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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Commission Regulations

implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water heaters and hot water storage tanks

and

supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of water heaters, hot water storage tanks and packages of water heater and solar device

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Accompanying document to the

Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water heaters and hot water storage tanks

Commission Delegated Regulation supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of water heaters, hot water storage tanks and packages of water heater and solar device

IMPACT ASSESSMENT

Lead DG: DG ENER

Associated DG: DG ENTR

Other involved services: SG, SJ, DG CLIMA, DG ENV, DG COMP, DG ECFIN, DG INFSO, DG MARKT, DG SANCO, DG TRADE, DG EMPL

Agenda planning or WP reference: **2009/ENER+/022 and 2009/ENER/027**

1. Section 1: Procedural issues and consultation of interested parties

1.1. Organisation and timing

These actions are priorities of the Action Plan on Energy Efficiency[1].

The ecodesign implementing regulation is based on Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the Commission to set ecodesign requirements for energy-related products[2], in the following abbreviated as "Ecodesign Directive". An energy-related product (ErP) shall be covered by ecodesign implementing measures, or by self-regulation (cf. criteria in Article 19), if the ErP represents significant sales volumes, while having a significant environmental impact and significant improvement potential (Article 15). The structure and content of an ecodesign implementing measure shall follow the provisions of the Ecodesign Directive (Annex VII).

The energy labelling delegated act is based on Directive 2010/30/EC of the European Parliament and of the Council on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products[3]. Pursuant to its Articles 10(1) and (2) a product shall be covered by a delegated act, if it has a significant potential for saving energy, and, where relevant, other essential resources, and products with equivalent functionality are available on the market which have a wide disparity in the relevant performance levels.

The Commission has carried out a technical, environmental and economic analysis in preparation of these initiatives, in the following called "preparatory study". The preparatory

[1] COM(2006)545 final.
[2] OJ L 285, 31.10.2009, p. 10.
[3] OJ L 153, 18.6.2010, p. 1.

study was carried out by external consultants[4] on behalf of the Commission's Directorate General for Energy (DG ENER). The preparatory study has followed the structure of the "Methodology Study Eco-design of Energy-using Products"[5] (MEEuP) developed for the Commission's Directorate General for Enterprise and Industry (DG ENTR). The MEEuP has been endorsed by stakeholders and is used in all ecodesign preparatory studies.

On 29 February 2008 and on 8 July 2008 meetings of the Ecodesign Consultation Forum established under Article 18 of the Ecodesign Directive were held in relation to water heaters and hot water storage tanks. In addition, the Consultation Forum was consulted in writing on working documents for ecodesign, energy labelling and transitional testing and calculation methods mid 2010, and the contributions of Member States and stakeholders are available on the Circa system.

Furthermore, on 11 April 2011 the Regulatory Committee exchanged views on the working documents for water heaters and for heaters (the latter were published in March 2011 and are covered by a separate impact assessment).

Article 19 of the Ecodesign Directive foresees a regulatory procedure with scrutiny under the Treaty establishing the European Community for the adoption of ecodesign implementing measures. If the Regulatory Committee gives a favourable opinion on a draft measure for Dedicated Water Heaters later in 2011, and neither European Parliament nor Council oppose, the measure is expected to be adopted by the Commission in the second half of 2011, with subsequent publication in the Official Journal of the European Union.

Measures implementing the Energy Labelling Directive are delegated acts pursuant to Article 290 of the Treaty on the Functioning of the European Union. If a delegated act adopted by the Commission is not opposed by European Parliament or Council, the measure will be published in the Official Journal of the European Union.

1.2. The consultation process for the draft impact assessment

A written Inter Service Consultation on the draft impact assessment took place in May 2011. Comments and recommendations were received from DG ENTR, DG ENV and DG EMPL. These were taken into account in this version.

Comments from the Impact Assessment Board on the draft version were related to the relationship with the Energy Performance of Buildings Directive; the applied methodology and data collection; the measurement and calculation methodology; the impact on manufacturers, particularly SMEs, and on exports; the comparison of the proposed measures with similar requirements in third countries; the impact on users. These issues as well as more technical comments have been addressed in the final version of the impact assessment report.

1.3. Transparency of the consultation process

External expertise on water heaters and hot water storage tanks was gathered in the framework of the preparatory study. It has been developed in an open process, taking into account input from relevant stakeholders including manufacturers, installers, retailers and

[4] "Preparatory Study on eco-design of water heaters", René Kemna et al.(VHK), final report of 2 July 2007; documentation available on the DG TREN ecodesign website http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm

[5] Methodology Report, final of 28 November 2005, VHK, available on DG TREN and DG ENTR ecodesign websites

their associations, environmental NGOs, consumer organisations, EU Member State experts and experts from third countries. The preparatory study provided a dedicated website where interim results and further relevant materials were published regularly for timely stakeholder consultation and input. The study website was promoted on the ecodesign-specific websites of DG ENER and DG ENTR. Several consultation meetings were held for discussing the preliminary results of the study.

Throughout the preparatory studies, the most closely involved DGs were kept informed of the studies and the positions of industry, stakeholders and MS through the CIRCA system. Closely involved DGs such as DG ENTR, CLIMA and ENV have been invited to, and attended, stakeholder meetings.

Subsequently systematic consultations were carried out on possible ecodesign and energy labelling requirements. During the meetings of the Ecodesign Consultation Forum on 29 February and 8 July 2008, for which also the other closely involved DGs were invited, Commission staff presented "working documents" with suggestions for ecodesign requirements and an energy labelling scheme for water heaters and hot water storage tanks[6], which are based on the results of the preparatory study. The working documents were published on DG ENER's ecodesign website, and stakeholder comments received in writing before and after the meeting are included in the Commission's CIRCA system.

An additional written consultation of the Ecodesign Consultation Forum and at expert level was launched in June 2010 on updated working documents for ecodesign and energy labelling measures for water heaters and hot water storage tanks, which build on the input/feedback provided during the earlier consultations of the Consultation Forum. The working documents were also shared with the European Parliament. Furthermore, the European Parliament and the Council were informed on the steps the Commission intended to take prior to the adoption of the delegated energy labelling regulation.

The ecodesign regulation and the delegated energy labelling regulation take into account the additional feedback on these working documents.

1.4. Stakeholders - consultation process

The positions of main stakeholders on crucial features of the Commission services' working documents can be summarised as follows.

Member States

The **Member States** support in general the suggested energy efficiency levels for ecodesign and the approach for energy labelling. The level of ambition for ecodesign requirements and the approach for an energy efficiency grading for the energy label based on primary energy consumption were in general considered appropriate, and the suggested time scales are supported.

As far as ecodesign requirements for NOx are concerned, the UK, Ireland and several other Member States (including Germany) requested to set ecodesign requirements for NOx emissions from water heater using liquid fuels at a level that corresponds to best available kerosene based technology. Some other Member States have requested to ensure that national levels set e.g. under the National Emissions Ceiling Directive should be considered. There was a consensus that the transition period for ecodesign requirements on NOx emissions should be shortened to three years instead of five years, with the exception of fuel heat pump

6 DG ENER ecodesign website: http://ec.europa.eu/energy/efficiency/ecodesign/forum_en.htm

water heaters and solar water heaters newly entering the market requiring five years to be able to comply with NOx requirements. Additionally, Germany pointed out that heat pump water heaters equipped with internal combustion engines cannot cope with the NOx requirements designed for external combustion.

Manufacturers/suppliers and installers

The general approach to set mandatory requirements in the framework of ecodesign, and energy labelling legislation is in general supported by industry[7] associations such as the European Committee of Domestic Equipment Manufacturers (CECED), the Association of the European Heating Industry (EHI), and the European Solar Thermal Industry Federation (ESTIF). The proposed levels and timing of the ecodesign requirements for energy efficiency are accepted. The maximum levels for NOx emissions suggested during the stakeholder consultation were considered to be too ambitious in particular for kerosene-based water heaters mainly used in the UK and in Ireland. In general NOx emissions are intrinsically higher for more efficient high temperature combustion, and ambitious NOx emissions may result in a loss of efficiency.

These concerns are reflected in the levels and timing for the ecodesign requirements set out in the regulation.

The energy efficiency ranking for the energy label is based on primary energy consumption is accepted, although some industry stakeholders would prefer energy efficiency rankings differentiated according to fossil fuels and electricity.

In order to avoid competitive disadvantages, the energy labelling regulation requires providing information to the end-user on the energy efficiency of packages of water heaters and solar parts which were placed on the market separately. A label and fiche have been proposed to allow dealers to label packages of products for the end-consumer. This approach is supported by installer associations and by suppliers.

Environmental and Consumer NGOs in general welcome ecodesign and energy labelling legislation. The suggested time scales and the timing for upgrades of ecodesign requirements and energy efficiency classes could sometimes be more ambitious. In addition, environmental NGOs stress that NOx levels should become effective much earlier than suggested in the working documents.

More detailed descriptions of the outcome of the consultation process can be found in Annex VIII.

Information on the many stakeholder and experts' consultations during the preparatory study can also be found on the dedicated webpage http://ecohotwater.org . Furthermore, there have been numerous position papers and notes from Member States, industry associations and NGOs which have been communicated on a permanent basis to all participants in the process through the Circa system, with the rare exception when procedures or confidentiality for business reasons did not allow to do so.

2. SECTION 2: PROBLEM DEFINITION

[7] See e.g. contributions of ORGALIME and CECED to the consultation of Directive 92/75/EEC, available on http://ec.europa.eu/energy/demand/legislation/domestic_en.htm#consultation; "CECED vision on Energy Efficiency" of 1st July 2007, available on www.ceced.eu;

2.1. Introduction

The underlying problem can be summarised in the following way: cost-effective and energy efficient technologies for water heaters and hot water storage tanks exist on the market, but their market penetration is lower than it could be.

As requested by Article 15 of the Ecodesign Directive, the preparatory studies identified the environmental aspects in relation to water heaters. In order to carry out the technical, environmental and economic analysis the preparatory study has considered representative electrical and gas-fired water heaters with relevant sizes, which are usually described in "size classes" (also called "load profiles") "S", "M", "L" etc. and which characterise the capacity of a water heater to generate hot sanitary water of a certain temperature at a certain rate.

In particular the study has, amongst others, provided the following key elements:

– the amount of electricity/gas needed to provide hot water according to tapping cycles which reflect the typical use of an "average" water heater ("base case") of the relevant size classes;

– the bill of materials, weight, packaging etc.;

– the installed base ("stock") and the annual sales for the period until 2020 and beyond, and the typical life time;

– technologies yielding reduced electricity/gas consumption, including renewable energy sources such as solar water heating and heat pumps, and the costs effects for applying them compared to the current "market average";

– the impact of the characteristics of the building infrastructure such as chimney, drains, draw-off points etc. on the suitability of water heater technologies for a given infrastructure.

The structure of the methodology of the technical, environmental and economic analysis is displayed in Annex I.

The study concludes that

– water heaters have a significant environmental impact within the Community

– water heaters present significant potential for improvement without entailing excessive costs

– the following environmental aspects are relevant for legislation now:

  – electricity/gas consumption in the use phase;

  – NOx emissions;

– The setting of ecodesign requirements for emissions of carbon monoxide and hydrocarbons is not yet appropriate, as no suitable measurement methods are available, and such ecodesign requirements should be considered for the review of this regulation. National rules for emissions of carbon monoxide and hydrocarbons may be maintained until corresponding ecodesign requirements become effective.

The study has shown that water heaters are a product category which meets the criteria listed in Article 15 §2 of the Ecodesign Directive and Article 10 § 2 of the Energy Labelling Directive, and therefore has to be covered by an implementing measure and delegated act respectively.

2.2. Market failures

The major barrier for the market uptake of water heaters with improved environmental performance is market failure due to:

– incomplete information, lack of awareness/interest for running costs/cost savings

– lack of incentives and capital for investments

Incomplete information, lack of awareness/interest for running costs/cost savings

– Water heaters are a "low-interest" product: the interest and the awareness for the implications of water heaters for the expenditure for gas and electricity is limited. Their energy efficiency until now has not been an important purchasing criterion.

– Incomplete information on running costs/cost savings: information on running costs/cost savings is not explicit and can be obtained only with difficulties. This implies, e.g., the following:

  – Even if water heaters were a "high-interest" product there is no objective method for assessing the energy efficiency rating and energy consumption of water heaters, which would allow a purchasing decision which adequately considers the running costs[8].

  – Therefore currently it is not possible to compare the performance and the expected running costs of water heaters, including comparison of different technologies and energy sources, and in particular the expected benefits of using renewable energy sources for water heating.

  – Authorities seeking to promote energy-efficient water heaters, e.g. by providing financial incentives, suffer from the lack of an objective energy efficiency rating method. This means that current efforts are aimed at the relatively small new housing market and are characterized by typology-based measures (e.g. x m² of solar thermal panel surface). Improvement options in the replacement market and improvement potential in conventional products or new products with energy input by renewable energy sources are largely not addressed. As a consequence some authorities have adopted just one single efficiency rate for *all* types of water heaters when implementing the EPBD.

– Innovative water heaters, e.g. with RES input, may be more complex products requiring particular know-how, which may not always be available. Due to the absence of an energy efficiency rating system installers there is little incentive to invest into capacity building/training.

Lack of incentives and financial capacities for investments

– Owners or sellers of property have often little incentives to invest in water heaters with improved environmental performance even if the investments are cost-effective, because the running costs for energy are paid by the tenant or buyer of the building, while additional up-front investments in water heaters with improved environmental performance compared with water heaters with "lower" environmental performance currently can hardly be recovered e.g. by asking for a higher rent.

– Adapting existing infrastructure to conditions required for operating highly efficient water heaters can require high investments, e.g. connecting property to the gas grid or

[8] See also Annex XIII.

renovations of the exhaust system of multiple apartment buildings necessary for applying condensing technology.

The market failure for the uptake of water heaters with improved environmental performance needs to be addressed. This impact assessment investigates which policy option is best suited to do so.

2.3. Related initiatives on Community and Member State level

Both on Community and on Member State level initiatives have been launched which aim at improving the environmental impact of water heaters.

– Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings[9], in the following called "EPBD", requires Member States, amongst others, to apply minimum requirements to the energy performance of new and, under certain conditions, existing buildings, and technical building systems, including hot water systems. According to Recital (12) of the EPBD Member States should use, where available and appropriate, harmonised instruments, in particular testing and calculation methods and energy efficiency classes developed under the Ecodesign and Energy Labelling Directives when setting energy performance requirements for hot water systems[10]. Furthermore, it lays down requirements as regards energy certification of buildings or building units, and regular inspection of certain heating systems, but excluding water heaters.

– The energy performance certificates required by the EPBD aim at providing information to buyers and sellers as regards the energy performance of the building and building units, thereby providing incentives for owners and sellers to invest in energy-efficient installations, including water heating systems.

– The requirements on technical building systems, including hot water systems, aim at optimising the energy use of such systems, in particular if installed in existing buildings.

– But the EPBD does not set harmonised energy efficiency requirements for hot water systems, and in particular their most important parts – heat generators and hot water storage tanks – of such systems, and it does not provide energy efficiency classes and testing and calculation methods.

– Union and Member State instruments have been put in place in order to stimulate investments in energy efficient housing[11].

– Council Directive of 29 June 1990 on the approximation of the laws of the Member States relating to appliances burning gaseous fuels (90/996/EEC)[12] contains an essential requirement related to the rational use of energy, which is not covered by a harmonised standard. Furthermore, electrical water heaters are not covered by this Directive.

– Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants[13] (in the following

9 OJ L 1, 4.1.2003, p.65.

10 The interrelation between requirements on technical building systems and ecodesign requirements for the placing on the market of products is further explained in the "Commission non-paper on the interaction between Ecodesign Directive and Energy Performance of Buildings Directive".

