Pb**	Zn	MU
		5	5	3.33	2	1	0.5	0.5	0.04	0.04	0.01
PAH	mg Ni eq.	**PAH**	**C6H6**	**CO**							
		20	0.004	0.000002							
PM	g PM10 eq.	**PM2.5**	**PM10**	'PM'							
		2	1	1							
HMw	mg Hg/20 eq.	**Hg**	**PAH**	**Cd**	**Pb**	**Ni**					
		20	20	11.1	0.14	0.05					
EP	g PO4 eq.	**P**	**P2O5**	**PO4**	**N**	**NH4+**	**BOD**	**S. solids**	**DOC**	**TOC**	**COD**
		3.07	1.34	1	0.42	0.33	0.1	0.11	0.08	0.066	0.05

Hazardous substances (manual calculation)

HS/SVHC	kg	**RoHS exceptions**	**REACH Substances of Very High Concern SVHC(list 2011)**
		Hg; Cd; Pb; Cr VI; PBB; PBDE	**e.g. Musk xylene; MDA; HBCDD; DEHP; BPP; DBP***

Physical impacts use phase (manual calculation)

Noise	sound power level, product-specific definition
Vibration	frequency & amplitude, product-specific definition
Radiaton	radiation level (Bq, Becquerel), product-specific definition
EMF	electro-magnetic field, product-specific definition

*Legend: All **black** values are derived from treaties and legislation; Cr III/Cu/Zn from E-PRTR 2006; HMU, MU, PM from LCA sources; **green** values= updated since 2005*

**= SVHC Candidate list of substances: mandatory notification of clients if product contains >0.1% mass and subject to special permit to place on the market (at the 'sunset date'); importers are obliged to notify the EHCA (www.ehca.eu) at an imported mass >1000 kg/year. As predecessor of the SVHC-list there is a Candidate list, for which notification at >0.1% mass fraction is mandatory, currently containing 24 substances (mainly plasticizers and chroming-related substances)*

Abbreviations impacts: GWP-100= Global Warming Potential at 100 years; AP is emissions with Acidifying Potential; NMVOC= Non Methane Volatile Organic Compounds; POP=Persistent Organic Pollutants; Hma= Heavy Metals emissions to air; PAH= Polycyclic Aromatic Compounds; PM= Particulate Matter; HMw= Heavy Metals & PAH emissions to water; EP= emissions to water with potential for Eutrophication and influencing oxygen balance; HS= Hazardous Substances; RoHS=(directive on) Restriction of HS; SVHC= Substances of Very High Concern; REACH= Registration, Evaluation and Authorisation of CHemicals

Abbreviations other: HMU= 'Heavy Metals' composition Unknown; MU= 'Metals' composition Unknown; PM 2.5= (fine) Particulate Matter, aerodynamic diameter 2.5 micrometers or less; PM10= (coarse) Particulate Matter, diameter 2.5-10 micrometers; BOD= Biochemical Oxygen Demand; S. solids = Suspended solids; TOC= Total Organic Carbon content; COD= Chemical Oxygen Demand; DOC=Degradable Organic Carbon content

Characterisation factors in the MEErP and EcoReport tool are rigorously based on values in EU legislation, as can be seen from the notes with the detailed tables per impact indicator . They do not pretend to be based on the 'latest scientific insights' in terms of impacts, but they assume that these 'latest insights' (in all likelihood elaborated in the existing LCA tools) were at some stage the input –or one of the inputs—to arrive at e.g. the limit values in legislation.

In the Methodology report Part 2 the legal background will be explained that led to the choice for the set of parameters. Subsequently, for each of the above-mentioned resources/environmental impacts, the most relevant issues are discussed, i.e.

- Introduction to the legal and EU policy context (policies and legislation);
- EU trends and targets;
- EU sources;
- Share of EU in global context;
- Role of the emissions in preparatory studies thus far;
- Measurement units and multipliers for the MEErP environmental analysis.

5.4 ErP EcoReport Manual

The ErP EcoReport facilitates the environmental impact analysis of Energy-related Products. The EcoReport, an MS Excel form, were redesigned and updated to make it suitable for Energy-related Products. It facilitates the environmental analysis of indicators marked with symbol 💻 in the previous section. Indicators marked with the symbol ✋ ('manual') are not included in EcoReport, but this does not mean that they are not a mandatory part of the environmental analysis in preparatory studies.

The EcoReport uses the Bill-of-Materials, Energy and other resources used during product life, as well as key parameters for manufacturing, distribution and end-of-life as input parameters. With the Unit Indicators, the tool generates the environmental impacts for the indicators required for the 4 stages of product-life. These impacts are summarized on the "Output" worksheet.

Furthermore, for analysts, the outputs per single input item are given on the "Raw" worksheet. On the next pages "ErP EcoReport version 1" of 2011 is illustrated. Both the "Output" and "Raw" worksheets allow the production and printing of any type of graphs available in MS Excel from the given data. In parallel to the calculation of environmental impacts, the Input and Output worksheets of the latest versions of the ErP EcoReport also include sections to facilitate the calculation of average Life Cycle Costs per product and the calculation of the total expenditure of EU consumers in the most recent year. Please note that the total expenditure relates to the production and distribution of new products plus the emissions and resources of the stock in that year. The total expenditure is given in direct costs to the end users in one year; running costs are not discounted and it is not a summation of individual Life Cycle Costs.

INPUT for the worksheet ErP EcoReport

Step 1 Input Bill of Materials

Open the ErP EcoReport and notice that there are four worksheets, “Input”, “Raw”, “Results” and “Extra Materials”. The Input Worksheet starts with a section of 40 lines reserved for the Bill-of-Materials. When more lines are needed, the plus sign on the left can be used to extend the list to the original 200 lines. Descriptions of the components can be filled in manually or pasted from e.g. standard CAD-files. Product weights have to be filled in manually. For the selection of a Process or Material, first a main category has to be selected and subsequently in that category the right material or process; both from drop-down menu’s.

In the BOM-section the weight per component is multiplied with the environmental Unit Indicators from the LCA Unit Indicators (see MEErP 2011 Methodology, Part 2). In the RAW Worksheet this can be seen. Also the product weights are summed per Category (Ferro, Non-Ferro, Bulk Plastics, etc.) and summed parameters are prepared for the manufacturing, distribution and en-of-life phases in the “Results” sheet.

Table 20 Input Materials Extraction &Production

Version 2VHK for European Commission Oct. 2011			Document subject to a legal notice (see below)	
ECODESIGN OF ENERGY-RELATED PRODUCTS			**EcoReport 2011: INPUTS** **Assessment of Environmental Impact**	
Nr	Product name		Date	Author
	Products			
Pos	MATERIALS Extraction & Production	Weight	Category	Material or Process
nr	Description of component	in g	Click &select	select Category first !
1				
2				
3				
4				
5				
39				
40				
	TOTAL	0		

Step 2 Manufacturing

The following section describes the (OEM) manufacturing of metals and plastics components. Most of this section uses fixed impacts on a weight basis (see explanations of rows 25, 34-37 of the table of LCA Unit Indicators in the MEErP 2011 Methodology, Part 2 report). Specific weights per process are calculated automatically from the BOM section. The only variable that can be edited is the percentage of sheetmetal scrap, i.e. the default 25% value can be changed.

Table 21 Manufacturing

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

Step 3 Final assembly and Distribution

The section on Final Assembly and Distribution covers all activities from OEM components to the final customer (rows 59-64 of of the table of LCA Unit Indicators in the MEErP 2011 Methodology, Part 2 report). The only design variable is volume of the final (packaged) product, but the impact also depends on what type of product is concerned. The latter is characterized by two Boolean (yes/no) variables.

Table 22 Distribution

Pos	DISTRIBUTION (incl. Final Assembly)		Answer	Category index (fixed)
nr	Description			
208	**Is it an ICT or Consumer Electronics product <15 kg?**		NO	59
209	**Is it an installed appliance (e.g. boiler)?**		NO	60
				62
210	**Volume of packaged final product in m^3**	**in m3**	100	63
				64

Step 4 Use Phase

For the Use Phase, the average Product Life in years has to be filled in. After that, the 'Electricity' subsection gives the option to fill in the electricity use split-up in 3 modes (on/standby/off mode). These modes can be used, but they don't have to be used; it is also possible to simply specify an aggregated annual energy use (in kWh) in the on-mode and fill in '1' in the next line. The thing to remember is that the energy use is given per year. The spreadsheet programme just sums the electricity use over the 3 modes and multiplies with the Product Life (in years).

The issue of how direct ErP impacts, indirect ErP impacts and totals are calculated has been explained in Task 3 (Chapter 3); the EcoReport tool foresees 3 sections for this: one for the indirect impact, one for the direct impact and a (non-editable) section summing the two.

The "Heat" consumption applies to stationary combustion installations using fossil fuels and more specifically for the product case of central heating boilers. It requires that the average heat output is filled in (in kW) as well as the number of hours the installation is supplying this heat output (or equivalent, if it is in part load). Under the heading 'Type and Efficiency' a number of standard heat generators with different efficiencies are presented. On request of stakeholders, the standard efficiency numbers can be varied within a pre-determined narrow bandwidth.

After the Heat subsection, the user can fill in the annual consumption in kg of other consumables like water, detergent, toner, paper, etc. Apart from water, the consumables can select up to 3 different consumable types per product from a drop-down list.

The last subsection deals with the travelling distance of maintenance and repair services, where the number of km over Product Life needs to be estimated. The following line - which cannot be edited - specifies the number of spare parts, presumably 1% of the impact of the BOM.

The Use Phase section uses the Unit Indicators from rows 57 (paper), 65-78 (electricity and heat), 79-84 (consumables), 86-87 (maintenance, repairs).

Table 23. Use phase

Pos	USE PHASE indirect ErP impact		unit	Subtotals
nr	Description			
211	ErP Product service Life in years (see comment)	0	years	
	Electricity			
212	On-mode: Consumption per hour, cycle, setting, etc.	0	kWh	0
213	On-mode: No. of hours, cycles, settings, etc. / year	0	#	
214	Standby-mode: Consumption per hour	0	kWh	0
215	Standby-mode: No. of hours / year	0	#	
216	Off-mode: Consumption per hour	0	kWh	0
217	Off-mode: No. of hours / year	0	#	
	TOTAL over ErP Product Life	0.00	MWh (=000 kWh)	66
	Heat			
218	Avg. Heat Power Output (when saved use a negative value)	0	kW	
219	No. of hours / year	0	hrs.	
220	Type and efficiency (Click & select)			86-not applicable

	TOTAL over ErP Product Life	**0.00**	**GJ**	
	Consumables (excl, spare parts)			**material**
221	**Water**	0	m^3/year	**84-Water per m3**
222	**Auxilliary material 1** **(Click & select)**	0	kg/ year	**86-None**
223	**Auxilliary material 2** **(Click & select)**	0	kg/ year	**86-None**
224	**Auxilliary material 3** **(Click & select)**	0	kg/ year	**86-None**
225	**Refrigerant refill** **(Click & select type, even if there is no refill)**	0	kg/ year	**1-none; 0000**
	Maintenance, Repairs, Service			
	not affected			
Pos nr	USE PHASE direct ErP impact Description		unit	Subtotals
226	**ErP Product (service) Life in years**	**0**	years	
	Electricity			
227	**On-mode: Consumption per hour, cycle, setting, etc.**	0	kWh	0
228	**On-mode: No. of hours, cycles, settings, etc. / year**	0	#	
229	**Standby-mode: Consumption per hour**	0	kWh	0
230	**Standby-mode: No. of hours / year**	0	#	
231	**Off-mode: Consumption per hour**	0	kWh	0
232	**Off-mode: No. of hours / year**	0	#	
	TOTAL over ErP Product Life	**0.00**	**MWh (=000 kWh)**	66
	Heat			
233	**Avg. Heat Power Output**	0	kW	
234	**No. of hours / year**	0	hrs.	
235	**Type and efficiency** **(Click & select)**			86-not applicable
	TOTAL over ErP Product Life	**0.00**	**GJ**	
	Consumables (excl, spare parts)			**material**
236	**Water**	0	m^3/year	**84-Water per m3**
237	**Auxilliary material 1** **(Click & select)**	0	kg/ year	**86-None**
238	**Auxilliary material 2** **(Click & select)**	0	kg/ year	**86-None**
239	**Auxilliary material 3** **(Click & select)**	0	kg/ year	**86-None**
240	**Refrigerant refill** **(Click & select type, even if there is no refill)**	0	kg/ year	**3-R404a; HFC blend; 3920**
	Maintenance, Repairs, Service			
241	**No. of km over Product-Life**	0	km / Product Life	87
242	**Spare parts** (fixed, 1% of product materials & manuf.)	0	g	1%

Pos	ENERGY TOTAL (=indirect + direct ErP impact in use phase)		unit	Subtotals
nr	Description			
	Electricity			0
243	***TOTAL over Product Life of ERP***	**0.00**	***MWh (=000 kWh)***	66
	Heat			
244	**extra for extraction and transport, ErP indirect**	0%		
245	**extra for extraction and transport, ErP direct**	0%		
246	***TOTAL over Product Life of ERP indirect***	**0.00**	***GJ***	86-not applicable
247	***TOTAL over Product Life of ERP direct***	**0.00**	***GJ***	86-not applicable
	Consumables (excl, spare parts)			***material***
248	***Water, Total over ErP Product Life***	*0*	m^3	**84-Water per m3**
249	***Auxilliary material 1***	*0*	*kg*	***86-None***
250	***Auxilliary material 2***	*0*	*kg*	***86-None***
251	***Auxilliary material 3***	*0*	*kg*	***86-None***
252	***Refrigerant refill** (Click & select type, even if there is no refill)*	*0*	*kg*	***Average GWP is 0***

Step 5 Disposal & Recycling

The last part of the environmental impact assessment deals with aspects of the end-of-life (EoL). Values displayed in red font can be edited (overwrite defaults).

Rows 253-256 are essential for the calculation of recycmax (see previous section), i.e. the mass[88] that is available for EoL-management, as a result of the product stock life (years between product purchased and product discarded[89]), the change in sales over a period that equals the product stock life, the change in the unit mass and –as a result-- change in overall mass consumption.

Rows 257-262 deal with the final calculation of recycmax and the available EoL mass per materials fraction. The current relative fractions (in %) are given in Row 257 and the analyst can indicate how this relative fraction was in products x years ago (x=product stock life) in row 258. The sum of the percentages should always be 100%. Note that the calculation of mercury is different, i.e. data are in mg/unit. Mercury is not included in the overall mass balance (negligible mass compared to the rest); the whole mercury mass balance, even though there is a production and possible use phase impact, is included in this EoL section for practical reasons. Rows 260-262 give the automatic calculation of the EoL mass available.

Rows 263-267 give the destination of the EoL available mass over 5 fractions: re-use, recycling (material), recovery (heat), incineration and landfill/missing/fugitive. All values, except for the metals where the credit is already taken into account on the basis of the given fixed percentages, can be edited. The sum of the percentages should always be 100%. Background information of each destination is given in the footnotes to the table.

[88] Includes the product mass and the consumption of mass of auxiliary materials/ refrigerants over product life.
[89] Not necessarily the same as the product service life. i.e. the period that the product is in use and operational, because many consumes keep the product stocked before they decide to throw it away.

Row 269 deals with recyclability, the potential of the new products to change the course of the materials flows , e.g. due to faster pre- disassembly or other ways to bring about less contamination of the mass to be recycled (see MEErP Methodology Report Part 2) . Therefore it is economically likely that the recycled mass at EoL will displace more virgin material in other applications . The recyclability does not influence the mass balance but it does give a reduction or increase up to 10% on all impacts of the recycled mass. It is forward looking, e.g. values different from 'avg' (=base case) should only be filled in for design options. Row 269 contains dropdown-boxes allowing the analyst a choice between best, better than average ('>avg'), average ('avg', applies to basecase), worse than average ('<avg') and worst. The reasoning is that through an optimised pre-disassembly of larger metal, glass, etc. parts --before the rest of the product goes into a shredder-based recycling route-- the contamination of these materials is limited and therefore they are more likely to be recycled in applications where they displace virgin materials. The appropriate criteria for this classification need to be determined in the preparatory study for a specific product.