11 See e.g. recital 18 of the EPBD.

12 OJ L 196, 26.7.1990, p. 15.

13 OJ L 309, 27.11.2001, p. 22.

abbreviated as "NECD") limits emissions of acidifying and eutrophying pollutants and ozone precursors from all sources of those pollutants arising as a result of human activities in the territory of the Member States. This Directive is expected to contribute to a limitation of NOx and SO2 emissions from water heaters to some extent. However, it does not set specific limits for the emission from water heaters, and the approach for limiting the relevant emissions from water heaters varies amongst Member States.

– Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC[14] (in the following also mentioned "Energy Services Directive" or abbreviated as "ESD") provides energy savings targets for Member States and creates the conditions for the development and promotion of the market for energy services, including measures improving the energy efficiency of water heaters and the "domestic" input to domestic hot water production. However, it is up to the Member States to select the concrete measures to achieve the energy savings targets, and no harmonised measures specifically targeted at improving the environmental performance of water heaters are provided for.

– A "Voluntary commitment on reducing standing losses of domestic electric storage water heaters" was initiated in 1999 by the European Committee of Manufacturers of Domestic Equipment (CECED). This commitment contributed to some extent to improving the energy efficiency of the covered water heaters, but it did not cover electric instantaneous water heaters and water heaters fired by fossil fuels. The last report on this initiative delivered in 2001, and the initiative was discontinued in 2007. Instead CECED called for legislative measures to "ensure future performance standards".

Conclusions

– The most significant aspect for improving the environmental performance of water heaters is the energy consumption during use and significant cost-effective energy saving solutions exist on the market.

– Market failures prevent cost-effective technologies leading to energy efficiency improvements from penetrating the market to a satisfactory extend by market forces alone.

– Initiatives at EU and Member State level address parts of the market failures:

  – EPBD, ESD and financial instruments at EU and Member State level address market failures related to lack of incentives and financial capacities for investments

  – NECD is expected to contribute to a reduction of NOx and SO2 emissions.

– However, the EPBD, the ESD and the NECD alone are not expected to correct the market failures as related to incomplete information, lack of awareness/interest for running costs/cost savings:

  – EPBD does not provide for inspection and reporting for water heaters.

  – EPBD and ESD do not provide for energy efficiency classes and testing and calculation methods.

  – EPBD and ESD do not provide for harmonised minimum performance requirements for the crucial main parts of the technical building system/hot water system, that is, heat generator and hot water storage tanks, that would "guarantee" a certain "minimum level" of improvements.

[14] OJ L 114, 27.4.2006, p. 64.

- As a consequence cost-effective improvement potentials for energy consumption are not realised, and the environmental performance of water heaters will not be improved to the desirable extent.
- Furthermore, there is a risk that energy efficiency requirements and emission limits, as well as energy efficiency rankings for water heaters which would be set individually by Member States could hamper the functioning of the internal market.
- As a consequence, ecodesign requirements and energy efficiency classes should be set under the Ecodesign and the Energy Labelling Directives, addressing market failures related to incomplete information, lack of awareness/interest for running costs/cost savings.
- Ecodesign requirements for the placing on the market of water heaters and hot water storage tanks are complementary to system requirements for hot water systems set under the EPBD:
  - Ecodesign requirements on energy efficiency and NOx emissions provide for harmonised requirements delivering a "guaranteed" level of environmental improvements as related to heat generators and hot water storage tanks, under which the requirements of the Member States for systems cannot fall.
  - Ecodesign requirements for the placing on the market of products ensure free circulation of complying products in the internal market, while system requirements should take into account the diversity of situation in the regions of the EU.
  - Energy efficiency classes and testing and calculation methods developed under the Ecodesign and the Energy labelling Directives should be used for the setting of system requirements, with a view to minimise potential fragmentation of the market as related to the setting of system requirements for hot water systems.

2.4. Baseline Scenario

2.4.1. Scenario methodology, Baseline 2005

The baseline scenario and the further scenarios are based on sales and product replacement projections, and energy efficiency trends for water heaters as developed in the preparatory study and updated. This approach took into account effects of other legislation such as the EPBD on the energy efficiency and the effect of the internal market approach in the proposed legislation compared to the possibility and limitations of Member States to realise cost-effective achievement of targets such as greenhouse gas reductions and energy efficiency targets by themselves. The calculation method for the scenario analysis is a so-called "stock model". This means that it is derived from accumulated annual sales and redundancy figures for water heaters over the period 1990-2020 (with a start-up period 1960-1990), i.e. it is a model of the numbers and types of water heaters that are installed and working, taking account of new installations, existing installations and replacement of existing installations over the period.

Regarding demand price elasticity, in general, the expected price increase in mass production of 10-15% will be balanced by significantly lower electricity and fuel costs for the consumer with a pay back period of only a few years. In addition, new competing technologies (such as solar technologies) will be covered in the measures on labelling and ecodesign offering alternatives to consumers. Replacement usually happens at failure of an existing appliance ("distress buy" when price tends to be less of an issue). In the future, it is foreseen that replacement will happen more and more often by the support of the building label and heating system inspections under the EPBD. When consumers are actively looking for a better installation and have more time to consider their purchase, pricing and labelling, linked with possible savings on energy costs, will have more effect in influencing the decision. The model is explained in more detail below and in the annexes, notably Annex II. For the background on sales and product replacement projections more information can also be found in the preparatory study on www.ecohotwater.org.The following parameters are used, as developed in the preparatory study:

– number of households;

– consumer behaviour, e.g. tendency to take longer showers;

– number of water heaters per household; and

– energy efficiency.

The main variable in the scenarios is energy and its derived parameters, and the following outputs are created for the scenarios:

– energy consumption in PJ/annum(a);

– carbon emissions in Mt CO2 equivalent/a, using a multiplier based on electricity and gas shares (see below) and the values from the preparatory study;

– acidifying emissions (e.g. NOx, SO2) in kt SOx equivalent/a;

– economic parameters: purchase price, energy expenditure, maintenance costs and total expenditure in billion EURO per year [2005 Euro, inflation-corrected at 2% per year].

The final outcomes are presented at an aggregated level ("water heater total"). In the intermediate stages, a distinction is made by water heater type and by load profile. The following water heater types are used:

– gas storage (GSWH) – water is heated by burning gas and stored in a tank ready for use;

– gas instantaneous (GIWH) – water is heated by gas ready for instant use;

– electric storage (ESWH);

– electric instantaneous (EIWH);

– solar-assisted units (SOL) – heat collected from the sun via solar panels is used to assist in the water heating;

– heat-pump assisted units (HP) – heat from ground or air is used for water heating.

The analysis is restricted to "dedicated" water heaters (DWH). "Combi"-types and cylinders (indirectly fired by gas/oil heaters) involving space heating *and* (sanitary) water functions will be dealt with in a separate impact assessment related to measures implementing the Ecodesign and the Energy Labelling Directives for heaters.

The scenarios consider the following effects related to the calculations of the energy consumption:

– multiple water heaters per household (secondary and primary water heater or several single-point units) lead to a diminished load per water heater;[15]

[15] The average penetration rate of water heaters in the EU is 132%, i.e. there are 32% more heaters than homes.

– water heaters installed in secondary homes account for approx. 20% of installed water heaters leading to a diminished load per unit, as such water heaters are mostly used at weekends or holidays

– increase of unit sales of water heaters from 10.7 million units in 2005 to 11.3 million units by 2020[16];

– increase of average annual load[17] (hot water equivalent, usually given in kWh): increase in load due to more comfort (e.g. more and longer showers), partially compensated by a decrease in average load per unit due to higher share of secondary water heaters[18], resulting in an average annual load increase by approx. 11% by 2020 (0.75% per year)

– improvement of the average water heater efficiency by 4% due to effects from EPBD implementation in Member States, in particular

  - increase of insulation thickness of ESWHs and GSWHs;
  - decrease of "pilot flame" use in favour of electronic ignition for GSWHs and GIWHs[19];
  - increase in market share of SOL[20]:
  - introduction of new (mainly electric) heat pump water heaters:
  - for load profiles M-L-XL mainly conventional heat pump technology;
  - for load profiles XXL-3XL-4XL super-critical (CO2) heat pumps[21]

For the economic calculations in Annex V, an average energy price in €/kWh primary energy is built from:

– electricity, gas and oil rates per kWh primary energy in the base-year 2005;

– annual (long-term) price rate increase of the individual energy sources, e.g. 2% for electric; 6% for gas;

– relative share of electricity and gas used for operating for water heaters, e.g. in the baseline scenario the electricity share increases from 78% in 1990 and 84% in 2005 to 88% in 2020.

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16 However, the market share of "dedicated" water heaters is decreasing, while the (combined) market share of "combi" types and "cylinder" types is expected to increase from around 35% in 2005 to 40% by 2020. All data in this impact assessment are aggregates for dedicated water heaters and dedicated water heaters or heating elements combined with storage tanks.

17 hot water equivalent, usually in kWh

18 Secondary water heater is a second water heater just for the kitchen tapping point. This should not be confused with water heaters in secondary homes (holiday homes etc.).

19 Water heaters using "pilot flame" ignition are already banned in France.

20 Especially in Spain, Portugal and other Southern European countries where “solar” is or will be mandatory for newly built dwellings, although DWH in new building accounts for 15% of the total market.

21 New information, not in the VHK preparatory study. Obtained 2008 from JRAIA [The Japan Refrigeration and Air conditioning Industry Association], reporting the following unit sales of CO2 heat pumps in Japan for space- and water heating where CO2 heat pumps are on the market since 2003.

Year	2003	2004	2005	2006	2007
Delivered units	72,629	115,147	194,419	322,979	398,981

Sales in the EU of these Asian products have just started. VHK estimates EU growth to be less spectacular, because the product is tuned to Japanese bathing methods [outdoor placement standard, indirectly heated bath, larger store] and therefore less suited for smaller dwellings. But for larger applications, e.g. collective water heating, it may be very interesting. Dedicated Water Heater product with primary energy efficiencies approaching 90-100% due to full temperature coverage (sink temperatures up to 80°C under the right conditions, no back-up needed).

For purchase price and maintenance costs used in Annex V, the data from the preparatory study are used as the starting values for the baseline scenario (base year 2005), e.g. the average weighted purchase price (incl. installation and VAT) is € 300 per unit[22]. Unit prices not corrected for inflation remained stable for the last decade, that is, they decreased in real terms.

Efficiency improvements are assumed to imply an increase in consumer purchase cost (installation and product price) of € 22 per percentage point of energy efficiency increase above 34%. This is an aggregated figure, from the preparatory study.

Maintenance costs are not scenario-specific and are set at € 30 per year and assumed to follow inflation at 2% per annum[23]. Product lifetime is also fixed, at an overall value of 15-17 years, depending on the type of water heater.

As explained further in Annex XIII, these assumptions were deemed realistic by the foremost market research specialist in the water heating sector based on over 20 years of experience in data collection and processing as well as scenario building and modelling. If there are any uncertainties, they affect the scenarios and sub-options in similar ways and will not influence the relative order of the outcome for policy options. It must be stressed that stakeholders were closely involved in the process and have not disputed the used data or the outcome of the scenarios.

2.4.2. Baseline projections for 2020

The relevant figures for the base year 2005 have been developed in the preparatory study, and are displayed in Annex V. The baseline scenario until 2020 is developed under the following conditions.

The end-use energy consumption of dedicated water heaters[24] in 2005 was estimated by the preparatory study to be 2156 TWh EU25[25]. This corresponds to a primary energy consumption of water heaters, if, as agreed with stakeholders and Member States, an average efficiency of 40% for electricity generation, including transmission losses, is used. Without taking dedicated measures the following environmental impacts are expected by 2020, compared to 2005:

increase of energy consumption of DWH from 2156 PJ to 2243 PJ

increase of CO2 emissions from 124 Mt to 129 Mt

increase of NOx emissions from 559 kt to 603 kt SOx equivalent

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22 Relative share 2005 ESWH/ EIWH/ GIWH/ GSWH/ SOL/ HP= 55/ 23/ 17/ 2/ 2 %. Average product price € 300 calculated from ESWH € 278; EIWH € 192; GSWH € 661; GIWH € 358; HP € 2000; SOL € 1326 (all unit prices incl. VAT excl. installation). Average installation costs € 150 calculated from ESWH € 112; EIWH € 75; GSWH € 397; GIWH € 214; HP € 600; SOL € 1000 (from VHK preparatory study, Task 5).

23 Average annual costs for maintenance and repairs: ESWH € 25; EIWH € 10; GSWH € 64; GIWH € 58; HP € 100; SOL € 100 (from VHK preparatory study, Task 5).

24 All data in this impact assessment are aggregates for dedicated water heaters and dedicated water heaters or heating elements combined with storage tanks.

25 Figures for EU-27 are somewhat higher and can be corrected on the basis of GDP.

2.5. Least life cycle cost energy efficiency, benchmarks and level of ambition

2.5.1. Least life cycle cost efficiency and benchmarks

The preparatory study has shown that existing cost-effective technical solutions allow for improvement of the energy consumption of DWH, and the following LLCC points and benchmarks for the energy efficiency of DWH[26] have been established by the preparatory study for the various size classes of DWH:

	XXS	XS	S	M	L	XL	XXL	3XL/ 4XL
Base case efficiency	27	27	23	35	37	38	34	52
LLCC efficiency	30	34	30	38	50	58	60	90
Improvement compared to base case	11	26	30	9	35	53	76	92
Benchmarks for best available technology	34	41	36	38[27]	100	100	100	150-185

The improvement potential is compared to the "base case" defined in the preparatory study, which represents an abstract average product, e.g. the average of the performance characteristics of common storage and instantaneous gas and electric water heaters.

2.5.2. Level of ambition of ecodesign requirements

According to Annex II of the Ecodesign Directive the level of energy efficiency or consumption should be set aiming at the least life-cycle cost minimum to end-users. However, for DWH the level of ambition cannot always be set at the LLCC point. It has to be ensured that replacement DWH are available on the market for all operating conditions, since e.g. an electric DWH cannot be replaced by a gas DWH if no gas infrastructure is available. Further:

– The LLCC efficiency is achieved for some size classes by certain design options for gas-fired DWH, while for other size classes it is achieved by certain design options for electrical DWH;

– The LLCC efficiency for size class M, for example, is an electric instantaneous DWH with electronic controls with power of approx. 25 kW. However, such DWH requires a corresponding building infrastructure with power lines providing the appropriate grid characteristics. This is not always the case, and according to Article 15 (5a) of the Ecodesign Directive, efficiency requirements have to be set such that DWH remain available to replace, e.g., an electric storage water heater in those buildings where an electric instantaneous DWH cannot be installed;

– The LLCC efficiency for size class L, for example, is a gas-fired storage DWH using smart controls. Such a DWH can only be applied in buildings with gas infrastructure.

Taking into account both the LLCC and the constraints related to building infrastructure and the availability of replacement DWH, the following level of ambition was agreed with stakeholders and Member States as being the appropriate for setting ecodesign requirements:

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[26] The energy efficiency of DWH is defined as the ratio of the delivered energy for the 24 hour water tapping pattern for the applicable load profile of the DWH, and the primary energy consumption.

[27] For COMBI heaters with solar system/heat pump as high as 70%-90%.

Load profile	**3XS**	**XXS**	**XS**	**S**	**M**	**L**	**XL**	**XXL**	**3XL**	**4XL**
Level of ambition energy efficiency:	32	32	32	32	36	37	38	60	64	64
for comparison: base case energy efficiency	27	27	27	23	35	37	38	34	52	52

One option to reach the level of ambition is the use of smart controls, favoured by several Member Sates. As several other Member States fear that the introduction of smart controls will lead to less insulated storage water heaters, a second requirements is introduced for water heaters using smart control requiring a minimum level of insulation.

Energy labelling for DWH pursuant to the Energy Labelling Directive aims at setting an energy efficiency ranking which

– provides information to end-users and installers on the energy performance of DWH, and promotes DWH with energy efficiency exceeding the ecodesign requirements;

– allows to distinguish between the energy performance of conventional DWH without RES input, while promoting DWH with RES input by clearly indicating the latter as being "best performing";

– provides a transparent ranking system which Member States may use e.g. for providing additional incentives to promote best-performing DWH.

2.6. Legal basis for EU action

The Ecodesign Directive and, more specifically, its Article 16 provides the legal basis for the Commission to adopt an ecodesign implementing measure for DWH. The Energy Labelling Directive and, more specifically, its Article 1, provides the legal basis for the Commission to adopt a delegated regulation for energy labelling for Dedicated Water Heaters.

As discussed in § 2.1, the study has shown that water heaters are a product category which meets the criteria listed in Article 15 §2 of the Ecodesign Directive and Article 10 § 2 of the Energy Labelling Directive, and therefore has to be covered by an implementing measure and delegated act respectively.

3. SECTION 3: OBJECTIVES

The preparatory study has confirmed that a cost effective potential for reducing the energy consumption of DWH exist. This potential is not tapped, as outlined above. The general objective is to develop a policy framework which

– ensures that all DWH placed on the market achieve energy efficiency corresponding to the level of ambition discussed in Section 4.7.2, or better,

– creates incentives for manufacturers to design energy efficient models,

– provides market transparency on energy efficiency of DWH and fosters the awareness for their energy efficiency,

– sets an energy efficiency ranking that can be used by Member States for national initiatives/incentives, e.g. in the framework of the EBPD or ESD, which further accelerate the market penetration of energy efficient models,

thereby

– transforming the DWH market towards products with improved energy performance,

– inducing significant reductions of the environmental impact related to energy consumption and NOx emissions of DWH,

– inducing cost savings for the end-user,

– ensuring the free movement of affected products within the internal market.

Furthermore, the objective is to satisfy the provisions of the Ecodesign Directive, and in particular its Article 15 (5), which requires that ecodesign implementing measures meet all the following criteria:

– a) there shall be no significant negative impacts 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 affordability and life cycle cost of the product;

– d) there shall be no significant negative impacts on industry's competitiveness;

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

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

4. SECTION 4: POLICY OPTIONS

The rationale for the key elements of the ecodesign regulation and the energy labelling measure is established on the basis of the preparatory study and the input from stakeholders. This is discussed in the second part of Section 4.

4.1. Option 1: No EU action

This option would mean that no EU action would be taken which would target specifically energy efficiency and NOx emissions of DWH.

– The barriers for realising the potentials to improve the energy efficiency and reduce NOx emissions of DWH would persist to a large extent, because the EPBD, the ESD and the NECD alone would not lead to an improvement of the environmental performance to a significant extent.

– It is to be expected that Member States would want to take individual, non-harmonised action. This would hamper the functioning of the internal market and lead to high administrative burdens and costs for manufacturers, in contradiction to the goals of the Ecodesign Directive.

– The specific mandate of the Legislator would not be respected.

Therefore this option is discarded from further analysis. As this corresponds with the BAU scenario, the quantitative effects of this option can be found in §5.7.

4.2. Option 2: Self regulation

This option is discarded for the following reason:

– No initiative for self-regulation on DWH pursuant to Annex VIII of the Ecodesign Directive has been brought forward.

In its 2002 report to the Commission on the voluntary commitment regarding the reduction of standing losses of household storage water heaters[28], CECED stated that the agreement was bound to two political factors that were considered providing "incentive compatibility" to the manufacturers' unilateral effort:

- The implementation of a standing losses declaration directive, which would have obliged also the non participants to declare their standing losses;
- Incentives for consumers to buy the new super efficient water heaters.

CECED noticed that none of the two conditions had been realised, which resulted in not proposing a new commitment at the end-date of the existing one.

In 2007, CECED expressed the opinion that it preferred legislation to voluntary agreements (‘Unilateral Industry Commitments”) as a regulatory instrument, because it found amongst others that voluntary agreements put the EU industry at a disadvantage with respect to so-

[28] CECED, *Voluntary Commitment on reducing standing losses of household storage water heaters, Second annual report to the Commission of the European Communities,* Brussels, April 2003.

called ‘free-riders’ (parties not committed to the agreement and offering low-price low-quality products)[29].

4.3. Option 3: Energy labelling for DWH only

This option means that an energy labelling scheme for DWH would be set up pursuant to the Energy Labelling Directive specifically DWH, without setting ecodesign requirements for DWH. In general two main objectives of labelling schemes are to increase the market penetration of, in this case, energy efficient products by providing incentives for innovation and technology development, and to help consumers to make cost effective purchasing decision by addressing running costs.

This option would imply the following:

– Energy labelling pursuant to the Energy labelling Directive creates market transparency, fosters awareness of consumers and creates incentives for manufacturers for innovation.

– However, a labelling scheme alone does not ensure that cost effective improvement potentials are realised for all products on the market, implying that the full energy and cost savings potential is not captured.

– As in Option 1, Member States could set minimum requirements individually, and the administrative burdens for manufacturers would be higher when compared with the burdens associated with ecodesign requirements.

– The specific mandate of the Legislator would not be respected.

Therefore the option to establish only an energy labelling scheme without setting ecodesign requirements is discarded, but the effects of labelling will be discussed in the scenario analysis in Annex III.

4.4. Option 4: Ecodesign requirements only

This option means that ecodesign requirements would be set in an implementing measure pursuant to the Ecodesign Directive, without establishing an energy labelling scheme for DWH pursuant to the Energy Labelling Directive. This option would imply the following:

– By setting minimum levels for the energy efficiency, which have to be fulfilled by all DWH placed on the market, the "worst performing" DWH would be banned from the market, leading to an improvement of the energy consumption of DWH;

– Information requirements pursuant to Annex I, part 2 of the Ecodesign Directive, which are addressed to manufacturers, could contribute to market transparency, consumer awareness and incentives for innovation.

– However, the retail sector plays a crucial role for providing relevant information to the end-user, and the Ecodesign Directive does not provide the appropriate legal framework for ensuring that the relevant information is available for the end-user when purchasing decision is made.

[29] CECED, *Top Executives Discontinue Voluntary Energy Efficiency Agreements for Large Appliances,* CECED press release, 21 March 2007.

– Therefore market transparency, consumer awareness and incentives for innovations would be created to a limited extent only, and improvements/innovations of energy efficiency would take place at a lower rate.

Therefore the option to establish only ecodesign requirements without establishing an energy labelling scheme is discarded, but the impact of ecodesign requirements will be discussed in the analysis of Option 7. The quantitative effects of this option can also be found in §5.7 and the scenario analysis in Annex III.

4.5. Option 5: minimum performance requirements and labelling

This option means that ecodesign requirements for DWH would be set in an implementing measure pursuant to the Ecodesign Directive, in combination with an energy labelling scheme for DWH established by an implementing directive pursuant to the Energy Labelling Directive. This option would imply the following:

– Ecodesign requirements ban the "worst performing" DWH from the market by ecodesign, and cost effective improvement potentials are realised for all products on the market, leading to an improvement of the energy consumption and a reduction of the NOx emissions of DWH.

– The specific mandate of the Legislator is respected.

– The energy labelling scheme creates market transparency, fosters awareness of consumers and creates incentives for manufacturers for innovation.

– However, requirements on technical building systems set in the framework of implementing the EPBD would facilitate the optimisation of the environmental performance of the entire water heating system, including separate requirements for new buildings, replacement and retrofit, thereby further enhancing the improvements expected from improving the environmental performance of the DWH placed on the market alone. These potential savings due to the EPBD would be lost in this option.

As the recast of the EPBD will be implemented this scenario is not realistic and therefore is discarded. Nevertheless, to illustrate the effect of the EPBD, this option has been included in the quantitative scenarios of §5.7.

4.6. Option 6: minimum performance requirements in the EPBD framework

This option means that Member States would set minimum energy performance requirements in respect of technical buildings systems, including DWH, which are installed in buildings, in the framework of the EPBD only. Such provision is part of the Commission's recast of the EPBD[30] (Article 8). This option would imply the following:

– Setting requirements on building systems only does not ensure that cost-effective improvement potentials for all DWH on the market are realised, implying that the full energy and cost savings potential is not captured.

– As in Option 1, Member States could set minimum requirements for the placing on the market of DWH individually, and the administrative burdens for manufacturers would be higher when compared with the burdens associated to ecodesign requirements.

[30] 2010/31/EU

– The specific mandate of the Legislator would not be respected.

Therefore the option to set only requirements on technical building systems alone without setting ecodesign requirements is discarded, but the effects will be discussed in the analysis of Option 6. For more details see Annex XI.

4.7. Option 7: combination of ecodesign, labelling and EPBD requirements

This option means that ecodesign requirements for DWH would be set in an implementing measure pursuant to the Ecodesign Directive, in combination with an energy labelling scheme for DWH established by an implementing directive pursuant to the Energy Labelling Directive, and minimum performance requirements for technical building systems set in the (recast of the) EPBD. This option would imply the following:

– Ecodesign requirements ban the "worst performing" DWH from the market by ecodesign, and cost effective improvement potentials are realised for all products on the market, leading to an improvement of the energy consumption and a reduction of the NOx emissions of DWH.

– The specific mandate of the Legislator is respected.

– The energy labelling scheme creates market transparency, fosters awareness of consumers and creates incentives for manufacturers for innovation.

– Requirements on technical building systems set in the framework of implementing the EPBD facilitate the optimisation of the environmental performance of the entire water heating system, including separate requirements for new buildings, replacement and retrofit, thereby further enhancing the improvements expected from improving the environmental performance of the DWH placed on the market alone.

– The combination of the three instruments implies that improvements which can be achieved with currently available cost-effective technology are fully captured, while incentives are created to invest into new energy efficient technologies and their market penetration is fostered, thereby ensuring rapid market transformation.

– The functioning of the internal market is ensured by harmonised ecodesign requirements and a harmonised labelling scheme, and administrative burdens and costs for manufacturers are reduced compared to individual Member State action.

This is the best option to address market failure for the uptake of water heaters with improved environmental performance. This option has been quantified as scenario 5 in Section 5 and Annex III. Some sub-options for NOx emissions and timing have been analysed in the text below and in Annex III.

The following sub-section contains details of the rationale for the key elements of the corresponding ecodesign regulation and Energy Labelling Directive, taking into account the provisions of Annex VII of the Ecodesign Directive and Article 12 of the Energy Labelling Directive. The rationale is established on the basis of the preparatory study and the input from stakeholders. The best timing to fulfil the ecodesign requirements, taking into account the requirements of the framework Ecodesign Directive, is discussed in § 5.8. Sub-options for option 7 taking into account emissions are discussed in § 5.2.

4.8. Key elements of the ecodesign regulation

The rationale for the measures is given in Section 2, Problem Definition. The details and argumentation of the details of measures are given in Annex III. The summary of key elements in paragraph 4.7 serves to introduce the key points to help understand the impact assessment. The structure in the subchapters below is based on Annex VII of the Framework Ecodesign Directive and has been used in all other measures. These points also follow from the preparatory study, the stakeholder meetings and the Consultation Forum.

4.8.1. Definition of product scope

The scope of the ecodesign regulation covers "water heaters" for production of sanitary hot water, with size class XXS or larger using electricity or gaseous or liquid fossil fuels, ambient heat or solar heat source. Excluded from the scope are heaters producing hot water for space heating *and* sanitary hot water, DWH using predominantly bio-fuels or solid fuels.

4.8.2. Ecodesign requirements

Energy efficiency levels

Ecodesign requirements for the energy efficiency (in percent) of DWH are set which are scheduled to come into force in three stages:

Stage 1, effective one year[31] after the regulation has come into force:

Load profile	**3XS**	**XXS**	**XS**	**S**	**M**	**L**	**XL**	**XXL**	**3XL**	**4XL**
Specific energy efficiency	22	23	26	26	30	30	30	32	32	32

Stage 2a, effective three years[32] after the regulation has come into force:

Load profile	**3XS**	**XXS**	**XS**	**S**	**M**	**L**	**XL**	**XXL**	**3XL**	**4XL**
Specific energy efficiency	32	32	32	32	36	37	38[33]	40	40	40

Stage 2b, effective five years after the Regulation has come into force:

Load profile	**3XS**	**XXS**	**XS**	**S**	**M**	**L**	**XL**	**XXL**	**3XL**	**4XL**
Specific energy efficiency	32	32	32	32	36	37	38	60	64	64

Member States required that the second stage 2 outlined in Section 2 is realised for water heaters with load profiles XXL, 3 XL and 4 XL earliest after 5 years. Achieving an energy efficiency of electric water heaters above 40 % in terms of primary energy (100 % in terms of final energy / EU conversion coefficient 2,5) means either the use of renewables or the fuel switch from electricity to gas/oil. This schedule aims at providing appropriate transition

[31] As a result of decisions taken during the regulatory process and in the Regulatory Committee that took place on 21 March 2013, these requirements will come into force two years after publication of the Regulation, being the impact on expected savings minimal.

[32] As a result of decisions taken during the regulatory process and in the Regulatory Committee that took place on 21 March 2013, these requirements will come into force four years after publication of the Regulation, being the impact on expected savings minimal.

[33] During the Regulatory Committee that took place on 21 March 2013 it was decided that the minimum energy efficiency for heaters with a declared XL profile shall be 37%, Five years after publication the minimum efficiency for XL water heaters will be also 37%. The impact of this change will be minimal (less than 1 TWh/year in 2020).

periods for manufacturers to design/re-design models in order to avoid negative impacts on industry's competitiveness and on the functionality from the perspective of the user (replacement market), in accordance with the criteria for ecodesign implementing measures set out in Section 3, while ensuring that DWH placed on the market during the time span between the stage 1, stage 2a and stage 2b achieve certain environmental performances and deliver important energy savings.

NOx emissions

In addition to the energy efficiency requirements, ecodesign requirements will set upper limits for NOx emissions three years and in the case of heat pump water heaters and solar water heaters five years after the regulation has come into force (GCV: gross calorific value):

(i) conventional water heaters using gaseous fuels: 70 mg/kWh fuel input in terms of *GCV*;

(ii) conventional water heaters using liquid fuels: 120 mg/kWh fuel input in terms of *GCV*.

(iii) heat pump water heaters equipped with external combustion using gaseous fuels and solar water heaters using gaseous fuels: 70 mg/kWh fuel input in terms of *GCV*;

(iv) heat pump water heaters equipped with external combustion using liquid fuels and solar water heaters using liquid fuels: 120 mg/kWh fuel input in terms of *GCV*;

(v) heat pump water heaters equipped with internal combustion engine using gaseous fuels: 240 mg/kWh fuel input in terms of *GCV*;

(vi) heat pump water heaters equipped with internal combustion engine using liquid fuels: 420 mg/kWh fuel input in terms of *GCV*.

Timing and values of the emission thresholds were established based on feedback from Member States as well as stakeholders. In particular, the emission limits for kerosene-based DWH correspond to the targets of a multi-annual programme in the UK that aims at reducing the NOx emissions from approx. 200 mg/kWh to 120 mg/kWh in the coming years[34].

4.8.3. Measurement methods

Measurement methods

Mandates for appropriate methods for measuring the energy consumption of DWH were given to the European Standardisation Bodies in 2002 on the basis of characteristic tapping cycles, which are used to define the load profiles (XS, S …). First results of the work done under the mandates are available, which are used, together with elements developed together with industry and other stakeholders after extensive technical expert meetings in the preparatory study, to define the transitional measurements methods to be used until harmonised standards have become available. These transitional measurement methods will be published in the Official Journal C to assist industry and market surveillance authorities instantly after adoption of the water heater measures.

[34] The Regulatory Committee on 21 March 2013 voted to postpone requirements on NO_x emissions for water heaters from three to five years after publication of the Regulation. In addition, the level of stringency for gaseous fuel water heaters was increased from 70 mg/kWh to 56 mg/kWh. The impact of this change on the reduction of NO_x emissions achieved by the Regulation will be limited (less than 1 kton SO_2 equivalent per year in 2020.