Table 24 Disposal & Recycling

Pos nr	DISPOSAL & RECYCLING Description				
253	product (stock) life L, in years	0	Please edit values with red font		
		current	L years ago	period growth PG in %	CAGR in %/a
254	unit sales in million units/year	0.000	0.000	0.0%	0.0%
255	product & aux. mass over service life, in g/unit	0	0	0.0%	0.0%
256	total mass sold, in t (1000 kg)	0	0	0.0%	0.0%

Pos nr	Description	1	2	3	4	5	6	7a	7b	7c	8	9	
	Per fraction (post-consumer)	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc. . excluding refrigant & Hg	refrigerant	Hg (mercury), **in mg/unit**	Extra	Auxiliaries	***TOTAL (CARG avg.)***
257	current fraction, in % of total mass (or mg/unit Hg)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0%	0.0%	*0.0%*
258	fraction x years ago, in % of total mass	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0%	0.0%	*0.0%*
259	CAGR per fraction r, in %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	current product mass in g	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
260	stock-effect, total mass in g/unit	0	0	0	0	0	0	0	0	0.0	0	0	*0*
261	EoL available, total mass ('arisings') in g/unit	0	0	0	0	0	0	0	0	0.0	0	0	*0*
262	EoL available, subtotals in g		0		0		0	0	0	0.0	0	0	*0*
													AVG
263	EoL mass fraction to re-use, in %						1%			1%		5%	*0.0%*
264	EoL mass fraction to (materials) recycling, in %	22%	22%		94%		50%	65%	30%	39%	60%	30%	*0.0%*
265	EoL mass fraction to (heat) recovery, in %	32%	32%		0%		0%	1%	0%	0%	0%	10%	*0.0%*
266	EoL mass fraction to non-recov. incineration, in %	12%	12%		0%		20%	5%	5%	5%	10%	10%	*0.0%*
267	EoL mass fraction to landfill/missing/fugitive, in %	33%	33%		5%		29%	29%	64%	55%	29%	45%	*0.0%*
268	TOTAL	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*101%*	*100%*	*100%*	*100%*	*100%*	*0.0%*

269	EoL recyclability****, (click& select: 'best', '>avg', 'avg' (basecase); '< avg'.; 'worst')	avg	avg	avg	avg	avg	avg	avg	avg	avg	avg	avg	*avg*
		0%	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	

L is product (stock) life = period between product purchased and product discarded

PG=growth rate over period of L years= (value current - value L years ago)/(value L years ago)

CAGR=Compound Annual Growth Rate = (1+ PG)^(1/L) - 1 (^= to the power)
EoL available mass' or 'arisings' = Total mass available for End-of-Life (EoL) management = recycmax * current fraction * product mass, with recycmax=1/(1+CAGR)^L,

'stock' = the surplus (or deficit) of mass in stock (in use or stored with consumer) due to growth (or decline) of the unit sales or the share of the materials fraction over a period that equals the product life. stock= stock-effect arisings - product mass*current fraction ; '

're-use'= fraction of EoL available mass in components that can be re-used in new products. The generic credit relative to the re-used mass is 65% on all impacts and for all fractions, taking into account the impact of collection, sorting, cleaning, etc. (as opposed to MEEuP 2005, where the collection effort was calculated separately). In case the specific re-use credit found for a specific product deviates from the default it is recommended to adapt the mass fraction accordingly.

recycling'= fraction of EoL available mass that is recycled for its materials. For metals this is already included in the production impact, based roughly on the fraction mentioned (values cannot be edited). For plastics, electronics, miscellaneous materials, refrigerants, mercury and the extra materials these values need to be edited (overwrite default values). The credit relates to the recyled mass and depends on the main virgin material that will be displaced by the recycled mass, the remaining value at final disposal (e.g. heat recovery) and/or avoidance of operations for disposal of hazardous substances (pyrolysis). E.g. for plastics the most popular displaced material is wood (e.g. 27 MJ/kg is < 50% of bulkplastics value) and remaining value at final disposal is 50% of the feedstock energy and GWP value.
For electronics (PWBs, ICs, controllers, displays, etc.) main credits come from recovery of metals (Cu, Fe, tin, traces of Au, Pt, Pd), glass (from displays, cullet displaces virgin material mainly in fiberglass insulation) and avoidance of treatment of hazardous substances (e.g. Pb, Cd, etc.). Note that the WEEE recast impact assessment report found official electronics recycling rates to be low (in 2005: 20% for tools, 27% for ITC equipment, 35-40% for TVs/monitors) but suspects actual, unreported (possibly incorrect) recycling activities to be substantially higher. For miscellaneous materials recycling fractions fully depend on the materials involved and a weighted average needs to be determined beforehand. For 'Misc.', including refrigerants and Hg, credit comes from re-use after purification, avoiding treatment as hazardous waste, etc. . For all materials, except metals (where it is assumed to be higher), a credit of 40% on all impacts is assumed related to the recycled mass. See MEErP Methodology Report Part 2 for more guidance.

'(heat) recovery' = fraction of EoL available mass where the combustion heat is used, e.g. for district heating. In the context of ErP it is assumed to apply only to plastics and all other materials for which a feedstock energy value is given. The credit is 75% of feedstock energy (net combustion value) and GWP.

'non-recov. Incineration' = fraction of EoL available mass that is incinerated without heat recovery, either because there is no effective contribution to the combustion (non-combustibles) , the incineration plant has no clients for waste heat, etc.. Impacts of 'incineration' as given in the Unit Indicator table (see MEErP Methodology Report Part 2, Table 13, row 92) apply.

'landfill/fugitive/missing' = fraction of EoL available mass that goes to landfill, that escapes during use (for substances that are gaseous or evaporate at atmospheric conditions like most refrigerants and mercury) and that are unaccounted for (illegal dumping etc.). Impacts of 'landfill' as given in the Unit Indicator table (see MEErP Methodology Report Part 2, Table 13, row 89) apply.

'recyclability' relates to the potential of the new products to change the course of the materials flows , e.g. due to faster pre- disassembly or other ways to bring about less contamination of the mass to be recycled (see MEErP Methodology Report Part 2) . Therefore it is economically likely that the recycled mass at EoL will displace more virgin material in other applications . The recyclability does not influence the mass balance but it does give a reduction or increase up to 10% on all impacts of the recycled mass. It is forward looking, e.g. values different from 'avg' (=base case) should only be filled in for design options.

NEW in MEErP 2011:

1.

Complete review of the EoL section, showing transparently the stock-effect (recycmax) and the materials flows per materials fraction.

2.

Recycling and recyclability of Electronics/Metals/Misc./Extra fractions was incorporated.

3.

Stock, recyclability and recycling values of the EXTRA MATERIALS were accommodated in the EoL section (values taken from the “EXTRA MATERIALS” sheet.)

Step 6 Calculation of EU totals and life Cycle Costs

After the inputs for calculating the environmental impacts, there is a small section that allows the calculation of EU totals and of the Life Cycle Costs. The Product Life (in years) is derived from the environmental section. Next the total annual EU sales and the installed EU stock, both in million units have to be given. Follows a section that asks the average price and - if applicable - the installation and maintenance costs of the product to the consumer (incl. taxes). For energy and water some default rates are given. Prices for other consumables can be filled in (see par. 6.8 of this report and the individual Product Cases). All these prices and rates can be adjusted. The same goes for the discount rate. What cannot be changed directly is the Present Worth Factor (in years). This is calculated from the discount rate, the escalation rate and the product life (see Chapter 6).

<u>NEW in MEErP 2011:</u> The escalation rate, i.e. the annual growth rate of running costs (energy, water), is a new feature that allows the analyst to take into account energy price projections. (see Ch. 6)

Finally, the last input in the LCC calculation is a rough indicator of the ratio between the energy consumption of the average new product and the energy consumption of the average product installed ('stock'). Approximately, if there has been no revolutionary growth or decrease in sales, the average product installed should equal the average new product a number of years ago, where the number of years equals half the product life. For instance, for whitegoods (refrigerators, dishwashers with a product life of ca. 15 years) this would be the average new product 7 to 8 years ago.

Table 25. Inputs for EU-Totals & LCC

nr	INPUTS FOR EU-Totals & economic Life Cycle Costs Description		unit
A	Product Life	**1**	years
B	Annual sales		mln. Units/year
C	EU Stock		mln. Units
D	Product price		Euro/unit
E	Installation/acquisition costs (if any)		Euro/ unit
F	Fuel rate (gas, oil, wood)		Euro/GJ
G	Electricity rate		Euro/kWh
H	Water rate		Euro/m^3
I	Aux. 1: None		Euro/kg
J	Aux. 2 :None		Euro/kg
K	Aux. 3: None		Euro/kg
L	Repair & maintenance costs		Euro/ unit
M	Discount rate (interest minus inflation)	**4.0%**	%
N	Escalation rate (project annual growth of running costs)	**4.0%**	%
O	Present Worth Factor (PWF) (calculated automatically)	**1**	(years)

P	Overall Improvement Ratio STOCK vs. NEW, Use Phase	**1.00**

OUTPUT Worksheet ErP EcoReport

The Output Worksheet immediately reflects the changes in the Input Worksheet. The most important table in the output worksheet is the first one, which indicates the environmental impacts per product over its life-cycle, subdivided in production, distribution, use and end-of-life.

NEW in MEErP 2011: The lines for ODP (air) emissions and emissions of POP to water, which both rendered negligible effect in the former MEEuP 2005 tool, were eliminated.

Table 26 Output ErP EcoReport

	Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
	Resources Use and Emissions		Material	Manuf.	**Total**	BUTION		Disposal	Recycl.	**Stock**	
	Materials	**unit**									
1	Bulk Plastics	g			**0**		**0**	0	0	0	**0**
2	TecPlastics	g			**0**		**0**	0	0	0	**0**
3	Ferro	g			**0**		**0**	0	0	0	**0**
4	Non-ferro	g			**0**		**0**	0	0	0	**0**
5	Coating	g			**0**		**0**	0	0	0	**0**
6	Electronics	g			**0**		**0**	0	0	0	**0**
7	Misc.	g			**0**		**0**	0	0	0	**0**
8	Extra	g			**0**		**0**	0	0	0	**0**
9	Auxiliaries	g			**0**		**0**	0	0	0	**0**
10	Refrigerant	g			**0**		**0**	0	0	0	**0**
	Total weight	g			**0**		**0**	0	0	0	**0**
									see note!		
	Other Resources & Waste							debet	credit		
11	Total Energy (GER)	MJ	0	0	**0**	**0**	**0**	0	0		**0**
12	of which, electricity (in primary MJ)	MJ	0	0	**0**	**0**	**0**	0	0		**0**
13	Water (process)	ltr	0	0	**0**	**0**	**0**	0	0		**0**
14	Water (cooling)	ltr	0	0	**0**	**0**	**0**	0	0		**0**
15	Waste, non-haz./ landfill	g	0	0	**0**	**0**	**0**	0	0		**0**
16	Waste, hazardous/ incinerated	g	0	0	**0**	**0**	**0**	0	0		**0**
	Emissions (Air)										
17	Greenhouse Gases in GWP100	kg CO2 eq.	0	0	**0**	**0**	**0**	0	0		**0**
18	Acidification, emissions	g SO2 eq.	0	0	**0**	**0**	**0**	0	0		**0**
19	Volatile Organic Compounds (VOC)	g	0	0	**0**	**0**	**0**	0	0		**0**
20	Persistent Organic Pollutants (POP)	ng i-Teq	0	0	**0**	**0**	**0**	0	0		**0**
21	Heavy Metals	mg Ni eq.	0	0	**0**	**0**	**0**	0	0		**0**
22	PAHs	mg Ni eq.	0	0	**0**	**0**	**0**	0	0		**0**
23	Particulate Matter (PM, dust)	g	0	0	**0**	**0**	**0**	0	0		**0**
	Emissions (Water)										
24	Heavy Metals	mg Hg/20	0	0	**0**	**0**	**0**	0	0		**0**
25	Eutrophication	g PO4	0	0	**0**	**0**	**0**	0	0		**0**

From this table and the inputs for LCC and EU Totals the total environmental impact of all products sold in the most recent years can be calculated, over the coming years (up till and including the end-of-life). This is not shown here, because the table looks the same as above, only the accounting units are different and of course the data are different. Basically what has happened is that all figures in the table above are multiplied by the EU sales (in mln. units).

The third table is also derived from the two above. It copies the production, distribution and end-of-life figures from the second table to indicate the EU environmental impact in the current year. But the use phase data are not copied directly, but first multiplied with the 'Overall Improvement Ratio' to indicate the difference between the new sales and the current stock. Policy makers largely cannot influence this, because on average most of the impact was caused already half a product lifetime ago. But it tells them how the product fits in the current statistics and - together with the previous table - it tells them how much progress (or not) the sector is already making.

The fourth table uses the totals from the third table and compares these total annual impacts with the EU total annual impacts, regarding resource use and emissions. The percentage is shown in the fourth column and gives a direct insight in the impact of a product.

The following table of the Output worksheet calculates two parameters, that both relate to economic expenditure, but that are otherwise completely different. The first parameter is the Life Cycle Costs of one product to an end-user, i.e. a (potential) buyer that calculates the economic rationale of his or her investment decision today and that looks into the future in terms of discounted running costs. This is important for the Base Case and the evaluation of an appropriate target (see Chapter 6). The second parameter calculates the EU Total of all expenditure to end-users in the most recent year, i.e. the running costs are not discounted and for the running costs in the use phase the calculation starts from the installed stock.

The Input and Output worksheets of the ErP EcoReport can be used to calculate the average EU product –the so-called Base Case—but it can also be used to calculate the Base Case including one or more design options. With each design option the environmental and the economic profile of the product will change. When opening several instances of the ErP EcoReport in MS Excel and summarizing the outcomes in a new spread sheet it is possible to experiment with the ranking of design options.

NEW in MEErP 2011: At the very end of the RESULTS sheet, there is a table that presents the total impacts of the product as a fraction of the EU-27. For this the normalisation Table 27 is used. The result gives an immediate impression whether and on which impacts the product score can be called 'significant'.