In addition to the existing mandates, further elements requiring standardisation such as measurements of NOx emissions are provided in the horizontal mandate for Ecodesign measures which was approved on 15 April 2011 by the Regulatory Committee 98/34 responsible for mandates to European Standardisation Organisations. The timeline for the harmonised standard indicated in the Ecodesign horizontal mandate is the 4^{th} quarter of 2012, like for heaters. This standard is intended to replace the Communication, as soon as it has been submitted by the European Standardisation Organisations under this mandate.

Verification procedure for market surveillance purposes

A verification procedure for market surveillance purposes has to be specified. The verification procedure should eventually be part of the harmonised measurement standards.

4.8.4. Ecodesign information requirements

In order to facilitate compliance checks manufacturers are requested to provide relevant information in the technical documentation referred to in Annexes IV and V of Directive 2009/125/EC.

4.8.5. Date for evaluation and possible revision

The main issues for a possible revision of the ecodesign regulation are

– the appropriateness of setting ecodesign requirements for greenhouse gas emissions attributable to refrigerant leakage and for emissions of carbon monoxide and hydrocarbons;

– the appropriateness of setting stricter ecodesign requirements for emissions of nitrogen oxides;

– the appropriateness of setting ecodesign requirements for water heaters specifically designed for using predominantly biomass fuels;

– the validity of the value of the conversion factor.

An assessment of the issues of points should take into account the time necessary for collecting, analysing and complementing the data and experiences related to these points. The assessment should also properly assess the technological progress on the one hand, and the need to ensure timely entry into force of a revised measure, if appropriate, on the other hand. A review should be presented to the Consultation Forum 5 years after entry into force of the regulation.

4.9. Key elements of the energy labelling regulation

Scope

In addition to the products in the scope of the ecodesign regulation, the scope of the energy labelling regulation also includes solar thermal equipment, such as solar collectors or solar tanks.

Suppliers of solar thermal equipment, in particular SMEs, and installer associations have pointed out that energy labelling of water heaters that use heat captured from solar radiation should not be restricted to solar water heaters being placed on the market as a "bundle" of parts using electricity and/or fossil fuels with additional solar thermal equipment. Otherwise the benefits of using solar thermal equipment would be apparent only in "bundles", but not when solar thermal equipment is placed on the market individually. As a consequence, the independent marketing of solar thermal equipment would be disadvantaged vis-à-vis the marketing of "bundles", resulting in a risk of competitive disadvantages for suppliers of solar thermal equipment and installers offering combinations of parts that were placed on the market individually, in particular SMEs.

In order to avoid such competitive disadvantages, the energy efficiency and the energy efficiency class of packages of water heaters operated by electricity and fuels with solar thermal parts is to be provided by dealers/suppliers to the end-user for packages consisting of parts placed on the market individually. This fair approach ensures that manufacturers of solar thermal equipment, in particular SMEs, do not have a competitive disadvantage vis-à-vis manufacturers of conventional water heaters starting up solar business.

Label format

The label displays the energy efficiency class of the DWH, an energy efficiency ranking and numerical values for relevant parameters. The energy efficiency classes are defined on the basis of the energy efficiency of the DWH as determined for ecodesign requirements.

Further to Article 10 of the Energy Labelling Directive, the energy label for water heaters is set such that best available technology without input from renewable energy sources achieves energy efficiency class "A", while energy efficiency classes "A+" are introduced for technologies using renewable energy sources, including combinations of "conventional" and "renewable" technologies (hybrid conventional water heaters, heat pump water heaters, small solar water heaters with < 50 % renewables). Additionally, large solar-only systems with load profiles M to 4XL and > 50 % renewables which are not placed on the market as one product but are able to achieve energy efficiency classes "A++" and "A+++" should be covered by the dealer label of packages of water heater and solar-only systems.

The product label format introduce the energy efficiency classes A-G and uses, together with the dealer label, the energy efficiency classes A+ to A+++, as this approach ensures that:

- incentives are created to select best available technology without input of renewable energy sources for those end-users who are not willing to invest into technologies with renewable energy sources, which require usually high up-front investments, as the message "class A corresponds to energy efficient technology" is maintained;

- a clear signal is provided to the market that technologies with input of renewable energy sources are available, and additional energy savings can be achieved by investing into technologies with input from renewable energy sources.

As a result, it is expected that this approach delivers the optimal transformation of the market towards high-efficiency water heaters market, as it provides incentives for improving the energy efficiency beyond ecodesign requirements and fosters the market penetration of highly efficient technologies with RES. The label is "language neutral", so that manufacturers may provide the complete label together with the individual product, which minimises the burden for the retail sector, but does not lead to significant costs for suppliers[35].

Table 1: Lower efficiency limits in Labelling proposal on water heaters

From one year after entry into force	3XS	XXS	XS	S	M	L	XL	XXL	3XL	4XL
A+++	62	62%	69%	90%	163%	188%	200%	213%	225%	238%
A++	53	53%	61%	72%	130%	150%	160%	170%	180%	190%
A+	44	44%	53%	55%	100%	115%	123%	131%	138%	146%
A	35	35%	38%	38%	65%	75%	80%	85%	90%	95%
B	32	32%	35%	35%	45%	50%	55%	60%	64%	64%
C	29	29%	32%	32%	36%	37%	38%	40%	40%	40%
D	26	26%	29%	29%	33%	34%	35%	36%	36%	36%
E	22	23%	26%	26%	30%	30%	30%	32%	32%	32%
F	19	20%	23%	23%	27%	27%	27%	28%	28%	28%
G	<19	<20%	<23%	<23%	<27%	<27%	<27%	<28%	<28%	<28%

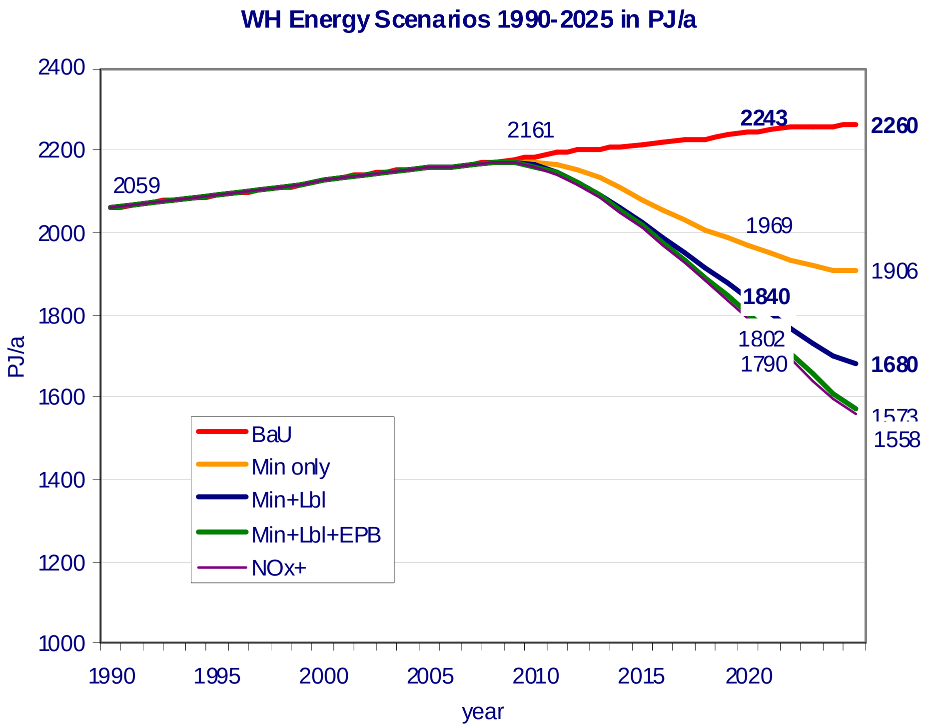
35 The cost of an individual label is less than 10 Eurocent.

5. SECTION 5: ANALYSIS OF THE IMPACTS

5.1. Energy Savings

The energy savings under the various scenarios are an integral part of the detailed modelling which has been carried out. The model takes account of current behaviour in the Member states regarding current energy use by the stock of water heaters and how this will be affected by the potential technology and market changes being assessed in this work. The graph below gives an overview of the outcome of the scenarios.

Figure 5.1 Energy scenarios for Dedicated Water Heating

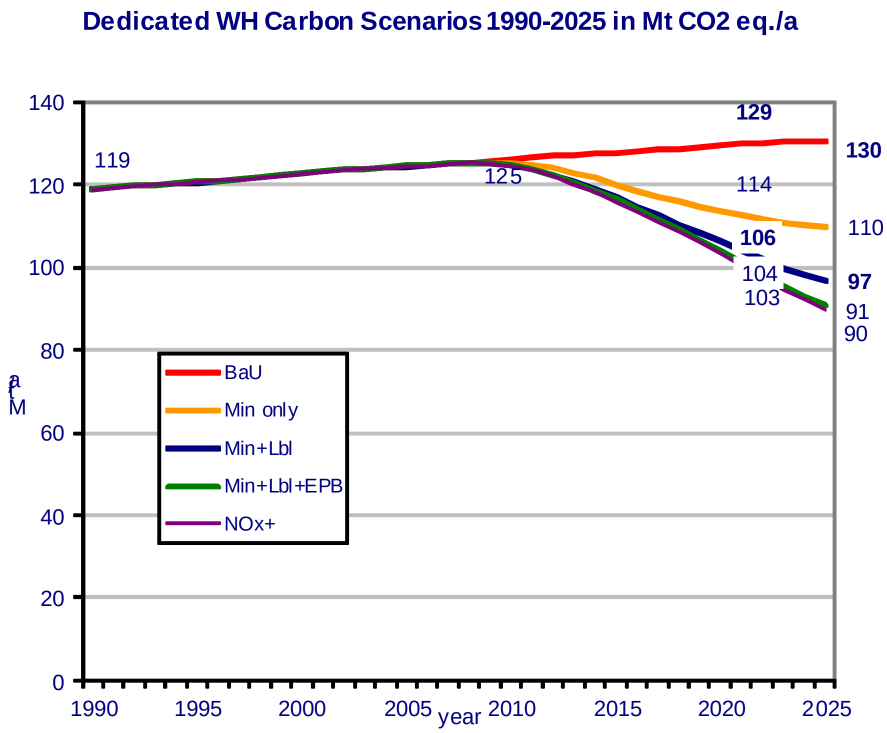


From the graph it is apparent that all of the scenarios induce significant energy savings in comparison to BaU. The Minimum standards only scenario is estimated to lead to a reduction in energy use of approximately 12%. However, if the minimum standards were pursued in combination with labelling it appears that this would lead to a substantial additional reduction, with a reduction of around 18% being estimated. The addition of EPB and NOx measures also induces additional savings, though less so than labelling, with the energy reduction in 2020 being estimated at around 20%.

5.2. Environmental impacts

As with the energy calculations the environmental impacts are an integral output of the detailed modelling which has been carried out. The key assumptions in this aspect are around the fuel mix that is predicted, both in terms of the water heaters and the electricity that is used to power some of them. The model provides information on both the carbon and NOx emissions under the various scenarios.

Figure 5.2 Carbon scenarios for Water Heating[36]



In the "Min+Lbl+EPB" scenario (compared to the BaU) the savings are 129-104= 25 Mt CO2 equivalent in 2020. In 2025, these savings are projected to be 39 Mt. As with energy savings, the minimum standards and the labelling make the largest impact with regard to CO_2 reductions.

The results of the modelling with regard to NOx emissions are in the graph below. The graph shows that Dedicated Water Heaters are a significant contributor to EU acidification (and smog) emissions (500-600 kt SOx equivalent per year, 5-6% of total). Furthermore, some 33% of NOx emissions (190 kt or 2% of total in 2025) can be saved through better energy efficiency[37].

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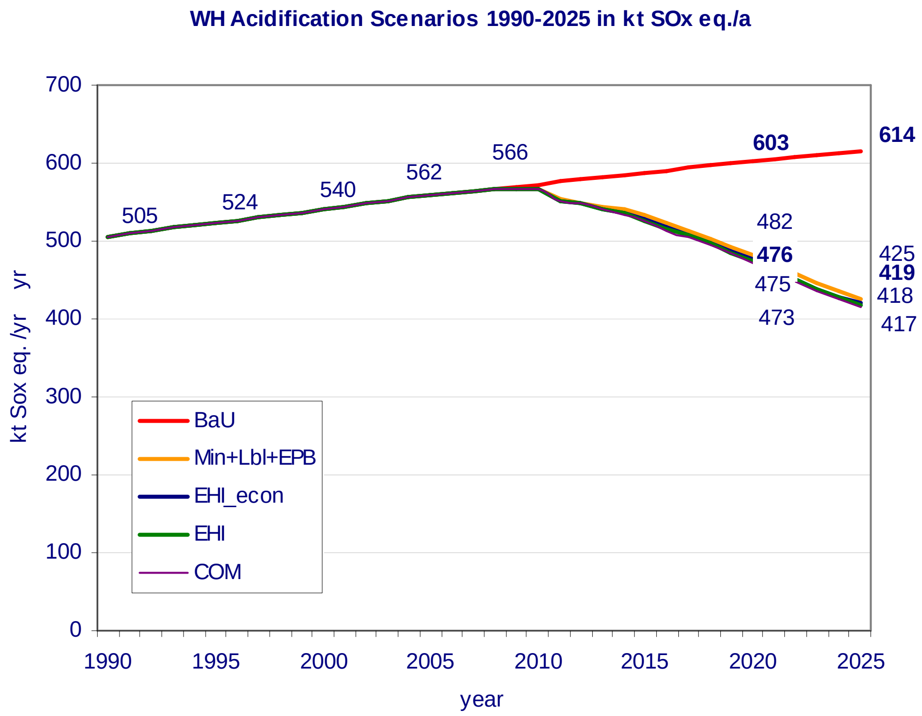
[36] The assessment is based on an original data set from the preparatory study for the EU-25, excluding Romania and Bulgaria, as for these countries no specific water heater information was available. For the EU-27, the value for EU-25 could be multiplied by 1.06 based on comparison of energy consumption.

[37] Because of combi-heaters, which also have a sanitary hot water function, an ecodesign measure on dedicated water heaters is linked to an ecodesign measure on heaters. Discussions and consultations on a heater measure, including emissions, are still on-going and for the sake of consistency may lead to changes in emissions for dedicated water heaters. Therefore emission data are indicative only.

The graph also shows that additional measures tackling the specific NOx emission (in mg/kWh), have little effect. Differences between the scenarios are very small and the maximum savings are some 10 kt SOx equivalent per year.

Figure 5.3 Dedicated Water Heater acidification scenarios[38]



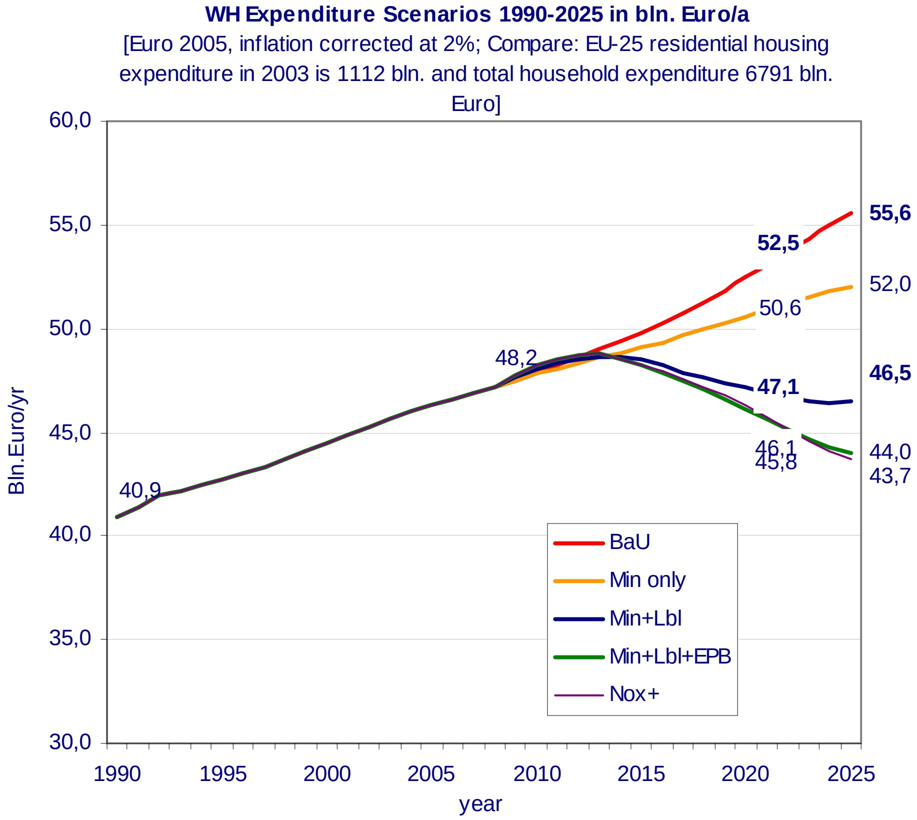
Further significant environmental parameters have been identified by the preparatory study (see above). Based on stakeholder meetings, consultation fora and bilateral contacts, setting ecodesign requirements on NOx while awaiting the development of standards for the emissions of other pollutants such as CO, hydrocarbons or GHG from refrigerants for possible regulation in a review of the measure, is supported by Member States and stakeholders. NOx emissions limits will also be included in the review of the measure. More information on emissions can be found in Annex VII.

5.3. Costs

The outputs of the model with regard to costs, cover two important aspects. The first one is the cost of capital of the equipment, which is expected to rise due to the extra sophistication required in more efficient water heaters. The second one is the operating cost, which is expected to decrease due to the lower energy consumption for a given output.

Figure 5.4 Expenditure scenarios for Dedicated Water Heating

38 The assessment is based on an original data set from the preparatory study for the EU-25, excluding Romania and Bulgaria, as for these countries no specific water heater information was available. To arrive at the value for the EU-27, the value for EU-25 could be multiplied by 1.06 based on comparison of energy consumption.



The savings in the "Min+Lbl+EPB" scenario (compared to Business-as-Usual) is € 6 billion in 2020 (or 10%). In 2025, these savings are projected to be € 12 billion (or 20%). The figure illustrates that, compared to BaU, most of the scenarios result in slightly increased total expenditure in the early years, due to the increase in capital costs, but as the efficiency savings increase due to rising energy costs and increasing market penetration of new more efficient appliances, the overall costs drop below BaU.

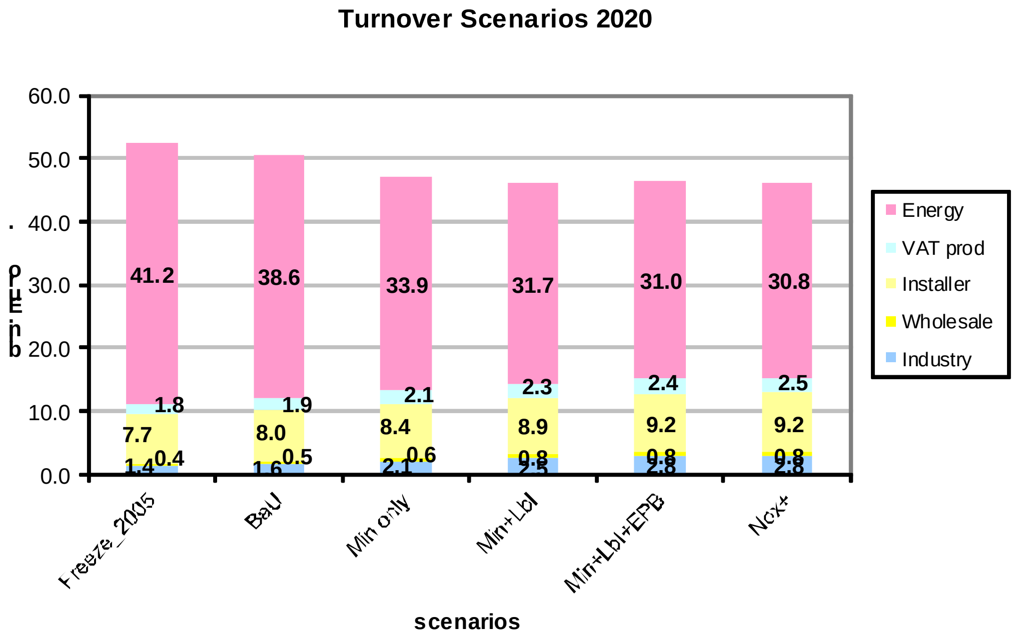
For the different scenarios, the expectation of more standardized products and a reduction/elimination of national requirements has been taken into account, which should result in more competition and thus all together in a decrease of prices. Furthermore, the product as such will offer better performance and will, against BaU, be more expensive to produce. We refer to Annex V and the preparatory study for the economic estimations such as the base price for a product, maintenance costs and price increase per efficiency %-point.

5.4. Turnover

The impact on turnover is based on the assumption that the various scenarios will require extra technologies that incur extra components, manufacturing costs and installation costs. For manufacturers the increase in turnover is based on the increased costs assumed for each water heater multiplied by the predicted sales. For distributors the increase is based on the assumption that as they take a fixed percentage on the costs of the products they sell an increase in the cost of the manufacturers goods will see a proportional increase in the turnover generated by the distributor's markup. The increase in installer turnover is based on the extra cost per unit installed and maintained multiplied by the number of installations.

The amount of energy sold, and hence income to the energy companies, also varies under the scenarios. However it is difficult to speak of "losses" to energy companies due to energy saving and the term "postponed profit" may be more accurate. The VAT income will also vary as a reflection of the cost of the water heaters. The effect of the current Energy Services Directive, whereby energy companies are encouraged to contribute to energy efficiency (e.g. by promoting or selling energy efficient equipment) has been estimated to be negligible for DWH.

Figure 5.5 Turnover scenarios



As with many of the other impacts the minimum (EUP) scenario induces relatively significant improvements against BaU with the addition of the labelling requirements again inducing significant positive changes. EPB requirements induce a less significant additional increase with the NOx scenarios only adding relatively small amounts to the turnover figures.

5.5. Employment

The impact of the potential changes in the water heater market on job creation and employment is influenced by numerous dependencies, market structures, tax systems etc. which vary by Member State. A detailed analysis would demand quite complex models including input-output analyses of all the water heater types in all of the Member States. Therefore a simpler method has been adopted, which, although less comprehensive, still offers a good indication of possible employment related impacts. The general approach is where the assumed additional turnover from the changes in the water heater market is divided by the average turnover per employee in the relevant sector (manufacture, distribution and installation) and multiplied by a specific factor, a methodology which has been used e.g. in Wuppertal Institut[39].

This factor depends on the specific labour intensity of the sector in question and can vary between 0.5 (share of material costs of energy efficiency measures twice as high as the usual mix of material and labour costs as presently observed in the EU27) and 1.0 (share of material costs according to usual mix). In the present study, the factor was therefore assumed to be 1.

The following figures in € for turnover per employee have been used:

- Manufacturer 0,166 million turnover/employee/year **(**Merloni Group, Annual Report 2007),
- 1,24 OEM personnel as fraction of Water Heater manufacturer personnel (estimate based on preparatory study and general added value per employee),
- Wholesaler 0,261 million./employee/year (Saint Gobain Group, Annual Report 2007),
- Installer 0.1 million/employee (avg. NL; statistics UNETO, www.uneto-vni.nl).

For the manufacturing and the OEM jobs it is important to recognise that a significant proportion will be created outside the EU[40]. For OEM employment we have estimated that 60% of the increase will be outside the EU (esp. China, Korea, Vietnam and some in Russia). In terms of location of the manufacturing jobs it seems sensible to follow the proportions of current production both within the EU and outside[41]. These indicate the following:

- For 2004 (€m): Total imports 83.2, EU net-production 266 (= 474 (total EU production) – 209 (EU exports);
- For 2005 (€m): Total imports 93.7, EU net- production 277 (= 506 (total EU production) – 230 (EU exports).

This suggests that in terms of value, approximately two thirds of EU demand for water heaters is met by EU production. However the preparatory report states that the trade associations (amongst others) have little faith in the accuracy of these figures.

It is important to consider also installers. The largest growth in employment will take place there.

In addition to the data in the table on page 11 and the information above, more specific information on employment effects can be found in Annex VI.

5.6. Boundary Impacts

In addition to the quantitative impacts covered in the previous section this impact analysis also needs to consider a number of boundary impacts, i.e. impacts which are of a more yes/no nature. The key impacts of this nature are discussed below:

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39 Wuppertal Institut (2006), Evaluation des Online-Modernisierungsratgebers von co2online, Wuppertal Institut, 2006

40 There is already a flood of imported (inefficient) water heaters at OEM level but EU manufacturers are still doing the marketing and the distribution. As trade statistics don't indicate these kinds of figures it is difficult to give an exact number. The danger for the European heating industry is that non-European producers take over the distribution side as well as the brands (as for instance with aircos).

41 Task 2 of "Eco-design of Water Heaters" study by VHK for the European Commission, DG Transport and Energy, 2007.

5.6.1. *Affordability and life cycle costs*

This issue is covered in detail in the quantitative impacts section on costs above. For the majority of the options the cost to consumers is recovered within a relatively short number of years. As shown in § 5.3, therefore there is no need for additional measures to mitigate any potential negative effects for users.

5.6.2. *Industry competitiveness*

In terms of sales into the EU market, EU manufacturers will all be faced with the same requirements under the various scenarios. The main exception to this relates to the way in which Member States will choose to implement EPB requirements. There has been a variety of approaches to the implementation of these between Member States. This could result in manufacturers who focus on particular markets having to meet slightly different technical or other requirements (and/or at slightly different times) to those that focus on other MS markets. The recast of the EPBD, best practices and benchmarking will lead to a more harmonised EU approach.

On a global scale there is also a chance that other geographic markets will adopt different standards to those pursued in the EU. This could oblige manufacturers to produce a variety of models for different markets, which would reduce their economies of scale and affect their competitiveness.

It is very difficult to give an indication of global competition in the field of water heaters as there are no global trade statistics publishing the cross border deliveries for the different components for water heaters. However, knowing that most imports to Europe are related to the cheaper mass produced type of water heaters, we could expect that with the production of water heaters at higher standards (and with more differentiation into the direction of renewables) most production will be done in Europe.

The heater and water heater market is to a large extent European, but sometimes even nationally or regionally defined. Therefore, in the measures, climate zones and degree days have been incorporated to reflect the European and regional climate situations. European sanitary hot water systems often provide hot water throughout the house or apartment, whereas in major third countries other hot water systems are used, for example local hot water systems in Japan and Australia. As a consequence manufacturers mostly produce for the EU market. Exports to third countries are limited. The proposed requirements are comparable to the ambition level (at the preparatory stage) of water heating products in South East Asia and China.

Redesign and investment costs for industry

For dedicated water heaters no concrete data were made available by affected industry that would allow a detailed quantitative assessment of re-design and investment costs. However, affected manufacturers have pointed out that investments are already currently being done in light of the expected measures, and therefore it is estimated that some market transformation has already taken place (see also § 5.8) and it is difficult to estimate which impacts still remain. Some estimates are made using assumptions which are based on the outcome of the stakeholder consultations, yielding solid qualitative, albeit not always fully quantitative results.

It is estimated that there are 10 large manufacturers and around 50 SMEs/niche players that market dedicated water heaters under their own brand. The catalogue of a large manufacturers typically contains 10 (non-ESWH) to 20 models (for ESWHs). For ESWHs at least half of the models are only different in height (not in diameter) and do not require tooling. This means that on average there are maximum 10 models that require redesign and retooling of the geometry. For SME manufacturers this is around 6 models. So in total, (10 x 10) + (50 x 6) = 400 base models would require retooling/redesign on the grounds of geometry. Also taking into account retooling/redesign of the electronics and plastics parts (the baseplate, CPU, etc.) the investment per model is estimated at € 0.2 million. To change all models on the EU-market would entail an indicative cost of around € 80 million. At a design cycle of 4 years this means € 20 million/year. Industry turnover is estimated to be € 2400 million, so this constitutes around 0.1%.[42] The foreseen timing takes this into account and thus no extra costs or expansion of R&D efforts is foreseen.

Impact on SMEs

Impact on SMEs (both manufacturers and installers) can be estimated to be positive. The installer label has been welcomed especially by manufacturers of solar thermal components, which are mostly SMEs. The measure allows them to show the benefits of their energy related products. Throughout the ecodesign process industry associations, in which SMEs are represented, have been closely involved and are supportive of the process and the envisaged legislation. SMEs have actively participated in discussions for establishing the calculation methodology and the preparations for the European standard (e.g. on issues like temperature and flow controls, output temperature).

It is estimated that around 10 large companies are present in the European market, which apart from heaters also manufacture water heaters. However, in the field of water heaters, especially solar-assisted water heaters, SMEs are more common than for heaters and have more market share. Further future consolidation, in line with the heater sector in the past decade, cannot be ruled out. The current number of SMEs with sales noticeable in an EU context is estimated to be around 30. SMEs producing "traditional" water heaters will have no great difficulty coping with the proposed measure. In addition, the proposed measures have a positive effect on the group of innovative SMEs using solar technologies. The measures promote solar-assisted appliances and make them more ‘mainstream’, which is good for the business of these SMEs. However, the fact that ‘solar’ could become ‘mainstream’ attracts the large market players into this segment, and - if not for any other reason but for economy-of-scale - SMEs fear this competition. Therefore they are reluctant to share disaggregated market information and their prognosis for the coming years. The signals from this stakeholder group on the proposed measure are therefore mainly positive but sometimes a bit ambiguous.

No micro enterprises exist as the R&D costs, the testing demands for safety (e.g. Gas Appliance Directive) and for compliance with building codes and EPBD requirements, and the sales and marketing would lead to too high costs per unit, making the activity uneconomical in a branch with large companies with economies of scale.

Further estimates about the impact on employment and SMEs are provided in § 5.5 and Annex VI.

5.6.3. No proprietary technology

The nature of the proposals is to request end points, in terms of energy efficiency and emissions. This approach is relatively technology blind as any technology which achieves the

[42] Note that this is not the full R&D costs. Over 90% of R&D expenditure in the sector goes to application engineering, testing, support of standards & business associations, etcetera. Nonetheless, it is clear that dedicated water heaters are a very R&D extensive sector.

end point will be acceptable (on the assumption that no other negative impacts occur). In some cases there are known means to achieve the ends. However these focus on general approaches rather than specific (proprietary) technologies.

5.6.4. Functionality of product

The products should still do their job just as effectively. Functionality will improve in many cases. For example a better insulated water storage tank will retain its heat better and hence be returned to full temperature more quickly (and at a lower cost, energy and environmental impact).

5.6.5. Health safety and environment

The products will still be expected to comply with all existing health and safety legislation, so there should be no impact here. As presented and discussed in the previous section all of the scenarios will bring benefits in terms of reduced carbon dioxide and acidifying gas emissions.

5.6.6. Administrative burden

As a consequence of the structure and procedures prescribed in the Ecodesign Framework Directive, the main carriers of any administrative burdens, Member States and industry, are part of the process (from the preparatory study to the end of the impact assessment process) for developing measurement methods to be used for testing and information to be provided. This was subject of discussions in several stakeholder meetings, two Consultation Forum meetings and one Regulatory Committee meeting.

Administrative costs defined as the coast of providing information in order to meet legal obligations is expected to be negligible, around 0.1 % of the cost per model for the end-consumer. Therefore the Standard Cost Model has not been applied in the impact assessment. Annex IX provides a detailed assessment of the administrative burden for manufacturers and retailers as well as for Member States and the Commission.