Table 27: Normalisation factors: EU-27 Totals 2007

Description	Value	Unit	References
Materials			
Plastics	**48**	**Mt**	Ref: Plastics Europe (demand by EU converters) [1]
Ferrous metals	**206**	**Mt**	Ref: Iron & Steel Statistics Bureau [1]
Non-ferrous metals	**20**	**Mt**	Ref: www.eaa.net et al. (Al 12.5+Cu 4.7 + Zn 0.8 + Pb 0.8 + Ni 0.3)
Glass	**10**	**Mt**	Ref: EC Summary of Impact Assessment on WEEE (SEC(2008)2934) [1]
Paper/cardboard	**88**	**Mt**	Paper/Cardboard. Ref: CEPI (EU consumption) [1]
Resources			
Energy	**75 697**	**PJ (NCV)**	Eurostat. Gross Inland Consumption EU-27. 2007. in Net Calorific Value
Heating fuels	**24 720**	**PJ (GCV)**	heat & heating fuels. final end-use (excl. transport and feedstock). Gross Calorific Value. Ref: VHK
Electricity	**2 800**	**TWh**	Final end-use. Ref: Eurostat[90]
Total water use	**247 000**	**M m^3**	Ref: http://ec.europa.eu/environment/water/quantity/pdf/exec_summary.pdf [1]
Non-haz. Waste	**2 947**	**Mt**	Ref: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Generat
Haz. Waste	**89**	**Mt**	ion_of_waste._total_arising_and_by_selected_economic_activities.
Emissions to air			
GHG emissions	**5 054**	**Mt CO_2eq**	Ref: EEA3 (CO_2 4187 + CH4 416 + N2O 374 + HFCs 63 + PFCs 4 + SF6 10)
Acidifying potential	**22 432**	**kt SO_2 eq.**	Ref: EEA1 (NO_x 11 151 + Sox 7 339 + NH_3 3 876)
NMVOC	**8 951**	**kt**	Ref: EEA1
POPs	**2 212**	**g i-Teq**	Ref: EEA1 (dioxins and furans only)
HM (air)	**5 903**	**t Ni eq**	Ref: EEA1 (Cd 118 + Hg 89 + Pb 2157 t); EEA2 (As 337 + Ni 2843 t); CML (Cr 517 + Cu 589 + Zn 6510 t)
PAHs	**1 369**	**t**	Ref: EEA1
PM formation	**3 522**	**kt**	Ref: EEA1 (1400 kt PM2.5-10 + 2122 kt PM10)
Emissions to water			
HM (water)	**12 853**	**t Hg/20**	Ref: CML (As 17+Cd 21.3 + Cr 271 + Cu 1690 + Pb 2260 + Hg 14.3 + Ni 551 t + Zn 11200 t)
Eutrophication	**900**	**kt PO_4eq**	Ref: EEA2 (Baltic 861 N/5.4 P + North Sea 761 N/14.4 P + Danube/Black Sea 270 N/ 14.2 P)

Sources:

EEA1, European Environmental Agency, National emissions reported to the Convention on Long-range Transboundary Air Pollution (LRTAP Convention), EU-27 (national territory), 2007. (extract Feb. 2011)

EEA2, Source apportionment of nitrogen and phosphorus inputs into the aquatic environment, 2005. [Compare: CML value for EU-15, 1995 is 1 263 kt PO4 eq. based on 1 370 kt N and 224 kt P; no data for aquatic emissions BOD, COD, DOC, TOC reported]

EEA3: EEA, Annual European Community greenhouse gas inventory 1990–2007 and inventory report 2009, Submission to the UNFCCC Secretariat, 2009. Total without LULUCF (Land-Use, Land-Use Change & Forestry)

EC1, European Commission (DG ENV), Ambient air pollution by AS, CD and NI compounds, Position Paper, 2001. [data sources stem from ca. 1990, EU-15 recalculated by VHK to 2007, EU-27 using multiplier 1,3 for EU-expansion and 55% emission reduction (e.g. Cd) 1990-2007; data are roughly in line with CML]

Eurostat, Energy Balance Sheets 2007-2008, European Commission, edition 2010.

VHK, Energy analysis of energy sector to final end use electricity and fuels (excl. transport & feedstock), based on Eurostat, elsewhere in this report

CML, Centrum voor Milieukunde Leiden, Characterisation and Normalisation factors (CML-IA xls file Nov. 2010; extract Feb. 2011); data for EU-15, 1995. Assumed that EU expansion to EU-17 and emission decrease 1995-2007 will balance.

[1] from intermediate source: AEA, ENTR Lot 3 Sound and Imaging Equipment, preparatory Ecodesign study, Nov. 2010

[90] Eurostat Energy Balance 2007-2008, 2010.

RAW Worksheet ErP EcoReport

As mentioned before, the RAW worksheet gives the calculated results per line of the BOM and the lines of e.g. the Use Phase. Thereby it allows manual checking and - as the case may be - manual correction of business specific parameters. Also the RAW worksheet contains an exact spreadsheet copy of the Unit Indicator table that is used, also for easy checking. Please note that the RAW worksheet works only one way: It shows the results at the most detailed level, but the cells are filled in by calculations on the Input worksheet.

Table 28. Worksheet RAW ErP EcoReport

Version 1 VHK for European Commission Jan. 2011 — Document subject to a legal notice (see below)

ECODESIGN OF ENERGY-RELATED PRODUCTS — **EcoReport: RAW OUTPUTS** Assessment of Environmental Impact

Nr: Product: Products Date: Author: vhk

MATERIALS EXTRACTION & PRODUCTION

Product					Energy			Water		Waste		Emissions to Air							to Water	
nr	component	wght	cat.	material	GER	electr	feedst	water	water	haz. Wa	non-haz.	GWP	AD	VOC	POP	HM	PAH	PM	Metals	EUP
		in g			MJ	MJ	MJ	ltr.	ltr.	g	g	kg CO2 eq	g SO2 eq	mg	ng i-Teq	mg Ni eq	mg Ni eq	g	mg Hg/20eq	mg PO4 eq
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
39																				
40																				
	TOTAL																			

EXTRA MATERIALS Worksheet ErP EcoReport

NEW in MEErP 2011: This new sheet contains a simple table, similar to table 27 in lay-out, that allows the user to define the Unit Indicators of materials or processes relevant for his/her own specific product. The person in charge has to retrieve the LCI data (emissions and resources use) and then multiply with the LCIA multipliers mentioned in Chapter 5 and fill in the numbers expressed in the appropriate units.

Table 29. Extra Materials sheet

Use these fields to add extra materials to the eco-report, these materials will be added to the list and can be selected on the input tab. Select category 8-Extra, and the new materials will appear under material or process. The values are per kg material. The EoL scenario can only be regulated by one "recycle %" value for the whole group. Recycling and re-use credits are assumed to be incorporated in the various impact indicators.

nr	Name material	Recycle %*	Primairy Energy	Electr energy	feedstock	water proces	Water cool	waste haz	waste non	GWP	AD	VOC	POP	Hma	PAH	PM	HMw	EP
unit		%	(MJ) MJ	(MJ) MJ	MJ	L	L	kg	kg	kg CO2 eq.	g SO2 eq.	g	ng i-Teq	mg Ni eq.	mg Ni eq.	g	mg Hg/20	g PO4
100																		
101																		
102																		
103																		
104																		
105																		
106																		
107																		
108																		
109																		
110																		
111																		
112																		
113																		
114																		
115																		
116																		
117																		
118																		
119																		
120																		

* one recling percentage for the whole group

6 TASK 5/6: ECONOMICS

5 ENVIRONMENT & ECONOMICS

5.1 Product-specific inputs

Choose from the previous tasks the most appropriate information

From all tasks 1 to 4:

Definition of the base case(s) (from all previous Tasks 1 to 4)

with per Base Case

Task 1: The most appropriate test standard for performance and consumption data

Task 2: EU-27 annual unit sales 2010

EU-27 unit stock 2010

Purchase price. the installation costs (specify end-of-life disposal costs comprised in product price)

Repair and maintenance costs

Unitary rates for energy, water and/or other consumables

Discount, inflation, interest rates to be applied

Product service life

Task 3 Annual resources consumption (energy, water, consumables, from Task 3.1) and direct emissions caused directly or indirectly during product life according to the real-life situation (from Task 3.2);

Product use&stock life, if appropriate (i.e. if deviates substantially from product service life)

As appropriate, multiplier(s) to transform standard test data to real-life consumption data

Average user demand/ load

Collection rate at end-of-life (per fraction if applicable)

Task4 Product weight and Bill-of-Materials (BOM), preferably in EcoReport format (from Task 4)

Primary scrap production during sheet metal manufacturing (avg. EU);[12]

Volume and weight of the packaged product avg. EU;

Selected EU scenario at end-of-life of materials flow for:

- Disposal (landfill, pyrolytic incineration);
- Thermal Recycling (non-hazardous incineration optimised for energy recovery);
- Re-use or materials recycling scenario.

5.2 Base-Case Environmental Impact Assessment. [see Chapter 5]

5.3 Base-Case Life Cycle Costs for consumer

Combining the results from tasks 2 and 3 for the Real-Life Base-Case determine the Life Cycle Costs

LCC = PP + PWF * OE, where LCC is Life Cycle Costs, PP is the purchase price, OE is the operating expense and PWF (Present Worth Factor) is PWF= {1 – 1/(1+ r) N }/r , in which N is the product life and r is the discount (interest-inflation) rate minus the growth rate of running cost components (e.g. energy, water rates)

5.4 EU Totals

Aggregate the Real-Life Base-Case environmental impact data and the Life Cycle Cost data (subtask 5.3 and 5.4) to EU-27 level, using stock and market data from task 2, indicating

5.4.1. The life cycle environmental impact and total LCC of the new products designed in 2010 or most recent year for which there are reliable date (this relates to a period of 2010 up to 2010+product life);

5.4.2 The annual (2010) impact of production, use and (estimated) disposal of the product group, both in terms of the annual environmental impacts and the annual monetary costs for consumers.

6 DESIGN OPTIONS

6.1 Options

Identify and describe (aggregated clusters of) design options to be taken into account (from Task 4, typically 4 to 8 design options are manageable)

6.2 Impacts [see Chapter 6]

Assess quantitatively the environmental improvement per option using the EcoReport tool. Compare the outcomes and report only on impacts that change significantly with the design options

6.3 Costs
Assess/ estimate price increase due to implementation of these design options, either on the basis of prices of products on the market and/or by applying a production cost model with sector-specific margins.

6.4 Analysis LLCC and BAT

6.4.1 Rank the individual design options by LCC (e.g. option 1, option 2, option 3);

6.4.2 Determine/ estimate possible positive or negative ('rebound') side effects of the individual design measures;

6.4.3 Estimate the accumulative improvement and cost effect of implementing the ranked options simultaneously (e.g. option 1, option 1+2, option 1+2+3, etc.), also taking into account the above side-effects;

6.4.4 Rank the accumulative design options; draw LCC-curves (1st Y-axis= LLCC, 2nd Y-axis= impact (e.g. energy), X-axis= options); identify the Least Life Cycle Cost (LLCC) point and the point with the Best Available Technology (BAT);

6.5 Long-term targets (BNAT) and systems analysis
Discussion of long-term technical potential on the basis of outcomes of applied and fundamental research, but still in the context of the present product archetype;
Discussion of long-term potential on the basis of changes of the total system to which the present archetype product belongs: Societal transitions, product-services substitution, dematerialisation, etc.

6.1 Life Cycle Costs

The calculation of Life Cycle Costs (LCC) is an explicit part of MEErP Tasks 5 (BaseCase) and MEErP Task 6 (Design Options).

In MEErP, based on the description on Annex II of the Ecodesign directive 2009/125/EC, the LCC analysis to end-users method '*uses a real discount rate on the basis of data provided from the European Central Bank and a realistic lifetime for the ErP; it is based on the sum of the variation in purchase price (resulting from variations in industrial costs) and in operating expenses, which result from the different levels of technical improvement options, discounted over the lifetime of the representative ErP. The operating expenses cover primarily energy consumption and additional expenses in other resources (such as water or detergent).*'

6.1.1 Consumer Life Cycle Costs

The basic LCC formula is:

LCC = PP + PWF * OE + EoL,

where

LCC is Life Cycle Costs to end-users in €,

PP is the purchase price (including installation costs) in €,

OE is the annual operating expense in €

PWF (Present Worth Factor) is

$$\mathbf{PWF} = \frac{1 - \frac{1}{(1+d)^N}}{d} \qquad (d \neq 0)$$

in which

N is the product life in years and

d is the discount rate rate in %

and in case *d=0* the value of *PWF=N*

EoL: End-of-life costs (disposal cost, recycling charge) or benefit (resale).

During the preparatory studies it became apparent that the price increase of the operating expense plays an important role and –as argued by consultants—should be an integral part of the LCC. As a result it is proposed to use the following formula for PWF

$$\mathbf{PWF = 1 - \left(\frac{1+e}{1+d}\right) \cdot \left[1 - \left(\frac{1+e}{1+d}\right)^{N}\right]} \qquad (d \neq e)$$

where

e is the aggregated annual growth rate of the operating expense (a.k.a. 'escalation rate', in €) and

in case *d=e* (mathematically undefined) ***PWF= N***

In US federal government publications the above *PWF* is known as *UPV*, *Uniform Present Value*[91], relating to the fact that the calculation is valid for a uniform value of growth rate *e* in time.

For many products the disposal-levy ('recupel') is included in the purchase price PP and the rest-value of most product at end of life is zero (0). In case the disposal costs are to be paid at the end-of-life the discounted Net Present Value (NPV) of the disposal costs should be added to PP. In case there is a rest-value of the product, then the discounted NPV of the rest-value should be deducted from PP.

In case the operating expense *OE* consists of several elements (e.g. energy, water, maintenance and repairs) with different annual growth rates then the parameter *e* is a weighted average of these elements. For example, if the annual operating expenses consist 90% of energy at a growth rate of 5%/a and 10% of maintenance costs at a growth rate of 2%/a, the aggregated annual growth rate *e* is 0.9*5% + 0.1*2% = 4.7%.

The data in Chapter 2 on discount rate and inflation-corrected energy rate growth rates will and the paragraph on the escalation rate of external damages has shown, that - at present - the three are very close together. The discount rate is 4% [92]. The external damages escalation rate of external damages is around 4% and the inflation-corrected energy rate growth rate is - at the moment - also in the order of 3-4%. This means, for cases where repair and maintenance costs are insignificant, the assumption of a case where r=p and thus PWF=1 would result in a negligible error.

As a result, the LCC formula for MEErP Task 5 and 6 the LCC can be simplified to

LCC= PP + N*OE + EoL

Note that this simplified formula cannot be applied if there is a significant (>1% point) difference between discount rate r and the aggregated growth rate of the operating expense.

[91] US Dept. of Commerce and National Institute of Standards and Technology (NIST), ENERGY PRICE INDICES AND DISCOUNT FACTORS FOR LIFE-CYCLE COST ANALYSIS, Annual Supplement to NIST Handbook 135 and NBS Special Publication 709. April 1, 2010 to March 31, 2011. Data for the Federal Methodology for Life-Cycle Cost Analysis, Title 10, CFR, Part 436, Subpart A; and for the Energy Conservation Mandatory Performance Standards for New Federal Residential Buildings, Title 10, CFR, Part 435, sponsored by US Dept. of Energy, Washington 2010.

[92] This discount rate is the required 4% discount rate of the impact assessment guidelines of the Commission

6.1.2 Least Life Cycle Costs (ranking design options)

The assessment of LLCC entails:

1. Ranking of the individual design options by LCC (e.g. option 1, option 2, option 3);
2. Determination/ estimation of possible positive or negative ('rebound') side effects of the individual design measures;
3. Estimating the accumulative improvement and cost effect of implementing the ranked options simultaneously (e.g. option 1, option 1+2, option 1+2+3, etc.), also taking into account the above side-effects;
4. Ranking of the accumulative design options, drawing of a LCC-curve (Y-axis= LLCC, X-axis= options) and identifying the Least Life Cycle Cost (LLCC) point and the point with the Best Available Technology (BAT).[93]

The individual design options usually have very different effects: Some may generate huge savings on running costs at hardly any extra production costs, others may be very expensive, deliver only small environmental improvements and give little reduction on running costs. This phenomenon is the basis for ranking the individual design options in terms of Life Cycle Costs versus environmental benefits.

The quantitative basis for the ranking of options, in case the options result in monetary savings (e.g. lower energy costs for the consumer) is the payback period. This is the time period it takes for an investor to recuperate the extra investment in purchase price *dPP* through the reduction in annual operating expense *dOE*. The operating expense should normally be corrected for discount rate and escalation rate, but –as is the case today for energy and most other impacts—if discount and escalation rate are equal the Simple Payback Period SPP can be used. The equation for comparing two alternatives 'A' and 'B' is then

$\boldsymbol{SPP_{AB} = dPP_{AB} / dOE_{AB}}$ (in years)

Note that the payback period approach –simple or more complex with discount and escalation rate for dOE—can only be used for economic evaluation if the product life of the design options is more or less the same. This is usually the case, but there are exceptions. For instance in the case of light sources ('lamps') there are huge differences in the technical life of halogen (1500-2000 h), compact-fluorescent CFL (6000-8000 h) and light emitting diode LED (claimed up to 40 000 h) types and the payback period method has no mechanism to evaluate those differences in lifespan.