5.7. Conclusion on economic, social and environmental impacts

Main impacts									
			Scenarios 2020						
			1	2	3	4	5a	5b	5c
Impacts [43] **(as Art. 15, sub. 4., subsub e. of 2009/125/EC)**			BAU	Min Only	Min+Lbl	Min+Lbl +EPB	min+Lbl +EPB+NOx		
Environment									
EU	ENERGY (primary)	PJ/a	2243	1969	1840	1802	1790		
EU	GHG	Mt CO2 eq./a	129	114	106	104	103		
EU	AP	kt SOx eq./a	603	603	482	482	476	475	473
Consumer									
EU totals	expenditure	€ bln/a***	50.6	47.1	46.1	46.3	46.2		
	purchase costs	€ bln/a	4.5	5.8	7.0	7.8	7.9		
	running costs	€ bln/a	46.1	41.3	39.1	38.5	38.2		
per product	product price	€	265	340	411	459	464		
	install cost	€	133	170	205	229	232		
	energy costs	€ /a	297	246	213	194	193		
	payback(SPP)	years	reference	1.5	2.1	2.6	2.9		
Business									
EU turnover	manuf	€ bln/a	1.6	2.1	2.5	2.8	2.8		
	whole-sale	€ bln/a	0.5	0.6	0.8	0.8	0.8		
	instal	€ bln/a	8.0	8.4	8.9	9.2	9.2		
Employment									
employ-ment (jobs)	industry EU (incl OEM)	'000	15	19	23	25	26		
	industry non-EU	'000	7	9	11	13	13		
	whole-sale	'000	2	2	3	3	3		
	installers	'000	80	84	89	92	92		
	TOTAL	'000	103	115	125	133	134		
	of which EU	'000	96	105	114	120	121		
	EXTRA EU jobs	'000	reference	9	18	24	25		
	of which SME**		reference	6	12	16	16		
**= partitioning 50% industry & wholesale, 80% installers									
***=all money amounts in Euro 2005 (inflation corrected)									

43 In preparing a draft implementing measure the Commission shall: (b) carry out an assessment which will consider the impact on environment, consumers and manufacturers, including SMEs, in terms of competitiveness including on markets outside the Community, innovation, market access and costs and benefits; (e) prepare an explanatory memorandum of the draft implementing measure based on the assessment referred to in point (b)".

Boundary conditions ("should be no negative impacts")							
	Scenarios 2020/ 2025						
	1	2	3	4	5a	5b	5c
Impacts "No negative impacts" following Art. 15, sub 5 of 2009/125/EC	BAU	Min Only	Min+Lbl	Min+Lbl +EPB	min+Lbl +EPB+NOx		
functionality of product	+	+	+	+	+	+	+
health, safety and environment	+	+	+	+	+	+	+
affordability and life cycle costs	+	+	+	+	+	0	-
industry competitiveness	+	+	+	+	+	+	+
no proprietary technology	+	+	+	+	+	+	+
no excessive administrative burden	+	+	+	+	+	+	+
5a= NOx scenario as in proposed regulation							
5b= NOx scenario at 70 mg/kWh							
5c= NOx scenario at 35 mg/kWh							

Based on assessment of costs and benefits Scenario 5a is the preferred option to solve the problem of the market failure for the uptake of water heaters with improved environmental performance, as it optimally fulfils the requirements of the Ecodesign and Energy Labelling Directives.

5.8. Sub-options considered for timing and ambition level of measures

Intermediate assessments on timing and ambition levels were performed over the past 5 years for quantitative scenario 5 (based on the policy option of §4.7). Following the first tier after 1 year there could be:

Sub-option 1: tier 2a minimum efficiency criteria take effect after 3 years for storage tanks and water heaters covering the main market share (3XS to XL) and tier 2b minimum efficiency criteria take effect after 5 years for large water heater (XXL to 4XL)

Good balance of ambition and implementation capacity of industry, certainly now industry has already started adapting. Member States required that the second stage 2 outlined in Section 2 and 4.8.2 is realised for large water heaters with load profiles XXL, 3 XL and 4 XL earliest after 5 years due to the proposed phase out of electric water heaters for these load profiles (collective housing).

Sub-option 2: tier 2 minimum efficiency criteria for all water heaters and storage tanks take effect after 1 year
(in effect skipping tier 1)

This would cause problems for R&D and the supply chain of manufacturers.

Sub-option 3: tier 2 minimum efficiency criteria for all water heaters and storage tanks take effect after 5 years

This is not necessary for manufacturers of water heaters 3XS to XL and storage tanks covering the main market share and would lead to an unnecessarily late take-off of environmental benefits and financial benefits for the end-consumers.

A more detailed analysis of these sub-options can be found in Annex X.

The market transformation in anticipation of the ecodesign measure during the unforeseen delays has not been part of the quantitative modelling. Therefore a more quantitative approach on the effects of timing compared to the original scenarios would not be relevant. However, the requirements for tier 1, after 1 year, can easily be met by all manufacturers. Tier 2 and its requirements, taking effect after 3 years, have not been seriously questioned either by the associations of manufacturers, which also include SMEs, or by individual SMEs, except for large water heaters with load profiles XXL to 4XL. In combination with the observed market transformation already taking place this warrants the conclusion that the proposal with sub-option 1 is reasonable. This will also guarantee that after three years the main part of the savings will become apparent.

It should be noted that minimum requirements in ecodesign measures generally take effect about 1 year (especially if the first tier is a transitional phase and more tiers are to follow) after adoption of the regulation. This is standard practice and therefore it is proposed for water heaters as well. This has never been a real problem, especially as the ecodesign process involves industry from the start of the preparatory study, and in the meetings with stakeholders this has been accepted.

It should be noted that the timing for energy labelling is the same as for ecodesign requirements.

5.9. Sensitivities considered

The preparatory study (Task 7) has performed several sensitivity analyses regarding energy rates (half or double) and other factors. The end result was that the target levels, which were at that time certainly not less ambitious than what is now proposed, are robust in terms of payback time and affordability.

6. SECTION 6: CONCLUSION

Following the principle of proportionality in the analysis effort, policy options 1 to 6 were discarded at an earlier phase of the analysis. The analysis of several sub-options for the intensity of an ecodesign regulation on the energy consumption shows that the present policy option 7 (§4.7, quantified as scenario 5a with timing sub-option 1) optimally fulfils the objectives, namely improving the market penetration of water heaters and hot water storage tanks using cost-effective and energy efficient technologies.

In particular, this regulation/sub-option 1 implies

– cost-effective reduction of energy consumption related to dedicated water heaters, leading to a reduction of the energy consumption by 453 PJ or 10.8 Mtoe annually by 2020 compared to the business as usual scenario, corresponding to energy cost savings of about 8 billion €, and about 26 million tons avoided CO_2 emissions and a reduction of annual nitrogen oxides emissions of 127 kt SOx equivalent in 2020,

– the consumer will have to pay more for the dedicated water heater and its installation but will save considerably in energy, resulting in a pay-back time of 3 years whereas the lifetime of a water heater is estimated to be 15-17 years;

– correction of market failures and improvement of the functioning of the internal market;

– no significant administrative burdens for manufacturers or retailers;

- insignificant, if any, increase of the purchasing cost, which would be largely overcompensated by savings during the use-phase of the product;
- that the specific mandate of the Legislator is respected[44];
- incentives for manufacturers to innovate and invest into technologies because of the energy label;
- market transparency and easily accessible information provided by the energy label, fostering consumer awareness and facilitating consideration of electricity consumption when making the purchasing decision;
- costs for re-design and re-assessment upon introduction of the regulation, which are limited in absolute terms, and not significant in relative terms (per product);
- fair competition by creation of a level playing field[45];
- no significant impacts on the competitiveness of industry, and in particular SMEs, due to the small absolute costs related to product re-design and re-assessment;
- a low risk for having negative impacts employment, in particular in SMEs.

7. SECTION 7: MONITORING AND EVALUATION

The appropriateness of scope, definitions and limits will be reviewed after 5 years from the adoption of the measure (as required by Annex VII.9 of the Ecodesign Directive and laid down in the implementing measure). Account will be taken also of the speed of technological development and input from stakeholders and Member States. Compliance with the legal provisions will follow the usual process of "New Approach" regulations as expressed by the CE marking.

Compliance checks are mainly done by market surveillance carried out by Member State authorities ensuring that the requirements are met. Further information from the field as e.g. complaints by consumer organisation or competitors could alert on possible deviations from the provisions and/or of the need to take action. In addition, the Commission and the Member States are increasingly cooperating to improve market surveillance, e.g. by exchanging surveillance results and coordinating their market surveillance efforts to avoid double checks. Taking into consideration the market structure, the involvement of industry in the legislative process, and the interest for labels as a marketing instrument, (near) immediate progress in implementation can be expected.

Input is also expected from work carried out with international partners, e.g. in the framework of the IEA Implementing Agreement for Energy Efficiency End-Use Equipment.

44 Article 16 of Directive 2009/125/EC explicitly asks for implementing measures for heating products.

45 All manufacturers prefer an internal market approach under the Ecodesign and Energy Labelling Directives, which enables them to reach out to the whole EU market, without national or regional specific requirements.

ANNEX I: STRUCTURE OF THE METHODOLOGY USED FOR ESTABLISHING THE TECHNICAL, ENVIRONMENTAL AND ECONOMIC ANALYSIS

Following the "Methodology Study Eco-design of Energy Using Products" ("MEEuP"), the tasks listed below are carried out for developing the technical, environmental and economic analysis referred to in Annex II of the Ecodesign Directive:

Task 1: Product definition, existing standards and legislation

Task 2: Economics and market analysis

Task3: Analysis of consumer behaviour and local infrastructure

Task 4: Technical analysis of existing products

Task 5: Definition of base case ("average" model) and related environmental impact

Task 6: Technical analysis of best available technology

Task 7: Improvement potential

Task 8: Policy, impact and sensitivity analysis

ANNEX II: DETAILS OF THE BASELINE SCENARIO

The base case defines the situation relating to water heaters as it stood in 2005 regarding the mix of water heaters in place and being purchased across the EU and the load profiles they are installed to meet. The typology was defined for the BRGC commercial analysis and does not relate to measures. These types of water heaters are grouped as follows:

- Dedicated Water Heaters (DWH):
  - Gas Storage (GSWH) (Water is heated by burning gas and stored in a tank ready for use);
  - Gas instantaneous (GIWH) (Water is heated by gas ready for instant use);
  - Electric Storage (ESWH); and
  - Electric Instantaneous (EIWH);
  - Solar-assisted units (SOL) (Heat collected from the sun via solar panels is used to assist in the water heating);
  - Heat-pump assisted units (HP) (Heat from another source, e.g. heat held in the ground, is used to assist in the water heating).

An overview of load profiles is given below. For the scenario analysis the 24-hour net hot water demand (in kWh/d) is the most important value. It indicates <u>peak</u> hot water demand. The preparatory study indicates that the <u>average</u> hot water requirement equals 60% of this load.

Table 1: Overview of load profiles

Size			**Examples of applications**
3XS	market share	**1%**	single point only
	Largest flow rate required (ΔT=45 K)	**2 ltr./min**	(semi-) public toilets (if hot water needed)
	Largest tapping required	**0,3 ltr**	
	24 h net hot water demand	**0,345 kWh/d**	
	Nr. of cycles per 24 h	**23**	
XXS	market share	**6,0%**	**small sink tap (no dishwash) [1 c]**
	Largest flow rate required (ΔT=45 K)	**2** ltr./ min.	single point only
	Largest tapping required	**2** ltr	(semi-) public toilets (if hot water needed)
	24 h net hot water demand	**2,1** kWh/ d	
	Nr. of cycles per 24 h	**18**	
XS	market share	**12,5%**	**average sink tap [1 b]**
	Largest flow rate required (ΔT=45 K)	**4** ltr./ min.	single point only
	Largest tapping required	**5** ltr	
	24 h net hot water demand	**2,1** kWh/ d	
	Nr. of cycles per 24 h	**16**	
S	market share	**24,0%**	**large sink tap/ small shower tap [1]**
	Largest flow rate required (ΔT=45 K)	**5** ltr./ min.	1 person household
	Largest tapping required	**9** ltr	student flat
	24 h net hot water demand	**2,1** kWh/ d	holiday home
	Nr. of cycles per 24 h	**11**	single point or small multi-point
M	market share	**52,7%**	**average shower tap [2]**
	Largest flow rate required (ΔT=45 K)	**6** ltr./min.	2-3 person household, showers
	Largest tapping required	**24** ltr.	multi-point
	24 h net hot water demand	**5,85** kWh/ d	larger holiday home
	Nr. of cycles per 24 h	**23**	
L	market share	**9,0%**	**bath tap [3]**
	Largest flow rate required (ΔT=45 K)	**10** ltr./ min.	4-5 person household with showers
	Largest tapping required	**62** ltr	and occasional bath
	24 h net hot water demand	**11,7** kWh/ d	small restaurants

Size			Examples of applications
	Nr. of cycles per 24 h	**24**	
XL	market share	**5,5%**	**large bath [4]**
	Largest flow rate required (ΔT=45 K)	**10** ltr./ min.	4-5 person household + daily bath
	Largest tapping required	**76** ltr	medium restaurants
	24 h net hot water demand	**19,1** kWh/ d	barber shop
	Nr. of cycles per 24 h	**30**	
XXL	market share	**8,8%**	**simultaneous bath+shower [5]**
	Largest flow rate required (ΔT=45 K)	**16** ltr./ min.	>4-5 person household, frequent bath
	Largest tapping required	**107** ltr	2-family household
	24 h net hot water demand	**24,5** kWh/ d	barber shop, large restaurants
	Nr. of cycles per 24 h	**30**	small public sauna or spa
3XL	market share	**<1%**	**multi-family (8 * M-class)**
	Largest flow rate required (ΔT=45 K)	**48** ltr./ min.	small hotels & camp sites
	Largest tapping required	**215** ltr	small collective shower facility
	24 h net hot water demand	**46,8** kWh/ d	also in cascades
	Nr. of cycles per 24 h	**23**	
4XL	market share	**<1%**	**collective hot water (16 * M-class)**
	Largest flow rate required (ΔT=45 K)	**96** ltr./ min.	larger multi-family, homes for elderly
	Largest tapping required	**430** ltr	swimming pool showers, hospitals, military, prisons
	24 h net hot water demand	**93,6** kWh/ a	hotels, car wash
	Nr. of cycles per 24 h	**23**	collective shower facilities (gym), also in cascades

Table 2 below summarizes the findings for the base case. Part A gives the 2005 sales figures, of a total of 10.7 million units per annum, subdivided by technology and by size-class.

The net load (60% of the tapping pattern) applicable to each size class, multiplied by the sales, is given in Table 2, part B. This amounts to a total of 15.6 TWh/a for the base case. The weighted average load per technology is important, as it used throughout the analysis.

Table 2, Part C, gives the estimated efficiencies from the base case with some minor corrections (e.g. it has been assumed that a significant portion of GIWH still uses pilot flames).

The ESWH has the disadvantage of power generation losses (primary energy= electric energy * 2.5). The majority of the GIWHs have the disadvantage of a pilot flame, consuming up to 800 kWh/year (ca. 80 m³ gas), plus an inefficient atmospheric burner. Especially for the smaller sizes (e.g. kitchen single point) this means that the primary energy efficiencies of GIWHs and ESWHs are comparable at below 30%.

Only for “S” and upwards are GIWH efficiencies better (around 40% and higher) because of the relatively smaller effect of pilot flame consumption or the use of higher quality equipment, e.g. electronic ignition or pre-mix burners.

For ESWHs the larger sizes are also more efficient because of a more favorable ratio between tank volume and outer surface as well as thicker insulation. However, it is currently rare for an ESWH to reach efficiencies over 33-34% in the mid-size range.

The energy rates play a double role. At daytime tariffs, e.g. with smaller ESWHs that are reheated immediately, the gas rates are 30% lower (€ 0,045/kWh gas vs. € 0,060/kWh primary for electric) but often the utilities will promote night-time operation at half the day-time rate, in which case the running costs of an ESWH will be lower, although the ESWH-tank needs to be almost twice as big which raises the product price.

The largest markets for GIWHs are Spain and Portugal, which together represent 70% of the EU market and 55% of EU unit sales. Some other countries with a noticeable share of GIWHs are Italy, France and Poland. Many Spanish and Portuguese GIWHs are primary water heaters, i.e. multi-point single family water heaters with capacities of over 10 liters/min. In these countries, GIWHs are among the most important water heating products with a larger market share than ESWHs (although these are also very important in Spain) and combi-heaters. BRGC reports that the GIWH market in Spain and Portugal is now static after having peaked in 2000.

A market that is growing rapidly in Spain, with Portugal expected to follow, is solar water heaters. This is also relevant in terms of the battle between GIWH and ESWH, because it raises the question as to which will become the favorite back-up heater for solar water heaters. At the moment, the electric back-up seems the most economical in terms of acquisition costs and –because the back-up heater is rarely taken into account- the higher running costs of ESWH versus GIWH are taken for granted.

This outline of the current situation illustrates why the GIWH industry would fear a (further) blow from stringent Ecodesign NOx-measures for dedicated water heaters, but this has also to be considered in conjunction with the effect of Ecodesign energy efficiency measures.

Table 2: Calculation of annual primary energy consumption Base Case (avg. EU-25, sold in 2005)

A. Total sales EU-25 in '000 units in the year 2005											
in '000 units	XXS	XS	S	M	L	XL	XXL	3XL	4XL	Total	
ESWH	964	482	482	1785	1357	473	354			5897	
EIWH	273	1542	96	518						2429	
HP					10					10	
GIWH		133	133	1418	165					1849	
GSWH				112	54	33	35			234	
SOL				100	149					249	
Total DWH	1237	2157	711	3933	1735	506	389	0	0	10668	
B. Net load in GWh/a (60% of tapping pattern * no. of units)											
Net load	461	461	461	1284	2559	4188	5387	10268	20537		
total net load in	XXS	XS	S	M	L	XL	XXL	3XL	4XL	Total	Average
ESWH	444	222	222	2,292	3,473	1,981	1,905			10,540	1787
EIWH	125	712	44	665						1,547	637
HP					26					26	2559
GIWH		61	61	1,821	422					2,366	1279
GSWH				144	138	138	189			609	2601
SOL				128	381					510	2047
Total DWH	570	995	328	5050	4441	2119	2094	0	0	15597	1462
C. Efficiency in % (primary energy, Gross Calorific Value)											
in %	XXS	XS	S	M	L	XL	XXL	3XL	4XL	weight	
ESWH	25%	23%	21%	27%	27%	29%	30%			28%	
EIWH	31%	30%	32%	35%						32%	
HP				55%	60%	60%	95%	95%	95%	60%	
GIWH		12%	25%	36%	44%					37%	
GSWH				29%	33%	38%	41%			36%	
SOL				90%	100%	110%	120%			97%	
D. Energy consumption in GWh/a (net load/ efficiency)											
Sales	XXS	XS	S	M	L	XL	XXL	3XL	4XL	Total	
ESWH	1,778	966	1,058	8,489	12,864	6,831	6,351			38,337	
EIWH	408	2,364	140	1,900						4,812	
HP					43					43	
GIWH		511	245	5,058	960					6,773	
GSWH				496	419	364	460			1,738	
SOL				143	381					524	
Total DWH	2,186	3,841	1,443	16,085	14,666	7,194	6,811	0	0	52,227	
Efficiency	26%	26%	23%	31%	30%	29%	31%			30%	
*=weighted for total net load in GWh/a, so taking into account both sales and load											

Table 2, Part D calculates the annual energy consumption of Dedicated Water Heaters sold in 2005 from the above. In total this amounts to 52 TWh of primary energy per annum. The overall efficiency is 30%.[46]

[46] Changes with respect to the preparatory study are:

- Solar efficiency 100% (was 50/60%);
- Dedicated heat pump water heating taken into account (was 0);
- Heat pump efficiency: ca. 75 % (60% for M-L-XL; 90% for XXL-3XL-4XL);
- ESWHs: 70% of XXL ESWHs and 50% of XL now assumed to be night-tariff appliances, i.e. load moved down by two classes (XXL becomes L; XL becomes M);
- Minor corrections on 2005 efficiency values for better continuity.

BaU-scenario modelling

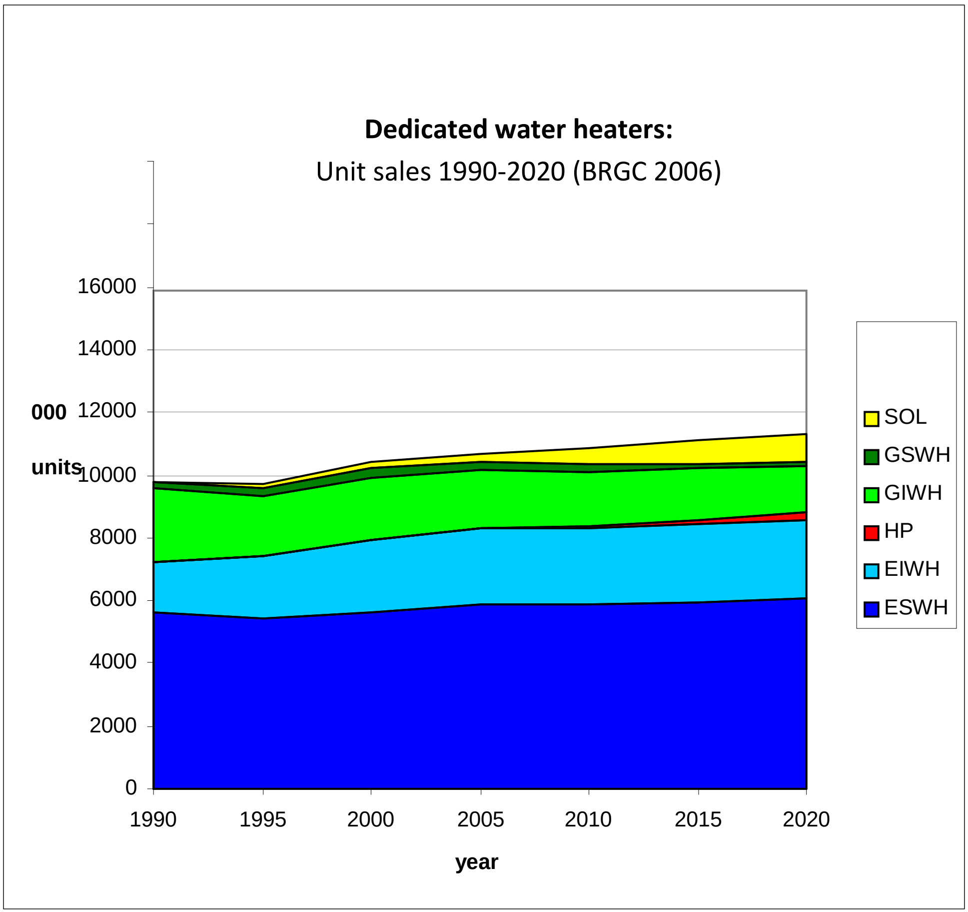
The Business as Usual (BaU) scenario is designed to model what would occur if the baseline continued into the future based on historic trends. The BaU-scenario takes into account the increase in number of households plus higher penetration rate ("growth effect" incorporated in sales projections), increase in comfort ("load effect" at 0.5%/yr) and a continuation of the efficiency improvement trend ("efficiency effect").The efficiency effect is given in Table 3. These values are used as in the stock model calculations. The values are based on the following considerations:

1. The base year 2005, where values derived from the base case values as shown in Table 3;
2. Post-2005, where it is assumed that the pilot flame will be substituted by electronic ignition and ESWH efficiency will increase through better insulation and smart control;
3. Pre-2005, where ESWHs and GIWHs were assumed to be less efficient.

The diagram in Fig. 1 shows that unit sales for dedicated water heaters are stable over time, but in terms of market share dedicated water heaters are losing ground, particularly to combi-heaters which combine the functions of space heating and providing sanitary hot water. Combi and cylinder (CYL) types of water heaters are expected to increase their share of water heater unit sales from around 35% in 2005 to 40% in 2020. The market study also expects solar-assisted units to play a more important role in the future.

The 2006 market study did not foresee a market share for dedicated heat pump water heaters. However, based on the latest information, a gradual market penetration at the expense of ESWHs has now been incorporated. However, without policy interventions to support market penetration numbers are expected to remain modest (similar to solar in the past).

Figure 1: Dedicated water heaters and combis: Unit sales per type 1990-2020 (BRGC)



The above figure chart gives the relevant data for the Business-as-Usual (BaU) scenario. It is mainly based on the preparatory study, but with some corrections:

- Negative effects: Increase in number of households (10-12%), increase comfort (8-10%; e.g. more and longer showers), increase in ownership (number of water heaters per households; currently 1.32 and rising);
- Positive effects: Decrease in average load per unit due to higher share of secondary water heaters[47] (assumed to compensate for increase in ownership[48]). Average efficiency increase through water heater replacement in line with trend (5-7%);
- Overall effect 2005-2020 in BaU scenario: circa 17% increase.

The 5-7% increase in efficiency is mainly based on developments triggered by EPBD measures in individual Member States, labelling and higher energy prices[49], as follows:

- Minor increase of insulation thickness with ESWHs and GSWHs;

47 Secondary water heater is a second water heater just for the kitchen tapping point. Not to be confused with water heaters in secondary homes (holiday homes etc.).

48 Mainly because no specific data are available.

49 The "water heater" has a low profile in terms of energy efficiency. For instance, lamps and fridges, with energy consumption that is only a fraction of water heaters, get much more attention in the media.

- Further decrease of pilot flame use in favour of electronic ignition for GSWHs and GIWHs. Pilot flames are already banned in some EU-countries (e.g. France);
- Gradual increase in market share of solar-assisted water heaters (SOL). Especially in Spain, Portugal and other Southern European countries where "solar" is or will be mandatory for newly built dwellings. Though new build is only a relatively small fraction (15%) of the total market;
- In (2009-2020) gradual introduction of new (mainly electric) Dedicated Heat Pump water heaters:
  - for load profiles M-L-XL mainly conventional heat pump technology;
  - for load profiles XXL-3XL-4XL super-critical (CO_2) heat pumps.[50]
- Within the group of Dedicated Water Heaters, apart from an increase of Solar Products and gradual introduction of heat pump products, no large shifts in market share are foreseen. ESWH unit sales may increase, but this is due to a higher share of smaller, secondary water heaters (single point products for use in kitchen).

Note that EPBD measures in most countries are based on "typology" measures (e.g. no pilot-flame, only solar, etc.). No methodology for a comprehensive "efficiency" rating exists. Labelling only has an influence in a few countries. The Dutch HRww label is the only one actually based on energy efficiency which takes the tapping pattern into account. The German Blue Angel label looks at steady-state efficiency but mainly focuses on emissions.

In terms of market share of Dedicated Water Heaters versus the Total (incl. COMBI and indirectly fired CYLinders) the current trend is assumed to continue over the 2005-2020 period, i.e.:

- the annual unit sales of Dedicated Water Heaters remains more or less stable at around 11 million units/year;
- relative market share (in %) is expected to drop, albeit at a slower pace than in the 1990-2005 period, from 62% to 59% (compare: 71% in 1990);
- The increase in total water heater demand is expected to be absorbed by gas-fired COMBI types;
- The slower pace of the decrease in market share is due to a slowing pace of gasification (expansion of the EU gas grid) and the increased popularity in Southern Europe of reversible air conditioners, i.e. electrical devices used both for space heating and cooling. These make it less cost-effective for households to pay for connection to the gas grid just to fuel a water heater. This encourages the use of cheaper (in investment costs) ESWHs, especially when the purchaser isn't the one paying the energy bill.

Overall, the BaU scenario results in a small shift in the fuel-mix from 53/47% for electric/gas in 1990 to 50/50% in 2020. Oil-fired dedicated water heaters are non-existent.[51]

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[50] New information, not in the VHK preparatory study, obtained in 2008 from JRAIA [The Japan Refrigeration and Air conditioning Industry Association], reports the following unit sales of CO_2 heat pumps for space- and water heating in Japan where CO_2 heat pumps are on the market since 2003.

Year	2003	2004	2005	2006	2007
Delivered units	72,629	115,147	194,419	322,979	398,981

Sales in the EU of these Asian products have just started. VHK estimates EU growth to be less spectacular, because the product is tuned to Japanese bathing methods [outdoor placement standard, indirectly heated bath, larger store] and therefore less suited for smaller dwellings. But for larger applications, e.g. collective water heating, it may be a very interesting Dedicated Water Heater product with primary energy efficiencies approaching 90-100% due to full temperature coverage (sink temperatures up to 80°C under the right conditions, no back-up needed).

[51] Heaters + indirect cylinders without a connection to the space heating could qualify as such, but –as mentioned- they are very rare.

Table 3: BaU scenario

	1990	1995	2000	2005	2010	2015	2020
Sales 000 units							
ESWH	5629	5450	5652	5895	5873	5964	6045
EIWH *	1619	1970	2303	2430	2406	2458	2509
HP				10	100	170	250
GIWH	2308	1929	1972	1849	1734	1615	1495
GSWH	250	261	291	234	208	167	126
SOL		103	170	249	543	730	916
TOTAL DWH.	9806	9713	10388	10667	10864	11103	11341
*=incl. electric showers							
Weighted efficiency (for load and sales)							
ESWH	26%	26%	26%	28%	28%	28%	29%
EIWH	28%	29%	30%	32%	33%	33%	33%
HP				60%	70%	75%	80%
GIWH	30%	30%	33%	37%	37%	38%	39%
GSWH	34%	35%	36%	36%	38%	39%	40%
SOL	85%	90%	92%	97%	100%	103%	106%
Average net load in kWh/a							
ESWH	1660	1701	1744	1787	1832	1878	1925
EIWH	591	606	621	637	653	669	686
HP	2376	2436	2497	2559	2623	2689	2756
GIWH	1188	1218	1248	1279	1311	1344	1378
GSWH	2416	2476	2538	2601	2667	2733	2801
SOL	1901	1948	1997	2047	2098	2151	2204
Avg. DWH.	1392	1407	1427	1462	1524	1576	1629
TWh primary/a							
ESWH	35.9	35.7	37.9	38.1	38.4	40,0	40.1
EIWH	3.4	4.1	4.8	4.8	4.8	5,0	5.2
HP				0.0	0.4	0.6	0.9
GIWH	9.1	7.8	7.5	6.5	6.1	5.7	5.3
GSWH	1.8	1.8	2.1	1.7	1.5	1.2	0.9
SOL	0.0	0.2	0.4	0.5	1.1	1.5	1.9
Total in TWh	50	50	53	52	52	54	54
Total in PJ	181	179	189	186	188	194	195
Average efficiency of DWH							
avg. kWh/a	5126	5115	5059	4845	4815	4863	4785
avg. efficiency	27%	28%	28%	30%	32%	32%	34%

ANNEX III: ADDITIONAL TECHNICAL DETAILS OF THE POLICY SCENARIOS

1. Ecodesign minimum requirements ('Min only')

The mandatory minimum level, weighted for the relative shares of load size shares, is the 38% in 2016. This value is used for the scenario. In addition, it is assumed that in the period 2016-2018 efficiency rises to 41%, after which the improvement stops.

In technical terms these levels of efficiency can be achieved by:

- substituting pilot flame with electronic ignition (from grid or water turbine) in GIWH;
- increasing insulation for ESWHs to current best-practice level. Products with unfavourable tank geometry might have to go beyond that (e.g. Vacuum Insulation Products (VIP) or full vacuum);
- smart controls for ESWHs.