In that case, economists would turn to the Equivalent Annual Cost (EAC) method or the 'chain' method. In the EAC method the basis is the (Net Present Value NPV of the) cost per year of owning and operating an asset over its entire lifespan. Simply put, without correction for NPV, the equation of *EAC* for a product 'A' (EAC_A) with purchase cost PP_A, lifetime N_A and annual operating expense OE_A is

$\boldsymbol{EAC_A = (PPA/N) + OE}$

For instance, when assuming an equal discount and escalation rate (NPV has no effect) a reference 'base case' lamp with a purchase price of € 2, a running cost of € 4/year over an 3 year lifetime has an EAC of € 4.66/year.

[93] This is usually the last point of the curve showing the product design with the lowest environmental impact, irrespective of the price.

This has to be compared to e.g. a 'design option' lamp with a purchase price of € 4, a running cost of € 3/year over a 9 year lifetime, resulting in an EAC of € 3.44/year. Using the EAC for ranking, the design option lamp is the more economic choice, saving on average € 1.22 per year (ca. 26%)[94].

An alternative method with identical result is the so-called chain method, which could be used more directly to assess how long it takes to recuperate the investment in years (comparable to SPP). In the chain method one could take the lifetime NA (in years) of the design option 'A' with the highest purchase price PPA and then compare it to the basecase 'B' with a lower price PPB and presumably a shorter lifespan NB. The ratio between the life-spans is then used to find the equivalent, discounted purchase price for product A. In a simple equation without inflation correction the 'payback' PBAB (in years) is then

$$PB_{AB} = dPP_{AB} / dOE_{AB}$$

With

$$dPP_{AB} = PP_A - (N_A/N_B) \cdot PP_B$$

Taking the values from the previous example, the payback PB_{AB} is negative because dOE_{AB} is positive and dPP_{AB} is negative. In other words, there is no question that option A is the most economical, because it is the most advantageous both from the point of view of accumulative purchase cost and from the point of view of annual operating expense.

The example will be different when using e.g. a purchase price of € 8 for design option 'A', instead of € 4. In that case the payback is 2 years:

$$PB_{AB} = [8 - (9/3) \cdot 2] / (4-3) = 2/1 = 2 \text{ years}$$

These methods, i.e. the EAC or chain method, are the ones to be used for ranking design options.

For investors that are highly strung for cash, like low-income consumers, these methods are still not very intuitive. But that is a matter of short-term financing and not of making an investment decision.

Nonetheless, these investors would like to know how long it takes to recapture the initial investment. E,g. in the last example they pay € 6 more for the design option solution and they save € 1/year in running costs. After 3 years the basecase lamp breaks down and they gain another € 2 for not having to buy a replacement. And only after 4 years the cashflow saved is enough to recapture the extra € 6 they initially paid extra. So, assuming they have zero cash, they would have to borrow the € 6 for 4 years. Discounting the incoming cash flows they may even need 5 years[95]. Especially if they can offer no collateral to a lender, these people may not get a loan and thus cannot do the investment. This phenomenon should be treated under the heading *'negative impact on consumers'* or rather a the affordability for certain consumer groups or SMEs. A preparatory study should signal this phenomenon, especially when the investments are substantial, and make policy makers aware that a financing solution –e.g. at the level of Member States, utilities, etc.—must be found. But it should **not** mix these considerations with the methodology to find the *Least Life Cycle Cost* target level.

A second phenomenon is the interaction between the design-options. When implementing multiple design options in the same product, the resulting environmental improvement is usually smaller than the sum of the environmental improvements per individual design option. In other words, if you have

[94] A.k.a. as ROI, Return on Investment

[95] This can be calculated 'manually', i.e. using accumulative annual costs and benefits in a table, possibly (if discount and escalation rates are not similar) using discounting.

already improved a product with one design option, every consequent design option will only realize a part of its individual potential. How exactly this interaction works depends very much on the product technology, but it may well lead to a different ranking of accumulated options than the ranking of the individual options in terms of total effect and costs.

After the ranking process the resulting graph will look like the one below for parameters that have an impact on the running costs to the end-user (energy, water, detergent, toner, paper, etc.).

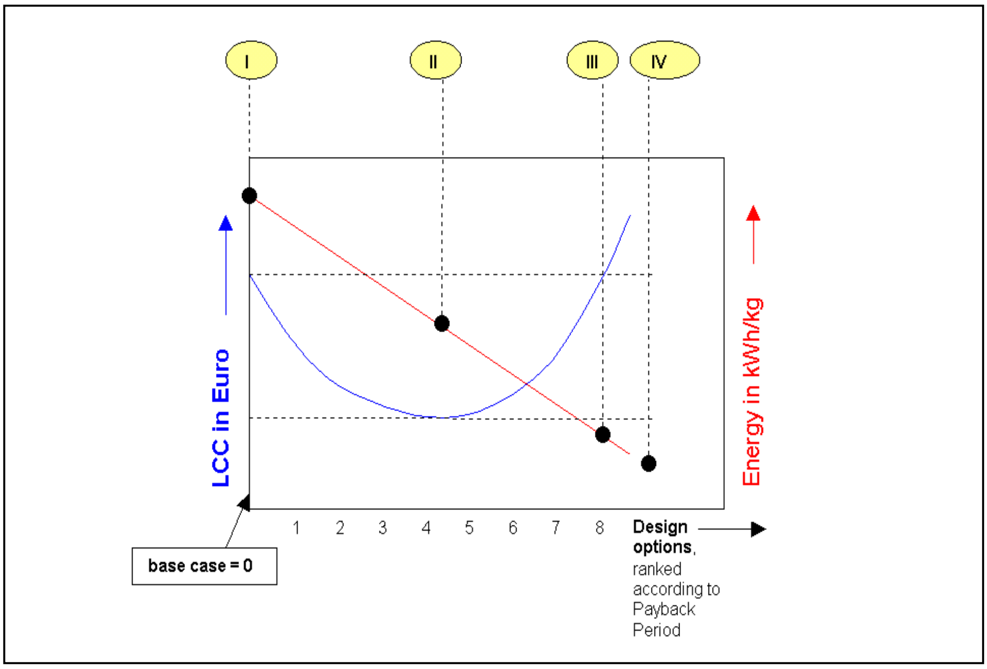


Figure 20: Archetype LCC curve

I = BaseCase; II = Least LCC; III = No financial loss (break-even point); IV = BAT point

Starting at the Life Cycle Costs (left y-axis) and Environmental performance parameter (right y-axis) of the Basecase (design option "0" on the left of the x-axis). With the introduction of the first 3 design options the LCC-curve will decrease due to savings on running costs. After design option nr. 4, the improvement of the environmental parameter will continue, but the extra saving on the discounted running costs will be less than the increase of the purchase point and the LCC will go up. This lowest point on the LCC-curve is called the point of the Least Life-Cycle Costs (LLCC). And the value of the Environmental Parameter (energy, water, etc.) at that point is proposed as the threshold value for minimum requirements (legislation or self-regulation).

Further up the LCC curve, as more and more design options are being implemented there are still two interesting points: The 'break-even point', where the purchasing power of the consumer remains equal to the current situation. Beyond this point any minimum requirement would usually become socially unacceptable, i.e. *there would be a significant negative impact on consumers in particular as regards the affordability and the life cycle costs of the product* (*compare Art. 15.1. (b) (iv) of 2009/125/EC*).

And finally there is the last point on the LCC curve indicating the costs at the maximum technical potential, the so-called Best Available Technology (BAT) As mentioned, in the context of design options that have an effect on the running costs, this BAT-point is ***not*** intended as a target level for legislation. It indicates what is technically feasible with the best-performing products and technologies available. And as such it indicates whether - after the LLCC has been established as a minimum target - there is enough room for product differentiation on the short term (see also BNAT, par. 7.7., which also looks at the long term).

From the point of view of social-economic feasibility the LLCC is optimal: such a threshold value would not only result in an environmentally superior product but even increase the purchasing power of the consumers as the total expenditure over the product-life decreases. This message is also of interest to retailers, consumer's associations and industry and others that have the best interest of all stakeholders in mind. . Naturally, even at LLCC, the price increase must remain within the bounds of what is affordable for the end-user; this will be an explicit task of the impact analysis.

It must be stressed that this LCC curve is typical for most direct ErP, i.e. where the improvements lead to lower running costs for the end-user (lower consumption of energy, water and auxiliary materials etc.) at the expense of a higher product-price. As the LCC consequences for each of the main environmental parameters per relevant product is analysed (a selection will have to be made), other types of trades-off, e.g. between higher direct production costs and the costs of take-back obligations under the new WEEE directive[96], will appear.

[96] new WEEE to be adopted soon (ENVI vote 2nd reading 4 October 2011)

7 TASK 7: SCENARIOS

7 SCENARIOS

7.1 Policy analysis

7.1.1 Describe stakeholder consultation during preparatory study

7.1.2 Describe barriers (and opportunities) for improvements environmental impact; opportunities for Ecodesign measures (from Tasks 1-4)

7.1.3 Describe pro's and cons of (combinations of) Ecodesign measures and other policy instruments (e.g. self regulation, energy label, EPBD); identify and describe overlaps with exisiting legislation

7.1.4 Select policy measures for further analysis, including timing and target levels, notably the options should

- Be based on the exact definition of the products, according to subtask 1.1 and modified/ confirmed by the other tasks;
- Provide ecodesign requirements, such as minimum (or maximum) requirements[97];
- Be complemented, where appropriate, with (dynamic) labelling and benchmark categories linked to possible incentives, relating to public procurement or direct and indirect fiscal instruments. In case of energy labelling, labelling categories should be proposed;
- Where appropriate, apply existing standards or propose needs/ generic requirements for harmonised standards to be developed;
- Provide measurement requirements, including measurement standards and/or methods;
- Consider possible self-regulation, such as voluntary agreement or sectoral benchmarks initiatives;
- Provide requirements on installation of the product or on user information.]

7.2 Scenario analysis

7.2.1 Set up a stock model for the baseline (Business-as-Usual BaU); calculate for the period 1990-2030, preceded by an appropriate built-up period (product life), for the following parameters per year X (X=1990-2030):

a. annual sales in X (from Task 2, with actual and interpolated values), subdivided in new (incl. 1st time users) and replacement sales;

b. annual stock of product (from Task 2)= accumulative sales in X and preceeding L-1 years (L=product life) minus products discarded in actual year (=sales in year X-L);

c. annual stock (number) or impact (e.g. in kWh) of the affected energy system (for indirect ErP);

d. annual net performance demand per unit (from Task 3), including growth rate if appropriate;

e. for significant impacts only: average unitary impact(s) (e.g. kWh energy and/or g emissions per performance unit, directly or indirectly) for products sold; this is the (set of) parameter(s) to be regulated;

f. total impact= stock units x performance demand per unit x unitary impact;

Report in a table showing 5 year intervals

Check the calculated total impact against values from this MEErP-report (when available) or other sources for consistency. Deviations of ± 15% are 'normal'; larger deviations require an explanation and possible adjustment of the stock model.

7.2.2 Calculate for the period 1990-2030 (with qualitative discussion of 2030-2050) for each of the options identified in 7.1.4 a scenario for total annual and accumulative impact of the policy mix, at the given timing and target level(s) (graphs and labels per impact type)

If no other data are available the following values may be assumed:

[97] Ecodesign requirements should always address improvements in terms of environmental performance, not in terms of technologies.

for the unitary impacts in the years of ('entry into force' minus 1-2 years) and 'implementation of (first) target' use interpolated values between baseline and (first) target
unitary impact levels in periods after target implementation, the impact depends on the policy mix: In the time period after minimum requirements alone, the market is usually assumed to pick up the baseline trend after 1 year; when combined with other measures (e.g. labelling) the trend stays more positive than baseline for at least 5 years. Timely revision of labelling may prolong that period by ca. 3 years

7.3 Impact analysis industry and consumers

7.3.1 Introduce economic parameters in the stock model:

a. Introduce baseline product price (from previous tasks), in Net Present Value for a reference year (e.g. 2010), taking into account inflation rates as given in MEErP

b. Introduce unitary energy, water, consumable rates, annual repair and maintenance costs.

c. Introduce dynamic parameters: inflation rate, growth rate unitary prices (energy, water, etc.)

d. Simplify the relationship between a product's unitary impacts and product purchase price: determine a linear price elasticity from known anchor points (BaseCase, LLCC, BAT) for price and unitary impact.

e. Determine the turnover rate per employment (from Task 2)

f. Determine the cost and margin built-up for the average product (%), with relative shares for OEMs, Manufacturer, Wholesale, Retail, VAT and other tax.

g. Introduce variables and mathematical relations in the stock model as appropriate (see also sensitivity analysis)

7.3.2 Calculate for the period 1990-2030 (with qualitative discussion of 2030-2050) for each of the options identified in 7.1.4 a scenario for total impact of the policy mix, at the given timing and target level(s) (graphs and labels per impact type)

a. EU-27 running costs including and excluding taxes (indicator of utility income and government income from energy/water/etc. VAT and other tax) in Euro2010, 1990-2030

b. EU-27 consumer expenditure, 1990-2030

c. EU-27 annual revenue industry, wholesale, retail, product VAT and other taxes (mln. Euro) in Euro2010, for reference years 2020 ad 2030 (or 2050 instead of 2030 for construction products)

d. indicative share of SMEs, share in industry revenue; qualitative discussion of possible effect

e. employment (no. of jobs) industry, wholesale, retail/installers for reference years 2020 and 2030;

7.4 Sensitivity analysis of the main parameters.

Recalculate selected scenarios for variation in

a. higher and lower (50%) energy prices;

b. higher and lower (50%) elasticity between product price and unitary impact parameter; c. new target levels or differences in timing as indicated by the Commission services;

d. life cycle costs covering the relevant factors and, where appropriate external environmental costs (societal LCC) **:**
Extend the calculation of the base-case Life Cycle Costs for the end-user with the societal costs for emissions indicated in Chapter 5, using the outcome of Task 5.2 (emissions in mass per product over product life) and the monetary values per emission (in €/unit of mass) in this Chapter 7

and report on the in-/decrements (in tables)

7.5 Summary

7.5.1 Summarise the main policy recommendations per product

7.5.2 Summarize the main outcomes of the scenarios for Baseline, 2020 and 2030 (2050 for construction products)

7.5.3 Summarize the risk of possible negative impacts on health, safety, etc. in one +/- table

7.1 Stock model

Task 7 gives comprehensive instructions on how to build a stock model for environmental analysis (MEErP Task 7.2), economical analysis (MEErP Task 7.3), incorporating the identified policy options (MEErP Task 7.1) and showing how the stock model is to be used for the sensitivity analysis (MEErP Task 7.4), especially as regards societal life cycle costs.

In this paragraph practical instructions for the set-up of the analysis in a spreadsheet (e.g. MS Excel) are given, including directions for the basic format of the equations.

Note that these are general guidelines and - depending on the product typology - there may be exceptions or even the necessity of a different approach.

7.1.1 Basic set-up

In the spreadsheet file, define (at least) the following 6 separate sheets:

1. PREP: A preparatory sheet containing the original relevant inputs from MEErP Tasks 2, 5 and 6, where these inputs - usually relating to several base case products and several design options - are aggregated to sales-weighted averages relating to one single product[98] and one simple formula describing the relationship between target levels (minimum requirement, in the relevant unit) and purchase price[99].
2. INPUT: An input sheet containing all (named) variables relevant for the calculation.
3. CALC: This sheet contains the actual 'stock model' calculation.
4. PRINT: Output sheet containing an extract from the CALC sheet in 5 year intervals for 1990-2030. To be used in an Annex of the MEErP Task 7 report (ca. 8-10 pages).
5. GRAPH: Output sheet containing graphics and small tables showing the effects of scenarios for the various parameters. To be used in the MEErP Task 7 report.
6. SUMMARY: Output sheet containing a 1 page table with the main in- or decrements of key parameters over the 2010-2020 period and another 1 page table for the 2010-2025 (or 2010-2030) period. To be used in the MEErP Task 7 summary and the executive summary of the whole project.

7.1.2 Preparation

In MEErP Tasks 1 to 6 it will usually be necessary to distinguish several subgroups and base cases of products in order to accurately define scope, differentiated target levels, etc.. However, this level of detail is not needed in the quantitative scenario analysis of MEErP Task 7 and therefore it is sufficient to work with sales-weighted averages and simplified formulas. Nonetheless, at any point in the legislative process following the preparatory study it may happen that the legislator wants to adjust the scope, e.g. take out or add product groups, or new information may become available. For those reasons it is necessary that the PREP sheet is part of the spreadsheet and there is an active link with the INPUT sheet.

As regards the simplification of the formula for the design options it is usually sufficient, unless the measures go beyond the LLCC target or the timing is more strict than the 'design cycle', to use a simple formula derived from the performance unit, e.g. efficiency *EFF* in %, and the product price *PP* in € for the base case *bc* and the least life cycle cost point *llcc*. For any target level of the performance unit *EFFtarget* the product price *PPtarget* can thus be found:

$$PP_{target} = PP_{bc} + (PP_{llcc} - PP_{bc}) * (EFF_{target} - EFF_{bc})/(EFF_{llcc} - EFF_{bc})$$

[98] Relevant parameters specified in Task 7.2.1, see Chapter 3

[99] This is indicated in Task 7.3.1 d) , see Chapter 3

This is a simplification, which misses out on the effect that some design options can be implemented at low costs whereas others give relatively smaller savings at much higher costs. Should this effect be very significant, then the formula can be divided in two or more parts using intermediate design options as anchor point.

The calculation of the target level of the purchase price should consider if the product is sold in a competitive or non-competitive market, i.e. should consider the (non)elasticity of the profit margin.

7.1.3 Inputs

This sheet will have several sections (or separate extra sheets), e.g.:

a. aggregated inputs from the PREP sheet(s),

b. relevant unitary energy, water, maintenance, etc. rates as well as other employment-related parameters described in Task 7.3.1

c. for the policy options/scenario's (e.g. 'baseline', 'label only', 'label & minimum requirements', etc.) from MEErP Task 7.1 this sheet contains the target level(s) and implementation date(s) and how the options may effect the environmental impact before and/or after the implementation date.

A sample of the INPUT sheet is given in Table 30. Note that direct ErP demand, applicable only if the product itself uses resources or causes emissions, is the performance output that the user requires from the product per year (see also 'functional unit'). The indirect ErP demand is the unavoidable part of the resources use or emissions of other products influenced by the product being studied. The efficiency is the ratio between the minimum resources use or unavoidable emissions and the actual resources or emissions. In case the unavoidable emissions (or resources use) are close to zero, also absolute figures can be used (e.g. mg emission per performance unit).

Table 30. ECODESIGN Scenario Analysis, INPUT sheet sample (fictitious)

INPUT data from PREP sheet, fictitious example

PARAMETER	**unit**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Sales	1000 # /a	from PREP, aggregate from Task 2								
Stock (T2)	1000 # /a	from PREP, aggregate from Task 2								
direct ErP demand	perform/unit.a	from PREP, aggregate from Task 3 (and copy in Task 5)								
indirect ErP demand	perform/unit.a	from PREP, aggregate from Task 3 (and copy in Task 5)								
BaU (baseline)										
direct ErP efficiency	%	from PREP, aggregate from Task 4 (and copy in Task 5)								
indirect ErP efficiency	%	from PREP, aggregate from Task 4 (and copy in Task 5)								

INPUT, data from MEErP 2011 (fictitious sample)

Baseprice	500	Product price + Installation costs incl. VAT 2010 [€/unit]. Aggregate from PREP sheet (Task 5)
PriceInc	20	Price increase per efficiency %-point [€/ %]; **Aggregate from PREP sheet (design options simplified formula)**
PriceDec	2.0%	Annual product price decrease [%/ a] through product rationalisation
Rel	0.18	Electricity rate 2010 [€/ kWh electric]
Rgas	0.052	Gas rate 2010 [€/kWh GCV]
Relinc	5%	Annual price increase electricity [%/ a]
Rgasinc	5%	Annual price increase gas [%/ a]
ManuFrac	53.8%	Manufacturer Selling Price as fraction of Product Price [%]
WholeMargin	30%	Margin Wholesaler [% on msp]
RetailMargin	20%	Margin Installer on product [% on wholesale price]
VAT	19%	Value Added Tax [in % on retail price]
ManuWages	0.166	Manufacturer turnover per employee [mln €/ a]
OEMfactor	1.24	OEM personell as fraction of WH manufacturer personell [-]
WholeWages	0.261	Manufacturer turnover per employee [mln €/ a]
RetailWages	0.1	Manufacturer turnover per employee [mln €/ a]
ExtraEUfrac	0.6	Fraction of OEM personell outside EU [% of OEM jobs]
Inflation	2.5%	Inflation rate [%/ a]
Interest	6.5%	Interest rate [%/a]
Discount	4%	The discount rate is expressed in real terms, taking account of inflation. This rate of 4%, used in the Commission's impact assessments[100], broadly corresponds to the average real yield on longer-term government debt in the EU over a period since the early 1980s. For impacts occurring more than 30 years in the future, the use of a declining discount rate could be used for sensitivity analysis, if this can be justified in the particular context
Power gen. & distr.	40%	Electric power generation & distribution efficiency
GWP fossil mix	0.057	kg/kWh primary

		1990		**2000**		**2010**		**2020**		**2030**
GWP electric	kg/kWh elec.	0.5		0.43		0.41		0.38		0.34

INPUT, estimated data for the sector on effectivity of policy measures

SCENARIO	**Tier 1**	**Tier 2**	**after Tier2 year**

[100] See European Commission's impact assessment guidelines, annex 11.6 discounting: http://ec.europa.eu/governance/impact/commission_guidelines/docs/ia_guidelines_annexes_en.pdf

	before Tier1 year	target	year	target	year	increase	time	increase	time
Min only	interpolate from BaU at Tier1 year minus design cycle (e.g. 2011)	..%	2015	..%	2017	+0.5%/a	>2016		
Lbl only		..%	2015	..%	2016	+1%/a	2 yrs	+0.5%/a	>2019
Min+Lbl		..%	2015	..%	2016	+1.5%/a	2 yrs	+0.5%/a	>2019

7.1.4 Calculations stock model

The CALC sheet contains the calculation of baseline and policy scenario impacts 1990-2030. A proven set-up is where the columns contain the single years, e.g. 1960-2030, and the rows contain the parameters, with for most parameters a subdivision per policy scenario.

The CALC sheet has a first series of columns, up till the year before the policy scenario enters into force, which calculates the baseline scenario (BaU, see Table 31). The main challenge for the person in charge is to match the calculated sales and stock values in this model with the sales and stock data found in MEErP Task 2. To this end the person in charge, if possible with the input of stakeholders, has to estimate values for the built-up period (e.g. 1960-1989)[101] and possibly tweak the assumed product life to fit. This is an iterative process, which may ultimately also result in an adjustment of the MEErP Task 2 data, e.g. if the data source for MEErP Task 2 was not robust and would lead to implausible results in MEErP Task 7.

Table 31. ECODESIGN Scenario Analysis, CALC sheet, Columns up to entry into force minus 1 year

		Accumulated results		Built-up period				Reference period, from 1990 until target date minus design cycle period D (e.g. 4 yr)						
PARAMETER	**unit**	**2010-'20**	**2010-'25**	**1960**	**1961**	**1962**	**etc.**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**etc**
Sales	1000 # /a	SUM	SUM	estimate				INPUT	interpolate				INPUT	
Stock	1000 # /a	SUM	SUM	calc. stock				calc. stock						
direct ErP demand	kWh/unit.a	void	void	est.				INPUT	interpolate				INPUT	
indirect ErP demand	kWh/unit.a	void	void	contractor est.				INPUT	interpolate				INPUT	
Perform. efficiency														
Bau	%	void	void	est.				INPUT	interpolate				INPUT	
Min only	%	void	void	copy BaU				copy BaU						
Lbl only	%	void	void	copy BaU				copy BaU						
Min & Lbl	%	void	void	copy BaU				copy BaU						
Rel. perform efficiency														
Bau	%	void	void	est.				INPUT	interpolate				INPUT	
Min only	%	void	void	copy BaU				copy BaU						
Lbl only	%	void	void	copy BaU				copy BaU						
Min & Lbl	%	void	void	copy BaU				copy BaU						
etc. (more parameters)														

The sales figure in a year x, *SAL(x)*, are built from the replacement sales, *REPSAL(x),* and the new sales, *NEWSAL(x).*

[101] This range will allow a proper consideration of stock characteristics that exist from 1990 onwards.

SAL(x) = REPSAL(x) + NEWSAL(x)

The new sales include first time users, buyers that previously employed an alternative solution outside the product group, and should be plausible from known trends. E.g. for mature markets these are trends in population growth, household size, building size, etc. as they were found in MEErP Task 3. For growth markets there is more uncertainty an estimates can best be made from third party projections.

The replacement sales are the sales from *L* years ago, where *L* is the product life:

REPSAL(x) = SAL(x – L)

A survival curve[102] can be applied around this year (x-L), but usually it is not needed.

The stock of installed products in year x, STOCK(x), is the accumulation of product sales over the past *L* years:

$$STOCK(x) = \sum_{t=x-L}^{t=x} SAL(t)$$

In a second series of columns, from the year before the entry into force of a measure (2010 or later) and onwards, the CALC sheet calculates the effects of the measures (see sample in Table 32). For the first 4 rows of the whole spreadsheet and the baseline (BaU) scenario this does not change much: the 5-year interval values are copied from the INPUT sheet, intermediate values are derived from interpolation, or the values are calculated as in the period before 2010.

The change is in the rows for each policy scenario, termed a, b and c (‘Min only’, ‘Lbl only’, ‘Min & Lbl’), starting with direct and indirect ErP efficiency.

[102] The products sold in year (x-L) are not all disposed of in year x, but some ‘die’ sooner and some die later. This sophistication can be applied e.g. with a ‘normal distribution’ around the year x, but it does not basically alter the outcome; it just provides a smoother curve, which can also be achieved in another way –e.g. when using the ‘smooth curve’ option in the spreadsheet.

Table 32. ECODESIGN Scenario Analysis, CALC sheet example, columns [entry-into-force minus 1 year] and beyond

Reference period, from [entry into force - 1 year] and onwards

	Entry into force - 1 year				**scenario (a) Tier 1 target (TGTYR1a)**			**scenario (a) Tier 2 target (TGTYR2a)**			
				scenario (b) Tier 1 (TGTYR1b)				**scenario (b) Tier 2 (TGTYR2a)**			
PARAMETER	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Sales	INPUT	interpolate				INPUT	interpolate				INPUT
Stock	calc. stock										
direct ErP demand	INPUT	interpolate				INPUT	interpolate				INPUT
indirect ErP demand	INPUT	interpolate				INPUT	interpolate				INPUT

Direct ErP efficiency effects

Bau	INPUT	interpolate				INPUT	interpolate				INPUT
Min only (scenario a)	INPUT	interpolate			target value TGTVAL1a	interpolate		target value TGTVAL2a	previous * (1+POSTa)	previous * (1+POSTa)	previous * (1+POSTa)
Lbl only (scenario b)	INPUT	inter-polate		target value TGTVAL1b	interpolate			target value TGTVAL2b	previous * (1+POSTb1)	previous * (1+POSTb1)	previous * (1+POSTb2)
Min & Lbl (scenario c)	INPUT	select highest value from values in two rows above (+possible synergy effect or effect from other policy measures)									

Indirect ErP efficiency effects

Bau	as above but for efficiency of other products as much as it is influenced by the product being studied
Min only	
Lbl only	
Min & Lbl	

Direct ErP energy use EU-27

BaU etc.	=Stock x direct ErP demand/direct ErP efficiency

Indirect ErP energy use EU-27 (if saving then negative)

BaU etc.	=Stock x indirect ErP Performance/indirect ErP efficiency

Total energy use EU-27

BaU etc.	=direct + indirect energy use EU-27

etc.

Calculation starts at the [year of entry into force of a measure minus 1 year] taken from the BaU-scenario. The values for the target years per tier (TGTYR.), the target values (TGTVAL.) and the growth rates after the last tier (POST.) are taken from the INPUT sheet. These values will be initially based on the outcome of Least LCC, the usual design cycle, experience from the past measures, etc..

After the preparatory study, with a spreadsheet model in place, it should be relatively easy to change in the following, if deemed appropriate, legislative process.

Commonly, the Tier 2 level for only minimum Ecodesign requirements ('Min only') would represent the Least LCC level and the Tier 2 timing would relate to the usual design cycle in the sector. Tier 1 is an intermediate level which would typically reflect only small - application engineering type -

adjustments to the product and mainly serves as capacity building with the stakeholders and the surveillance authorities.

For mandatory energy labelling ('Lbl only') the starting point, at the time of the market analysis, is a market average of typically between "C" and "D" class and an "A"-class that is empty. Already 1 year before entry into force of the measure, this will have changed, e.g. to an average "C" and 5-10% of products in the "A" class. Three years later the "A" class might be 30-40% (average "B") and again two to three years later the "A" class might be 60-70% with 10% already substantially better than "A" (average "A"). At the latest at that time, the labelling legislation should change (e.g. add new classes "A+"), otherwise the market will fall back to the lower baseline efficiency growth. This has been the experience with most whitegoods (refrigerators, washing machines, etc.) in the 1990's; but for other products, e.g. where the label is less visible, it may be different.

As regards the combination of minimum requirements and labelling ('Min & Lbl'), the sample file above just picks the highest value from either the 'Min only' or 'Lbl only' value in that year, possibly increasing it with a synergy effect. For instance, with the 'Lbl only' scenario it may be hard to fully eliminate the "E", "F" and "G" classes if there is a sizeable market segment where there is a split responsibility between the buyer and the user paying the energy bill. In that case and assuming that 'Lbl only' gives the highest value, an extra percentage can be added for the combination ('Min & Lbl'). It will depend on the product being studied.

Once the efficiency impacts of measures under the various policy measures is assessed, the rest of the calculation is relatively straightforward. Some equations for assessing the EU-27 energy use are already given (if 'efficiency' relates to energy, but it could also relate to other impacts). The calculation of other parameters is given in paragraph 6.10 to 6.14.

It should be mentioned that the stock model for MEErP Task 7 is relatively simple, e.g. when compared to some of the other models that are used in the U.S.. These latter models, e.g. used in the US DoE Appliance Standards program, include wider economic impacts (e.g. effect on trade) and side-effects e.g. the 'rebound' effect[103]. The latter has been studied in the "Adressing the Rebound Effect" project[104], which has mapped dozens of studies providing quantified analysis of the rebound effect for given products and services.

For products where the rebound effect played a rol, most estimates in this study showed a negative effect on the initially projected savings in the order 10-30%. For instance, in UK projections on the savings of better building insulation a reduction of 15% was applied to take account of the rebound effect of people 'comfort taking' with higher indoor temperatures.

[103] 'Rebound' effect relates to the extra sales of an energy-related product and/or the extra use of that product because the consumers are no longer inhibited by feelings of 'guilt' and/or by the running costs. An example is the growth in garden-lighting that followed the introduction of compact fluorescent (CFL) lamps in the 1980's.

[104] http://rebound.eu-smr.eu/

7.1.5 Outputs

The design of the PRINT and GRAPH and SUMMARY output sheets will depend on the overall design of the preparatory documents. Examples are given below.

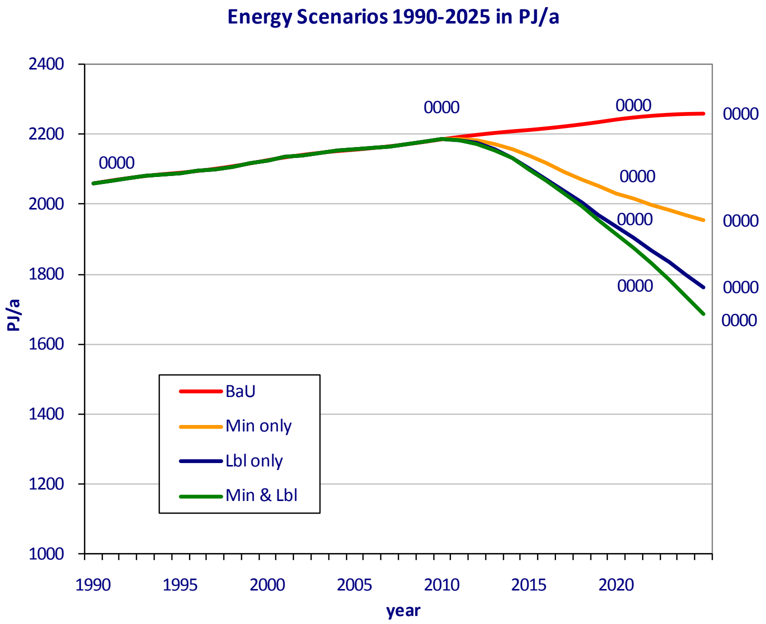


Figure 21: GRAPH sheet, example of primary energy diagram

Table 33 PRINT sheet, example of table for report annex

Table B1. STOCK Environmental									
	1990	1995	2000	2005	2010	2015	2020	2025	2030
net load (kWh/a)	0000	0000	0000	0000	0000	0000	0000	0000	0000
sales (000)	0000	0000	0000	0000	0000	0000	0000	0000	0000
stock (000)	0000	0000	0000	0000	0000	0000	0000	0000	0000
Efficiency									
BaU	00%	00%	00%	00%	00%	00%	00%	00%	00%
Min only	00%	00%	00%	00%	00%	00%	00%	00%	00%
Lbl only	00%	00%	00%	00%	00%	00%	00%	00%	00%
Min+Lbl	00%	00%	00%	00%	00%	00%	00%	00%	00%
kWh/a.unit									
BaU	00%	00%	00%	00%	00%	00%	00%	00%	00%
Min only	00%	00%	00%	00%	00%	00%	00%	00%	00%
Lbl only	00%	00%	00%	00%	00%	00%	00%	00%	00%
Min+Lbl	00%	00%	00%	00%	00%	00%	00%	00%	00%
TWh primary/a new sales (without corr.)									
BaU	00	00	00	00	00	00	00	00	00
Min only	00	00	00	00	00	00	00	00	00
Lbl only	00	00	00	00	00	00	00	00	00
Min+Lbl	00	00	00	00	00	00	00	00	00
etc.									

Table 34 SUMMARY sheet, example 2020 scenario

SUMMARY			Scenarios 2020			
			1	2	3	4
IMPACTS (as Art. 15, sub. 4., subsub e.)			**BAU**	**Min Only**	**Min+Lbl**	**Min+Lbl**
ENVIRONMENT						
	ENERGY	PJ/a	**0000**	**0000**	**0000**	**0000**
	GHG	Mt CO_2 eq./a	**000**	**000**	**000**	**000**
	AP	kt SO_x eq./a	**000**	**000**	**000**	**000**
CONSUMER						
EU totals	expenditure	€ bln./a*	**00.0**	**00.0**	**00.0**	**00.0**
	purchase costs	€ bln./a*	0.0	0.0	0.0	0.0
	running costs	€ bln./a*	00.0	00.0	00.0	00.0
per product	product price	€	000	000	000	000
	install cost	€	000	000	000	000
	energy costs	€ /a	000	000	000	000
	payback(SPP)	years	reference	**0.0**	**0.0**	**0.0**
BUSINESS						
EU turnover	manufacturer	€ bln./a*	**0.0**	**0.0**	**0.0**	**0.0**
	wholesale	€ bln./a*	**0.0**	**0.0**	**0.0**	**0.0**
	retail/ installer	€ bln./a*	**0.0**	**0.0**	**0.0**	**0.0**
EMPLOYMENT						
employ-ment (jobs)	industry EU (incl OEM)	'000	00	00	00	00
	industry non-EU	'000	00	00	00	00
	whole-sale	'000	00	00	00	00
	installers	'000	00	00	00	00
	TOTAL	'000	**00**	**00**	**00**	**00**
	of which EU	'000	00	00	00	00
	EXTRA EU jobs	'000	reference	**00**	**00**	**00**
	of which SME		reference	00	00	00
*=all money amounts in Euro 2010 (inflation corrected)						
BOUNDARY CONDITIONS ("should be no negative impacts")						
			Scenarios 2020/ 2025			
			1	2	3	4
IMPACTS "No negative impacts" following Art. 15, sub 5			**BAU**	**Min Only**	**Min+Lbl**	**Min+Lbl**
functionality of product			+	+	+	+
health, safety and environment			+	+	+	+
affordability and life cycle costs			+	+	+	+
industry competitiveness			+	+	+	+
no proprietary technology			+	+	+	+
no excessive administrative burden			+	+	+	+

7.2 Design Option Incremental Costs

Both for MEErP Task 6 and 7, the price change (and possibly change of installation costs) due to product design improvements is very important, because it sets Least LCC target levels and largely determines the revenues for business stakeholders and affordability for consumers.

For existing products that already have the design options incorporated, it may seem like a relatively easy task of retrieving the list-prices and apply a previously established average discount to arrive at a street-price. Consumer associations are a good source in this respect. Alternatively, but not preferably, industry and trade experts may be interviewed (e.g. through a questionnaire) to acquire their estimate of the price data.

The problem with this approach is that it gives only a snapshot of the instantaneous price level. Especially if the improved products have only been on the market for a few years, this may be highly misleading, because they are usually sold at a hefty commercial bonus. In these first few years, the price reflects what the market is willing to pay and not what the new feature would actually cost in a competitive market arising from mandatory measures.

In order to establish the long-term price increase of a design option there are two alternatives:

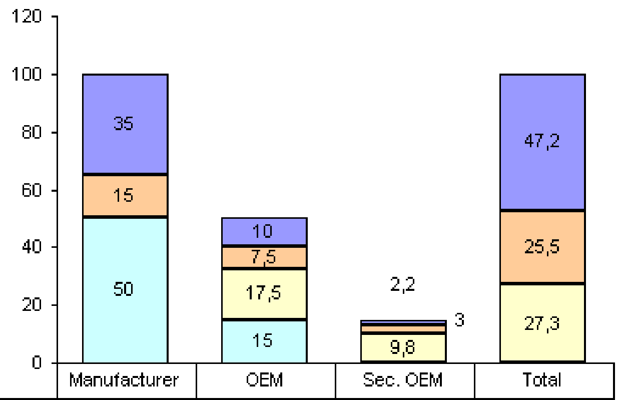
- for new product features that have already reached the stage of component mass-production a 'bottom-up' engineering approach is appropriate. This requires, even if only at an approximate level, a detailed cost split-up of the new OEM components, extra assembly hours, capital write-off, etc. to arrive at the *strict manufacturing cost increase*. Subsequently, the manufacturing overhead and industry margin is applied to arrive at the manufacturer's selling price (msp). Finally, the sector-specific wholesale and retail margins and --for consumer products-- VAT and levies are applied to arrive at the consumer street-price. See Table 35 for an example of msp split-up that is fairly typical for the EU durable consumer goods industry. Wholesale margin (30%) and retail margin (20%) are typical for this particular boiler product. For e.g. whitegoods, retail margins are higher (50-150%)
- for parts and features that have not yet reached the final stage of development and mass-production, the 'bottom-up' engineering approach will either have to 'dig deeper', i.e. analyzing prices of component materials and processing, or - more likely - has to rely on long-term projections by authorative and unbiased sources. For instance, in the case of OLED and LED lighting the ultimate price level can only be assessed in the latter way.

Several stakeholders suggest that the Preparatory Study teams assess the potential for developing "Learning Curve" product pricing to apply to the product, meaning establishing some historical trend in price and efficiency over time, to try and develop a historical trend in technology and price evolution, and then conduct a sensitivity analysis at the expected learning curve (lower) price point. There are three discrete factors at play that all impact price after a regulation has taken effect: (1) the price may increase because manufacturers are now incorporating better components, more material, more expensive parts; (2) the price may decrease because companies generally get better at manufacturing, they may redesign to reduce the number of components, they may have a programme focused on substituting parts designed to reduce costs; any OEM supplied parts such as high-efficiency compressors may get less expensive since a larger volume is being ordered (economies of scale); and (3) the price may decrease because energy efficient models tend to command a higher profit margin in the market, which will be eroded when that level becomes the minimum regulated standard that everyone makes. When presenting price projections, these three factors should be distinguished, if available data allows.

Table 35. MSP (manufacturer selling price) of CH boiler, split up (source: ENER Lot 1, VHK, 2007)

MSP (manufacturer selling price)	100%	
Overhead (marketing, admin, margin)	35%	
Labour (finishing, assembly, testing, packaging)	15%	
Subassemblies & components (OEM)	50%	
of which		
OEM: Overhead		
OEM: Labour		15% (=7.5% * msp)
OEM: Raw materials		35% (=17.5% * msp)
OEM: Secondary OEMs		30% (= 15% * msp)
of which		
Sec. OEM: Overhead		15% (=2.2% * msp)
Sec. OEM: Labour		20% (=3% * msp)
Sec. OEM: Raw materials		65% (=9.8% *msp)

Overall: Overhead 47.2%, labour 25.5%, materials 27.3%



	Manufacturer	OEM	Sec. OEM	Total
overhead	35	10	2,2	47,2
labour	15	7,5	3	25,5
raw material		17,5	9,8	27,3
OEM	50	15		

7.3 Product Life

Product service life (in years) is an essential parameter for LCC calculations in MEErP Tasks 5 and 6 as well as the scenario analysis in MEErP Task 7.

Values are given in the Energy Service Directive 2006[105] and past preparatory studies.

7.4 Revenues

MEErP Task 7 entails the scenario analysis of the economic impact of measures on stakeholders, split between industry (including OEMs[106]), wholesale, retail, product taxes (incl. VAT). The scenarios comprise the current situation (e.g. 2010) and projections for 2020, 2025 and 2030.

The revenues are calculated from annual unit sales multiplied with the share of the acquisition costs for the various actors, e.g. as is shown in table 33. The accuracy of the estimates for the industrial revenues level can be increased by checking the data against the Annual Reports of the largest manufacturers and their self-proclaimed market shares. Other sources include reports by industry associations publishing sector data and commercial market research organisations, but in the latter case –unless the organisation is part of the consortium performing the preparatory study—recent data will not be available for publication for commercial reasons (copyright).

The projection of business revenues is highly relevant for policy makers. First of all to assess the relative importance of a product group with respect the EU's Gross Domestic Product (€ 11.200 billion in 2009). Second of all, it shows whether an Ecodesign measure will not have a negative impact on stakeholders, as required in Ecodesign Directive 2009/125/EC.

An important question is how the scenario analysis will deal with the effects of the economic crisis. For most product sectors - unless there is a strong government incentive - the most likely scenario is a peak in sales in 2007 and then a dip in sales value of 20-30% over 2008-2009. By the end of 2010 sales will be back at 2004-2005 levels (in total value) and the growth rate will resume its average pace of the period 2000-2005. [107]

This average 2000-2005 annual growth rate is to be assumed for the period 2010-2030 in a baseline scenario for a product in a mature market (>70-80% market penetration). For a product in a growth market the growth rate can be expected to decrease in time. When 70-80% of the potential customers have been served, annual growth rates of around 2% are typical.

For alternative scenarios "with measures" in principle the same annual growth rate applies as for the baseline scenario, unless

- the Ecodesign minimum requirements leads to purchase prices that are not economical (beyond Least LCC) or not affordable for certain consumer groups and
- the usual 'design cycle' is not respected for the final target level.

[105] DIRECTIVE 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC. To be replaced by a new Energy Efficiency Directive in 2011/2012; see "Proposal for a Directive on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC" [COM(2011)370, 22/06/2011]

[106] Original Equipment Manufacturers, general term used for component and subassembly suppliers

[107] 2009 Ageing Report: Economic and budgetary projections forthe EU-27 Member States, European Commission, Economic and Financial Affairs, 2009, graph 2

If these two conditions are met, the quantitative scenario analysis will usually result in an increase of the acquisition costs and thus higher revenues for all actors involved.

The length of the 'design cycle' is the customary time period for redesign of the product platform in a specific sector. For average products (e.g. whitegoods) this period is 3-4 years, starting from the adoption of the legislation. For more conservative sectors, like installed products, this period may be longer (5 years); for more innovative sectors, like ICT products, this may be shorter (2-3 years). Not that this relates to the final target level, i.e. the second tier in a 2-tier measure. First tier requirements are usually intended to step-up best practice (application engineering), but for new R&D activities involving heavy retooling the second tier (or the 'A' class in an energy label) is the relevant requirement.

In a qualitative section, the scenario analysis may also briefly touch upon some 'strengths and weaknesses' and 'opportunities and threats' (SWOT) for EU industry and trade that are more difficult to quantify, but may be relevant for policy makers. This brief SWOT analysis may possibly extended in the Commission's impact assessment.

The strengths and weaknesses of a specific EU-sector should be judged on a case-by-case basis, but generally speaking the EU-industry strengths vis-à-vis extra-EU industry lie in a high quality products, well-trained R&D personnel, well-established brands, distribution and installer networks as well as intimate knowledge of consumer needs of the half-a-billion inhabitants in the EU-market. The weakness is in relatively high labour costs and increasing import-dependence (with unpredictable price consequences) for energy resources and raw materials. Generally speaking this would imply that the EU industry benefits most from innovative products, preferably requiring substantial (local) customer support (e.g. with installation).

The main industry opportunities lie - amongst others - in

- a more open and transparent EU single market, enhancing possibilities for trade within the EU-27;
- higher revenues, due to EU-wide higher environmental and resources-efficiency standards and more awareness with consumers on the total (environmental) cost-of-ownership;
- global leadership in environmentally friendly advanced technology and products, increasing EU competitiveness on the home market (compare Japan).

The main potential threats for the industry depend on the time-horizon:

- short-term: New product development and tooling require more investments and the drain on financial resources may be threatening for already financially weak companies and market sectors;
- mid-term: Consumers/ buyers may be less convinced of the economics of buying efficient products than anticipated. Especially in situations of split responsibilities between buyer and user (i.e. the one paying the energy bill), the buyer may postpone acquisition and/or look for alternative solutions that are cheaper and –as yet-- not regulated. The latter may also result from cheap extra-EU imports that slip through the mazes of market surveillance;
- long-term: A more open and transparent EU single market, in combination with the EU's WTO obligations[108], also facilitates the entry of extra-EU companies on the EU market, especially if ambition levels for Ecodesign and adjacent measures (e.g. energy labelling) are low and simple to implement in new products.

[108] World Trade Organisation treaty promoting free global trade by eliminating import/export tariffs.

For the wholesale and retail-sector the threats are less severe than for industry. In principle, given that the relative margin stays the same, the increased price directly results in higher revenues. Possibly, e.g. in case of multi-package products, there may be some increase in logistics support. And in case of more sophisticated products more customer support or installation work may be required. But the latter would also result in a higher turnover. Only the industry's long term threat might apply also to the distribution sector, i.e. if the ambition level is so low that the resulting simple products can be sold through the internet there might be a serious loss of revenues and employment.

7.5 Consumer expenditure

The annual consumer expenditure is the sum of the running costs (energy and other consumables, maintenance and repairs) for the total number of units installed ('stock') plus the acquisition costs of annual sales (purchase price, possibly installation costs) and possible disposal costs charged at acquisition and/or end-of-life to consumers. The difference with the Life Cycle Costs (LCC), e.g. the total LCC of products purchased in a particular year, is the time-dimension. With 'annual expenditure' the assessment relates to the present. With LCC the assessment relates to the present costs (for acquisition e.g.) and future (running) costs discounted to the present value. In stable conditions, especially when the expected real (inflation-corrected) rise in tariffs equals more or less the Commission's discount rate of 4% (as is currently the case, see e.g. chapter 7), the difference between the LCC of products purchased in the current year and the consumer expenditure in that same year will be almost identical.

The assessment of consumer expenditure [the difference with LCC will be further clarified/ expanded in the next version of this report] is part of the impact and scenario analysis in MEErP Task 7. The outcome is relevant for the EU's consumer policy in general, i.e. in relationship to the consumer budget assessment and buying power. For the assessment of affordability for specific consumer groups the scenario analysis will be too generic.

7.6 Employment

Estimating the employment effect of Ecodesign measures, with particular attention to the role of SMEs, is part of the impact and scenario analyses in MEErP Task 7. It is particularly relevant for the EU policy in the field of job creation and avoidance of job loss, following the 2008-2009 economic crises. In 4Q 2010 the EU-27 had a labour force of around 217 million employees plus over 21 million people unemployed (8.9 %) on a total population of over 500 million inhabitants.

Of the 217 million EU employees around 130 million were employed in the so-called 'non-financial business sector' (NACE 2 sectors A to M). The rest are employed in the predominantly public sector (health care, education, public administration, and defence), culture and community services as well as householders and extraterritorial organisations.

The jobs in the non-financial business sector can be subdivided into agricultural (5.6 %), industry (24 %) and services (70%).

For the EU employment impact and scenario analysis there are several complementary sources:

1. Eurostat's Labour Force Survey, which is a quarterly survey of 1,5 mln. workers, supplying input amongst others to the European Commission employment policy.[109] This is the most

[109] Annual publication e.g. European Commission Directorate-General for Employment, Social Affairs and Equal Opportunities, *Employment in Europe 2010*. For quarterly reports see Eurostat LFS database.

comprehensive source for employment not only in business activities but also in the public sector. It uses the NACE Revision 2 classification to describe the number and type of jobs per economic activity, but at a highly aggregated level (see Table 41). This gives a dome estimate of the sectors involved.

2. For more detailed NACE R2 subsector labour statistics, Eurostat publishes data on its website. An example is given in the table below for the construction sector. Similar statistics for other sectors can be found. This narrows down the estimate of the jobs and gives an impression of the SME share in the sector.

Table 36. EU-27 Employment, in million jobs, by occupation and economic activity, 4Q 2010 (Eurostat, lfsq_eisn2- data, NACE 2* and ISCO 88)

ISCO88 occupation -->		Legislators, senior officials and managers	Professionals	Technicians and associate professionals	Clerks	Service workers and shop and market sales workers	Skilled agricultural and fishery workers	Craft and related trades workers	Plant and machine operators and assemblers	Elementary occupations	Armed forces	No response	**TOTAL**
	NACE_R2 sector												
A -	Agriculture, forestry and fishing	0.4	0.1	0.2	0.1	0.1	7.9	0.1	0.4	1.6			**10.9**
B -	Mining and quarrying	0.1	0.1	0.1	0.0			0.3	0.2	0.1			**0.8**
C -	Manufacturing	2.4	2.6	4.5	2.7	0.8	0.1	10.5	7.9	2.5		0.1	**34.1**
D -	Electricity, gas, steam and air conditioning supply**	0.1	0.3	0.4	0.2			0.4	0.2	0.1			**1.6**
E -	Water supply; sewerage, waste management and remediation activities	0.1	0.1	0.2	0.2			0.2	0.4	0.4			**1.6**
F -	Construction	1.2	0.8	1.1	0.8	0.1	0.0	10.2	1.1	1.3		0.0	**16.6**
G -	Wholesale and retail trade; repair of motor vehicles and motorcycles	4.9	1.1	4.4	3.8	9.8	0.1	2.9	1.1	2.3		0.1	**30.5**
H -	Transportation and storage	0.7	0.3	1.0	2.3	0.4		0.5	4.7	1.0		0.0	**11.0**
I -	Accommodation and food service activities	1.7	0.1	0.2	0.5	5.3		0.1	0.1	1.2		0.0	**9.2**
J -	Information and communication	0.8	2.4	1.7	0.7	0.1		0.2	0.1	0.2		0.0	**6.2**
K -	Financial and insurance activities	1.0	0.9	2.1	2.3	0.1		0.0		0.1			**6.5**
L -	Real estate activities	0.2	0.1	0.7	0.3	0.0		0.1		0.3			**1.7**
M -	Professional, scientific and technical activities	1.1	4.5	2.9	1.6	0.1	0.0	0.2	0.1	0.2		0.0	**10.7**
N -	Administrative and support service activities	0.7	0.4	0.9	1.1	0.9	0.5	0.6	0.3	3.1		0.0	**8.5**
O -	Public administration and defence; compulsory social security	0.8	2.9	3.7	2.8	2.1	0.1	0.4	0.3	1.2	1.4	0.0	**15.6**
P -	Education	0.5	9.2	2.6	0.8	1.4	0.0	0.1	0.0	1.3		0.1	**16.1**
Q -	Human health and social work activities	0.7	4.4	7.3	1.6	6.3	0.0	0.3	0.2	1.5		0.1	**22.4**
R -	Arts, entertainment and recreation	0.3	0.9	0.9	0.6	0.3	0.1	0.1	0.0	0.3			**3.4**
S -	Other service activities	0.4	0.6	0.7	0.5	2.0	0.1	0.4	0.2	0.5			**5.3**
T -	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use			0.0	0.0	0.4	0.1	0.0		2.0			**2.6**
U -	Activities of extraterritorial organisations and bodies	0.0	0.1	0.0	0.0								**0.2**
NRP	No response	0.1	0.2	0.2	0.1	0.1		0.1	0.1	0.1		0.1	**1.2**
TOT	**TOTAL - Total - All NACE activities**	**18.2**	**31.9**	**35.7**	**23.0**	**30.3**	**9.0**	**27.8**	**17.4**	**21.2**	**1.4**	**0.8**	**216.9**

*= Labour Force Survey. Note that the NACE 2 nomenclature (employed since 2008) differs from NACE 1.1. used elsewhere in this report
**=probably Eurostat means district heating

Table 37. Structure of the construction industry EU-27, 2007 (source: Eurostat 2010)

	Number of enterprises	number of persons employed	turnover	value added	apparent labour productivit (per person employed)	gross operating rate (2)	invest. Rate(2)
	1000		*EUR million*		*EUR 1000*	*%*	
Construction	**3 090**	**14 793**	**1 665 092**	**562 159**	**38.0**	**12**	**9**
Site preparation	117	460	55 540	19 178	41.7	:	20
General construction	1 270	8 112	1 070 417	325 650	40.1	11	11
Building installation	759	3 483	324 624	125 337	36.0	12	5
Building completion	930	2 637	202 221	86 329	32.7	17	7
Renting of const. equipment	16	89	10 131	4 812	54.0	24	:

(2) 2006

3. Finally, for the employment effect caused by the products - not the economic activity - the annual reports of the companies are to be used as a source. More specifically the average revenue per employee in the company is used as a parameter. In the preparatory studies thus far, this figure was between € 120.000 and € 180.000 per employee per year. For OEM employment, the manufacturing jobs are multiplied with an OEM-factor derived from the cost calculation. In past studies, the OEM-factor was between 1,2 and 1,5. For the wholesale sector (€ 0.25 – 0.3 mln. per employee) and the retail sector (€ 80-120.000 per employee) the wages were estimated from the total known employment in the sector and its turnover.

Note that for the employment impact estimates it is not necessary to investigate the interdependence of the economic activities, e.g. through the EU-27 input-analysis tables, as has been done for some sectors by industry associations. Such an elaborate time-consuming analysis is limited to economic activities and would anyway not result in employment impacts per product. Therefore it is believed that a more thorough analysis of company figures is sufficient

7.7 Sensitivity analysis: Societal life cycle costs

Whereas most of the elements of the sensitivity analysis are self-explanatory, the calculation of the societal life cycle costs requires more guidance.

External societal damages/costs

In its assessment from November 2011 of the monetary costs of pollution from industrial and power plants in the E-PRTR database[110], the European Environmental Agency used the latest insights and data. Apart from CO2 and regional air pollutants (NOx, SO2, NH3, NMVOC, PM) the EEA included also air pollution from heavy metals (As, Cd, Hg, Ni, Pb) and organic micro-pollutants (PAHs, benzene,

[110] EEA, Revealing the costs of air pollution, Technical Report No. 15/2011, Copenhagen, Nov. 2011.

dioxins and furans). It is thus a fairly complete coverage of the air pollutants that are also distinguished in the MEErP/EcoReport.

The EEA estimated the cost of external damage caused by emissions from the E-PRTR industrial facilities in 2009 at least at EUR 102–169 billion. Of this, the largest contribution came from power generation sector at € 66-112 billion (roughly 66% at mid value comparison). Furthermore, the EEA reports that the largest pollutant contributing was CO2, not in terms of damage but as an ETS trading item, accounting for € 63 billion (around 45%). Regional air pollutants account for € 38 – 105 billion, whereas the contributions of heavy metals (€ 0.35 billion) and organic micro-pollutants (€ 0.15 billion) are relatively very small.

The unitary damages, in € per metric tone, are given in the figure below (note the logarithmic Y-axis scale).

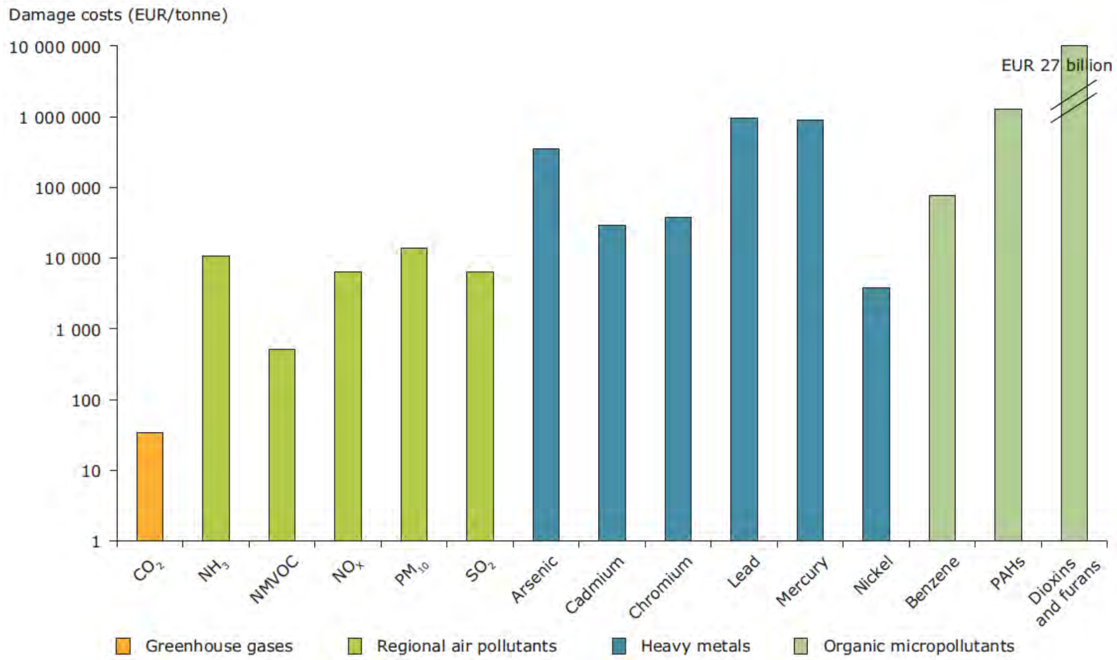


Figure 22. Estimates of the European average damage cost per tonne emitted for selected air pollutants

(note the logarithmic scale on the Y-axis), Source: European Environmental Agency EEA, Nov. 2011.

The coverage of the emissions of E-PRTR industrial and power installations with respect of the EU totals varies considerably with the type of pollutant. For CO2 it is 44%. For three regional air pollutants (NH3, NMVOC, PM) coverage is in the range of 5-7%, whereas for NOx the E-PRTR installations constitute 27% and for SO2 even 67% of the total EU emissions. Heavy metals coverage is in the range of 15-40% of EU total. For dioxins and furans it is 43% and for PAHs 6%.[111]

The uncertainties of the assessment are substantial. Hereafter the details are discussed in more detail.

[111] Pollutant types with low coverage are dominant in non-industry sectors, e.g. transport (PAHs, NMVOC, PM) and agriculture (NH3) .

CO2

The societal costs of CO2 emissions used by the EEA are not external damages, but an adoption of an UK methodology to estimate the long-term monetary savings from investments in carbon abatement[112]. From this methodology the EEA chooses the 'central' (as opposed to 'low' or 'high') UK scenario with a projected carbon value of € 33.6 in 2020, derived from the expected Emission Trading System (ETS) trading price.

The MEErP follow the same principle, i.e. take trading prices as a basis for societal costs, also because the existence of the ETS leaves very little other choice. However, the MEErP value for CO2 –derived from previous UK projections and trading prices at 1.1.2011 (i.e. € 14/tCO2)-- are similar to what is called a 'low' scenario, i.e. arriving at a real cost[113] of € 20/t in 2020 (start price € 14 per 1.1.2011 with 4% real annual growth rate). The current trading price (Nov. 2011) of € 7.9/t would confirm that such a 'low' scenario is more plausible.

The range for CO2 is derived from estimates in the IPPC 4tht Assessment Report[114], which estimates the societal costs of carbon emissions at anywhere between € 3 and € 70 per tonne CO2 equivalent.

Regional air pollutants

The external damages from regional air pollutants varies very widely (>factor 10 between highest and lowest) between Member States, e.g. as a result of receptor (e.g. population) density and the probability of dispersion in open sea.

The EEA based its evaluation for regional air pollutants is based on VOLY (Value of Life Years lost), because regional air pollutants are usually of a chronic nature (not acute). The alternative method, i.e. the one that is used by the EEA for heavy metals and organic micro-pollutants, is the use of the VSL (Value of Statistical Life), which yields results that are a factor 2.8 higher. Results according to this alternative method are also calculated in the EEA report and explain the wide range of damages for regional air pollutants, i.e. between € 38 (VOLY method) and € 105 billion (VSL method).

The EEA states conformity with the CAFE-CBA principles[115], but –as opposed to the latest 2007 CAFE sensitivity analyses by AEAT which considered the effect negligible—it does take into account the damage from reduced crop production (from AOT40[116], using the EMEP[117] model). Also note that the EEA assumes in its analysis that PM10 and PM2.5 external damages per mass unit are equal, whereas in CAFE the damages of PM2.5 were considered double those of PM10.

The damages investigated stem from human exposure to particulate matter PM2.5 and ground-level ozone (O_3) leading to certain mortality and morbidity rates[118], as well as reduction in crop reduction and SO_2 damaging utilitarian buildings. This covers a substantial part of damages, but not all. Of the damages that are omitted, the damage to ecosystems (effects on biodiversity, forest production, etc. from excess O_3 exposure, acidification and nitrogen deposition) is probably the most significant, but the EEA considers valuation of ecological impacts currently too uncertain. (also see 'Reality check' paragraph hereafter)

[112] UK Dept. of Energy and Climate Change (DECC), A brief guide to the carbon valuation methodology for UK policy appraisal, October 2011.
[113] 'Real' is corrected for inflation.
[114] IPPC Intergovernmental Panel on Climate Change, 4th Assessment Report, 2007.
[115] CAFE is Cleaner Air for Europe, where external damages were used to establish the new NEC values . Dedicated website www.cafe-cba.org . See also European Commission, DG Environment website.
[116] Accumulated Ozone exposure over a Threshold of 40 ppb(=80 µg/m3)
[117] European Monitoring and Evaluation Programme. Website: www.emep.int
[118] Notably for respiratory and cardiological affections

Heavy metals and organic micro-pollutants

The EEA bases its assessment of external damages from heavy metals and organic micro-pollutants on the RiskPoll model[119], which –as mentioned—mainly looks at VSL impacts typical of health damage from acute exposure. Riskpoll investigates several routes of potential exposure to a pollutant, including inhalation, consumption of contaminated tap water, agricultural crops and animal products, such as fish, meat, milk, fruits and vegetables, and grains and cereals. RiskPoll does not take into account pathways of groundwater contamination, dermal contact and soil ingestion. The latter two are considered negligible; groundwater contamination could be of concern according to the EEA.

EEA calculates damage costs by multiplying the physical impacts (cancer cases or IQ points lost[120]) by the appropriate unit cost (Euros per incident). The default unit costs in RiskPoll are as follows (discounted to 2005 Euro): EUR 2 000 000 for a fatal cancer, EUR 500 000 for a non-fatal cancer incident and EUR 9 300 for the loss of an IQ point. The cancer unit cost includes medical expenses (cost of illness), wage and productivity losses, and the willingness to pay to avoid the pain and suffering inflicted by the disease (welfare loss). Non-fatal cancers refer to incidents where the survival probability is greater than five years from the time of diagnosis. It is assumed that between 10 % and 20 % of cancer cases are non-fatal. The share is even greater for dioxins/furans, where up to 50 % of cancer cases are non-fatal. The unit cost of non-fatal cancers does not include welfare loss. The unit cost of an IQ point includes expenses associated with remedial learning and loss in potential lifetime earnings.

The table on the next page gives an overview.

[119] Relevant publications mentioned in ibid 1: Spadaro, J. V. and Rabl, A., 2004, 'Pathway analysis for population-total health impacts of toxic metal emissions', Risk Analysis, 25(5).
Spadaro, J. V. and Rabl, A., 2008a, 'Global health impacts and costs due to mercury emissions', Risk Analysis, 28(3).
Spadaro, J. V. and Rabl, A., 2008b, 'Estimating the uncertainty of damage costs of pollution: a simple transparent method and typical results', Environmental Impact Assessment Review, 28:166–183.

[120] 'IQ points lost' relates to loss of Intelligence Quote points, e.g. with children when exposed to neurotoxins (Hg and Pb, other heavy metals and organic micro-pollutants are human carcinogens).

Table 38. Unitary external damage costs, their range and European totals (main sources: CO2 ETS trading price 1.1.2011, EEA 2011)

Air pollutant	**[1] damage cost (EUR/kg)**	**[2] Range**	**[3] aggregated national emissions total (mln. kg)**	**[4] total damage cost (mln. EUR & %)**	
CO2 **[5]**	**0.014**	0.003-0.070	4.614.500	64.603	
subtotal greenhouse gases				*64.603*	21,3%
NH3	**13.19**	1.3 - 27.2	3.862	50.926	
NOx	**8.01**	0.6 - 13.9	9.631	77.137	
SO2	**8.26**	1.4 - 12.8	5.044	41.669	
VOC	**0.76**	0.05 - 1.93	7.993	6.099	
PM2.5 equivalent **[6]**	**28.80**	4.6 - 29	2.041	58.775	
subtotal regional air pollutants				*234.606*	*77.4%*
Arsenic	**349.00**	30 - 530	0.19	66	
Cadmium	**29.00**	5.2 - 47	0.10	3	
Chromium	**38.00**	7.0–63	0.32	12	
Lead	**965.00**	90–1 480	2.08	2.010	
Mercury	**910.00**	80–1 360	0.08	68	
Nickel	**3.80**	0.7–6.3	1.00	4	
subtotal heavy metals				*2.163*	*0.7%*
Benzene	**0.08**	0.014-0.012	n.a.	n.a.	
PAH (BaP equivalent)	**1279.00**	120–1 960	1.46	1.871	
Dioxins and furans (POPs group)	**27 million**	1.5–37 million	0.000002	54	
subtotal organic micro-pollutants				*1.925*	*0.6%*
Total incl. CO2 (external damages + gain on CO2 abatement) **in mln. EUR**				**303 297**	
Total excl. CO2 (external damages only)**, in mln.EUR**				**218 090**	

[1] Unitary 'marginal damage cost' as assessed by the European Environmental Agency (EEA), Nov. 2011 (Revealing the cost of air pollution), except for CO2 (see [5])

[2] The 'range' for CO2 is the range of 'Societal Carbon Costs as indicated by the IPPC 4th assessment Report. For regional air pollutants, the 'range' shows the variation found between the EU Member States. For other pollutants in the list, the 'range' is the 68% confidence interval.

[3] National total emissions reported for the year 2009 by countries to the UNECE LRTAP Convention and, for CO2, under the EU Greenhouse Gas Monitoring Mechanism

[4] Multiplication [2] x [3]. Note that the CO2 damages relate to trading prices 1.1.2011 and not to the EEA 2020 value. Also note that the EEA aggregated national CO2 emission figure relates only to CO2 and not to other greenhouse gases (which is around 5000 Mt for the EU-27). If both these effects were taken into account, the external greenhouse gases cost would be a factor 2.8 higher, i.e. 1700 billion Euro and costituting 90% of total damage costs.

[5] The CO2 values given is the only one in the table NOT from the EEA (the EEA assumes € 33.6/t for 2020 as explained in the text hereafter). The unitary costs shows the ETS trading price of carbon per 1.1.2011, which –in the analysis—should be used with an annual escalation rate (growth rate after correction for inflation) of 4%. This would then result in € 20/t in 2020. As emission total the published 2009 figure for EU-27 from EU GHG Inventory was used (comma-error in the EEA aggregated national emissions level).

[6] The EEA study converts PM10 data (nominal EUR 18.70/kg) from the E-PRTR to PM2.5 by dividing by a factor of 1.54. Reportedly, this conversion is necessary for consistency with the damage functions agreed under the CAFE programme and the dispersion modelling carried out by EMEP. Note that in EU 2007 the total PM10 emissions (2.5μm <particle size < 10μm) were 1400 kt and PM2.5 (particle size < 10μm) were 2122 kt. (see Normalisation factors table in Chapter 5).

Integration in MEErP

Based on the above, the conclusion is that there is a high probability that unit monetary costs presented by the EEA, even if they would take into account all structural impacts, do not underestimate the external damages. Hence, with the exception of CO2 where an adjustment was done to reflect the latest insights, they are taken as a suitable basis for application.

Table 39. Monetary damages due to emissions to air in the EU

	Value per kg emission	**aggregated value for MEErP accounting**
	Euro/kg	**Euro/kg**
CO_2 eq.	€ 0.014	
GWP in CO_2 eq.		€ 0.014
NH_3 (=1,88 SO2 eq.)*	€ 13.19	
NOx (=0.7 SO2 eq.)	€ 8.01	
SO_2	€ 8.26	
acidification potential AP in SO_2 eq.		€ 8.50
NMVOCs	€ 0.76	
non-methane volatile organic compounds VOC in mass units		€ 0.76
PM10	€ 18.70	
PM2.5 (=2 PM10 eq.)	€ 28.80	
particulate matter PM in PM10 eq.		€ 15.46
Arsenic (3,33 Ni eq.)	€ 349.00	
Cadmium (5 Ni eq.)	€ 29.00	
Chromium (0.5 Ni eq.)	€ 38.00	
Lead (0.04 Ni eq.	€ 965.00	
Mercury (5 Ni eq.)	€ 910.00	
Nickel (1 Ni. Eq.)	€ 3.80	
*HMa electricity [66-68], copper [29-32]***		€ 300.00
HMa Stainless St [26], CRT[44], bitumen[56],		€ 40.00
HMa other materials & processes		€ 175.00
PAH (BaP equivalent)	€ 1 279.00	€ 1 279.00
POPs (Dioxins and furans)	€ 27 million	€ 27 million

Annual nominal growth rate, ca. 6-7%

Escalation rate (inflation corrected): 4%

*= Numbers in ( ): characterisation factors from Chapter 5. The aggregated MEErP accounting multipliers are derived from the characterisation factors and weighted for the total EU emissions as presented in the EEA table.
*= Numbers in [ ] relate to numbers in EcoReport Unit indicator table (see MEErP part 2). Average cost for electricity is higher because of higher share Hg; for copper alloys the cause is a very high share of Pb. For stainless steel costs are lower because of high share Ni and Cr. For CRT displays, glass & bitumen there is a relative high share of Pb and relatively low share of other heavy metals.

The accounting of the societal life cycle costs entails the following steps:

1. The environmental analysis in MEErP and EcoReport 2011 provides the total mass of emissions of the indicators (GWP, AP, VOC, PM, HMa, PAH, POPs) during production, distribution, use and end-of-life(recycling and disposal), separately counting HMa fractions for stainless steel, CRT, bitumen, electricity and copper.
2. The mass of an indicator in each life cycle stage is multiplied with the 'MEErP equivalent' price in the table to arrive at the external damages (in Euro). Subsequently,
3. the external damages of production and distribution are added to the purchase price PP,
4. the NPV end-of-life damages (i.e. after discounting over product life, using discount and escalation rate) are also added to the PP and
5. the annual damages during the use phase (total divided by product stock life) are added to the operating expense OE.
6. The outcome, calculated with the LCC and PWF formulas in the previous paragraph, is the societal life cycle cost (LCC_{soc}) of the product.

The calculation of the societal LCC is automated in the EcoReport 2011 Tool (last rows of OUTPUT sheet)

In a simple equation, the societal life cycle costs LCC_{soc} are the sum of the external damages due to production and distribution PP_{ext}, the running costs OE_{ext} over a product service lifetime of N years and the costs of end-of-life EOL_{ext}:

As discussed in Chapter 6, the simple equation can be used if the discount rate equals the escalation rate (as is the case today). If this is not the case then the equations with discount and escalation rate should be used to establish the Present Worth Factor (PWF) as explained in Chapter 6.

A preparatory study should calculate the implications of including the societal life cycle costs on the outcome and recommendations of the study and work out LLCC target whereby the consumer life cycle costs would be extended with the external monetary damages, i.e. to see whether the targets calculated with the 'normal' LCC calculations in the previous chapters are robust.

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Directive 1999/30/EC of 22 april 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air

Directive 2000/69/EC of 16 november 2000 relating to limit values for benzene and carbon monoxide in ambient air

Directive 2000/69/EC of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air.

Directive 2001/77/EC of 27 September 2001 on the promotion of electricity produced from renewable energy sourcesThe 2003 Biofuels () aimed at 5,75% renewable energy share in transportation by 2010.

Directive 2001/80/EC on Large Combustion Plants (repealed with effect of 1 Jan. 2016 and replaced by provisions in the Industrial Emissions directive 2010/75/EC)

Directive 2002/3/EC of 12 Feb. 2002 relating to (ground level) ozone in ambient air, where NOx and VOCs should be monitored as precursors of ozone

Directive 2002/96/EC on waste of electrical and electronic equipment (WEEE)

Directive 2003/30/EC of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels

Directive 2003/87/EC of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Emissions Trading Scheme ETS)

Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity (including its planned reform)

Directive 2004/107/EC of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

Directive 2004/17/EC of 31 march 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors and 2004/18/EC of 31 march 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts. see also http://EC.europa.eu/internal_market/publicprocurement/other_aspects/index_en.htm

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Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe.

Directive 2008/98/EC of 19 November 2008 on waste and repealing certain Directives (Waste Framework Directive WFD) repealing 75/439/EEC (Waste Oils Directive), 91/689/EEC (Hazardous Waste Directive) and 2006/12/EC (Waste Directive) with effect from 12 December 2010. To be replaced end 2011.

Directive 2009/125/EC of 21 october 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (Ecodesign directive)

Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources (RES recast)

Directive 2010/30/EC of 19 may 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products (Energy Labelling directive)

Directive 2010/31/EC of 19 may 2010 on the energy performance of buildings (EPBD recast)

Directive 2010/75/EU of 24 november 2010 on industrial emissions (integrated pollution prevention and control)

Directive 2011/65/EU of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment ('RoHS 2', recast of RoHS Directive 2002/95/EC of 23 January 2003)

Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment. UWWTD (Urban Waste Water Treatment Directive)

Directive 96/62/EC of 27 september 1996 on ambient air quality assessment and management

EC, Second ECCP Progress Report: Can we meet our Kyoto targets?, April 2003. See http://ec.europa.eu/clima/documentation/eccp/index_en.htm

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Ecodesign preparatory studies, Name, product and latest source/status

ENER Lot 1 - Boilers and combi-boilers, Working document

ENER Lot 2 - Water heaters, Working Document

ENER Lot 3 - PC and computer monitors, Working Document

ENER Lot 3 - Monitors, Working Document

ENER Lot 4 - Imaging Equipment, Proposal Voluntary Agreement

ENER Lot 5 - Televisions, Commission Regulation 642/2009 (22.7.2009)

ENER Lot 6 - Standby and Off-mode losses of EuPs, Commission Regulation 1275/2008 (17.12.2008)

ENER Lot 7 - External power supplies, Commission Regulation 278/2009 (16.4.2009)

ENER Lot 8/9- Tertiary Lighting, Commission Regulation 245/2009 (13.4.2009) amended by 347/2009 (21.4.2010)

ENER Lot 10 - Room air conditioning appliances, local air coolers and comfort fans, Working document Nov 2010

ENER Lot 10 - Residential ventilation and kitchen hoods, Working document

ENER Lot 11 - Electric motors, Commission Regulation 640/2009 (22.7.2009)

ENER Lot 11 - Circulators, Commission Regulation 641/2009 (22.7.2009)

ENER Lot 11 - Pumps, Working Document

ENER Lot 11 - Commission Regulation 327/2011 (30.3.2011)

ENER Lot 12 - Commercial refrigerators and freezers, Working document

ENER Lot 13 - Domestic refrigerators and freezers, Commission Regulation 643/2009 (22.7.2009)

ENER Lot 14 - Domestic washing machines, Commission Regulation 1015/2010 (10.11.2010)

ENER Lot 14 - Domestic Dishwashers, Commission Regulation 1016/2010 (10.11.2010)

ENER Lot 15 - Solid fuel small combustion installations, preparatory study finalised

ENER Lot 16 - Laundry driers, Working document

ENER Lot 17 - Vacuum cleaners, Working document

ENER Lot 18 - Complex set-top boxes, Working Document

ENER Lot 18 a Simple Set-top boxes, Commission Regulation 107/2009 (4.2.2009)

ENER Lot 19 - General lighting (non-directional), Commission Regulation 244/2009 (18.3.2009)

ENER Lot 19 - Directional lighting, Working documents 2010-2011

ENER Lot 20 - Local room heating products, Preparatory study ongoing

ENER Lot 21 - Central heating products, Preparatory study ongoing

ENER Lot 22 - Domestic and commercial ovens, Preparatory study ongoing

ENER Lot 23 - Domestic and commercial hobs and grills, Preparatory study ongoing

ENER Lot 24 - Professional Dishwashers, Final Report Prep. Study Nov 2010

ENER Lot 24 - Professional Laundry machines and dryers, Preperatory study ongoing

ENER Lot 25 - Non-tertiary coffee machines, Working Document

ENER Lot 26 - Networked standby losses, Preparatory study finalised

ENER Medical imaging equipment, Draft voluntary agreement COCIR Nov 2009

ENER Lot 27 - Uninterruptiple power supplies, Tender

ENER Lot 28/29 - Pumps (other than Lot 11), Tender

ENER Lot 30 - Other electric motors (outside Regulation 640/2009), Tender

ENER Lot 31 - Compressors (outside Regulation 640/2009), Tender

ENTR Lot 1 - Refrigerating and freezing equipment, Prep. study finalised

ENTR Lot 2 - Distribution and power transformers, Preparatory study finalised

ENTR Lot 3 - Sound and imaging equipment, Prep. study finalised

ENTR Lot 4 - Industrial and Laboratory furnaces and ovens, Preparatory study ongoing

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