For EIWHs, no extra effort would be required to meet these levels. Furthermore, as all types are allowed up to XL, no fuel shift or even type shift is necessary. For the largest tapping profiles, conventional electric and probably most gas-fired water heaters – which are rare in these sizes anyway[52] – would not be able to achieve the proposed level without solar or heat-pump assistance with coverage >50% in sizes XXL, 3XL and 4XL.

Alternatively, the stringent levels for large dedicated water heaters (e.g. for collective heating) may drive some buyers towards individual (per apartment) rather than collective water heating. This also has a savings effect in terms of storage, distribution and control losses, especially if accompanied by smart control.

One factor which could have a negative effect on primary energy efficiency is a possible fuel shift from e.g. a collective oil- or gas fired indirect cylinder being replaced by ESWHs in individual apartments in order to avoid investments in renewables for the large collective installation or to avoid the structural costs[53] of individual fossil-fuel fired products. Especially for rented apartments this may be considered as a cheap solution for the owners of the building. Depending on the efficiency of the old and new products, the actual result may even be positive in terms of primary energy efficiency, but it is certain (with ESWHs having a maximum primary energy efficiency of 40%) that an important potential saving will be missed.

In addition, national authorities could allow building owners to recover the extra investment costs in the rent or allow a wider definition of "rent", i.e. including the energy costs within it, as is done by some Dutch building corporations.

2. Labelling ('Lbl only')

A labelling program – e.g. also extended to mandatory inclusion in offers made by installers – is important for the following reasons:

- It helps buyers, retailers, and builders to make informed choices;
- It gives authorities a method of identifying the best products which can be linked to specific financial incentives, promotion, etc.;
- Labelling provides a tool for market surveillance and to check if policy goals are being met.

[52] Typically this is the domain of indirectly gas- or oil fired cylinders.

[53] E.g. gas network, chimneys. Note that for some dedicated water heaters, used only at the time of tapping, chimney solutions can be much simpler than for heaters.

Labelling of domestic water heaters has been on the agenda of the Energy Labelling framework Directive 92/75/EC, and subsequently its recast 2010/30/EU, for the last 15 years. Despite several SAVE studies, Commission mandates to CEN/Cenelec, etc. no labelling measure yet exists. The main problem has been the lack of harmonised test standards for this heterogeneous product group. Ecodesign measures and rating methods for water heaters will enable – for the first time – comprehensive energy efficiency labelling for this product group.

Table 2 below shows the lower efficiency thresholds for labelling classes. With the introduction of a A+, A++ and A+++ labelling on top of the conventional labelling, it provides challenging levels for products using renewable and/or experimental technologies such as solar, heat pumps, vacuum-insulation, etc.).

Labelling is set independent of the energy source, as labelling should help consumers to make a good comparison between the different kinds of DWHs.

Table 2: Energy efficiency classes of water heaters

	3XS	XXS	XS	S	M	L	XL	XXL	3XL	4XL
A^{+++}	$\eta_{wh} \geq 62$	$\eta_{wh} \geq 62$	$\eta_{wh} \geq 69$	$\eta_{wh} \geq 90$	$\eta_{wh} \geq 163$	$\eta_{wh} \geq 188$	$\eta_{wh} \geq 200$	$\eta_{wh} \geq 213$	$\eta_{wh} \geq 225$	$\eta_{wh} \geq 238$
A^{++}	$53 \leq \eta_{wh} < 62$	$53 \leq \eta_{wh} < 62$	$61 \leq \eta_{wh} < 69$	$72 \leq \eta_{wh} < 90$	$130 \leq \eta_{wh} < 163$	$150 \leq \eta_{wh} < 188$	$160 \leq \eta_{wh} < 200$	$170 \leq \eta_{wh} < 213$	$180 \leq \eta_{wh} < 225$	$190 \leq \eta_{wh} < 238$
A^{+}	$44 \leq \eta_{wh} < 53$	$44 \leq \eta_{wh} < 53$	$53 \leq \eta_{wh} < 61$	$55 \leq \eta_{wh} < 72$	$100 \leq \eta_{wh} <130$	$115 \leq \eta_{wh} < 150$	$123 \leq \eta_{wh} < 160$	$131 \leq \eta_{wh} < 170$	$138 \leq \eta_{wh} < 180$	$146 \leq \eta_{wh} < 190$
A	$35 \leq \eta_{wh} < 44$	$35 \leq \eta_{wh} < 44$	$38 \leq \eta_{wh} < 53$	$38 \leq \eta_{wh} < 55$	$65 \leq \eta_{wh} < 100$	$75 \leq \eta_{wh} < 115$	$80 \leq \eta_{wh} < 123$	$85 \leq \eta_{wh} < 131$	$90 \leq \eta_{wh} < 138$	$95 \leq \eta_{wh} < 146$
B	$32 \leq \eta_{wh} < 35$	$32 \leq \eta_{wh} < 35$	$35 \leq \eta_{wh} < 38$	$35 \leq \eta_{wh} < 38$	$45 \leq \eta_{wh} < 65$	$50 \leq \eta_{wh} < 75$	$55 \leq \eta_{wh} < 80$	$60 \leq \eta_{wh} < 85$	$64 \leq \eta_{wh} < 90$	$64 \leq \eta_{wh} < 95$
C	$29 \leq \eta_{wh} < 32$	$29 \leq \eta_{wh} < 32$	$32 \leq \eta_{wh} < 35$	$32 \leq \eta_{wh} < 35$	$36 \leq \eta_{wh} < 45$	$37 \leq \eta_{wh} < 50$	$38 \leq \eta_{wh} < 55$	$40 \leq \eta_{wh} < 60$	$40 \leq \eta_{wh} < 64$	$40 \leq \eta_{wh} < 64$
D	$26 \leq \eta_{wh} < 29$	$26 \leq \eta_{wh} < 29$	$29 \leq \eta_{wh} < 32$	$29 \leq \eta_{wh} < 32$	$33 \leq \eta_{wh} < 36$	$34 \leq \eta_{wh} < 37$	$35 \leq \eta_{wh} < 38$	$36 \leq \eta_{wh} < 40$	$36 \leq \eta_{wh} < 40$	$36 \leq \eta_{wh} < 40$
E	$22 \leq \eta_{wh} < 26$	$23 \leq \eta_{wh} < 26$	$26 \leq \eta_{wh} < 29$	$26 \leq \eta_{wh} < 29$	$30 \leq \eta_{wh} < 33$	$30 \leq \eta_{wh} < 34$	$30 \leq \eta_{wh} < 35$	$32 \leq \eta_{wh} < 36$	$32 \leq \eta_{wh} < 36$	$32 \leq \eta_{wh} < 36$
F	$19 \leq \eta_{wh} < 22$	$20 \leq \eta_{wh} < 23$	$23 \leq \eta_{wh} < 26$	$23 \leq \eta_{wh} < 26$	$27 \leq \eta_{wh} < 30$	$27 \leq \eta_{wh} < 30$	$27 \leq \eta_{wh} < 30$	$28 \leq \eta_{wh} < 32$	$28 \leq \eta_{wh} < 32$	$28 \leq \eta_{wh} < 32$
G	$\eta_{wh} < 19$	$\eta_{wh} < 20$	$\eta_{wh} < 23$	$\eta_{wh} < 23$	$\eta_{wh} <27$	$\eta_{wh} <27$	$\eta_{wh} <27$	$\eta_{wh} <28$	$\eta_{wh} <28$	$\eta_{wh} <28$

2. Energy efficiency class of storage tanks

The energy efficiency class of storage tanks is determined on the basis of accordance with its standing loss as set out in Table 3.

Table 3: Energy efficiency classes of storage tanks

Energy efficiency class	Standing loss *S* in Watts, with storage volume *V* in litres
A+	$S < 5{,}5 + 3{,}16 \cdot V^{0,4}$
A	$5{,}5 + 3{,}16 \cdot V^{0,4} \leq S < 8{,}5 + 4{,}25 \cdot V^{0,4}$
B	$8{,}5 + 4{,}25 \cdot V^{0,4} \leq S < 12 + 5{,}93 \cdot V^{0,4}$
C	$12 + 5{,}93 \cdot V^{0,4} \leq S < 16{,}66 + 8{,}33 \cdot V^{0,4}$
D	$16{,}66 + 8{,}33 \cdot V^{0,4} \leq S < 21 + 10{,}33 \cdot V^{0,4}$
E	$21 + 10{,}33 \cdot V^{0,4} \leq S < 26 + 13{,}66 \cdot V^{0,4}$
F	$26 + 13{,}66 \cdot V^{0,4} \leq S < 31 + 16{,}66 \cdot V^{0,4}$
G	$S > 31 + 16{,}66 \cdot V^{0,4}$

3. Minimum requirements and labelling (‘Min+Lbl’)

In terms of saving effect, labelling is an important tool to increase the effectiveness of Ecodesign beyond the minimum level.

In the “Min+Lbl” scenario, it is assumed that 5 years after introduction 40% of products will be at least at the “A” level, 30% of products will be in “B”, 20% in “C” and 10% in “D”. The aggregate weighted efficiency is 43% (in 2014).

The 40/30/20/10 split for A/B/C/D is in line with the trends in the white goods sector. Above, a study from the Dutch Fiscal Administration (Belastingdienst) shows that within 5 years – from a starting situation of 0% market share for “A”-labeled appliances at introduction of the mandatory EU Energy Label – most “A” labeled white goods (washing machines, dishwashers, refrigerators, etc.) reached a 40% market share. [54]

The average improvement for all sales over the same period was by – at least – two energy classes (from average score “D” to “B”). The subsidy scheme and other (financial) incentives were found to be important accelerators, driving the market share of “A” labeled appliances even higher and/or over a shorter time period.[55]

In order to reach the level of 43%, the average efficiency has to improve by 1% points annually between 2009 and 2013, which is a pace also assumed to apply up till 2018. From 2018 to 2025, the improvement rate will even out at only 0.5 efficiency % point annually.

In technical terms, these levels of efficiency can be achieved by extra measures, such as:

- room-sealed GIWH with pre-mix burner, possibly condensing through heat exchanger between flue gas and cold water inlet;
- full substitution of hydraulic EIWH by electronic EIWH with smart control;
- further increased insulation (beyond best-practice, e.g. through vacuum insulation) level for part of ESWH, GSWH, SOL, HP;

[54] Belastingdienst/Centrum voor proces- en productontwikkeling (Dutch Ministry of Finance, Tax Services), RAPPORTAGE VAN ONDERZOEKSBEVINDINGEN IN HET KADER VAN DE EVALUATIE VAN DE ENERGIEPREMIEREGELING, The Hague, 21 juni 2002.

[55] This is also confirmed by miscellaneous data from market research by consultancy GfK. There is only one exception to this rule: laundry driers where the “A” level required a technology jump (for mass production), was only recently realised, thus more than 10 years later. This will not be the case for water heaters as class “A” appliances are already now available.

- smart control for GSWH, SOL and HP;
- more SOL and HP solutions in general and higher coverage of water heating by renewables fraction;
- more efficient back-up heaters (expected more gas-fired) for SOL and conventional electric HP solutions;
- especially for larger sizes: electric super-critical HP (CO_2 refrigerant) and gas-fired absorption HP covering the full temperature range., i.e. requiring no back-up heater for water heating. If circumstances indicate so: more geothermal (vertical ground source) heat pumps.

The shift from collective to individual water heating in apartment buildings is an important side-effect of building owners wanting to avoid investments in new large collective heaters and their associated infrastructure, e.g. fuel supply for some renewable energy fuelled (woodchip) heaters. If managed properly at the level of individual Member States, this can also lead to savings on storage and distribution losses. The same goes for negative side-effects of fuel switching as mentioned earlier.

Labelling shouldn't have a big impact on the biggest sizes of Dedicated Water Heaters as the group of purchasers (housing corporations/SMEs) is most of the time aware of the efficiency of these products. As explained, a switch from collective to individual water heating would rather be the result of increased minimum standards rather than labelling. Labelling – together with more stringent minimum standards – will have a bigger impact on the smaller sizes. If there is a gas grid access, labelling will have a possible strong effect. We believe that manufacturers will be able to produce gas fired water heaters with an A label in mass production and thus at a reasonable extra cost if compared to electric ones. As ESWHs have a maximum primary efficiency of 40%, labelling will be especially positive within the classes S to XL (efficiency potential is increasing with the size). For the smallest ones (XXS and XS) a switch from gas to electricity is more plausible as the effects in efficiency increase (buying a new GSWH with a higher label) can be offset by an increase in cost. Still, going from an old GSWH to a new ESWH or an EIWH efficiency can be improved from 27% to 40%. However, further potential savings will be missed. If there is no gas supply and if you have a profile related to the sizes S to XL, the only alternative is to invest in renewables. The price difference between an ESWH and renewable alternatives is currently very high so we believe the effect of labelling will be rather small for this niche.

4. Scenario 3 plus Energy Performance of Buildings (' Min+Lbl+EPB')

Water heaters are part of a building and as such are covered by the energy certification and minimum requirements of the EPB. Consistency between Ecodesign measures and EPBD (Energy Performance of Buildings Directive) measures is therefore essential.

The main problem is that there is no harmonised EPB methodology and it is assumed that this will remain the case for years to come. Every EU Member State has its own methodology and one single EPB methodology. For water heaters specifically, this means that in each Member State their energy efficiency will be evaluated differently and with a different result for the energy certificate (existing buildings) or the minimum requirement (new buildings). It should be noted that the current installation requirements and system evaluation methods are thin on the ground for Water Heaters (compared with heaters/heating systems). In practice, most Member States will probably follow 'Annex IV' on Eco-design implanting measures for Dedicated Water Heaters.

The recast EPBD is not likely to change this. At the current pace, a deadline for true harmonisation of the EPB methodology is difficult to give. Any aspect of water heater design not covered by Ecodesign may be evaluated differently in the EPB of each Member State, which is suboptimal for the development of a single market. It means that it will allow Member States to apply more stringent standards for installation than for the product under Ecodesign and that the labelling class limits will be used to provide consumer advice. On the other hand, if the outcome of the current discussions will be positive, the revised EPBD tells MS to have installation requirements for water heaters and to require these to be based on the installation of a water heater of a particular size category and an energy efficiency as defined under 'Labelling'. In this case, we would have a partial harmonization and an important element which would encourage MS to use 'Annex IV' on Eco-design implanting measures for dedicated water heaters. This suggests an aggregate 2015 target level of 45% in the "Min+Lbl+EPB" scenario. In order to reach that level an efficiency increase of 1.4% points annually is needed for the 2009-2017 period. Due to the synergy of combining all different types of measures this improvement rate is assumed to remain stable from 2018 onwards.

These values are very close to the "Min+Lbl" scenario. The data are also comparable in technical and economic terms. The principal difference is that the EPB can make sure that the Min+Lbl values are actually met, avoiding unwanted side-effects for rental apartments and other purchasing situations where the buyer is not the one paying the energy bill.

Finally, the EPB-scenario should enhance the effect of labelling, first because it should reduce the need for manufacturers to devote their design expertise to meeting national (regional) rules, and because it should help many markets to overcome the 40% limit. From there on, extra costs of improvement are likely to be lower and more continuous (e.g. they will be an improving Coefficient Of Performance (COP) of heat pumps, increasing solar are etc.).

5. NOx Scenarios: Scenario 4 plus NOx requirements

Possible sub-options to the NOx requirements were investigated.

Sub-option 5a as proposed in the draft regulation and set out in paragraph 4.7 and 5.2 above remains the preferred option. Stricter sub-options 5b and 5c would hardly make a difference as illustrated in figure 5.3, but they would lead to less favourable Least Life Cycle Costs for the consumer. The technical problems associated with these stricter sub-options would also impact industry by forcing it to redesign and optimise for this emission instead of further improving energy efficiency (which saves much more NOx). Stricter sub-options would also lead to calls for a longer timeline before the measure would take effect, thus reducing accumulated savings of energy and accumulated reductions in CO_2 and NOx by 2020.

As possible sub-options, the effect of imposing less stringent limits has been contemplated but based on comments from Member States, NGOs and industry this was not further explored. More lenient values would not help Member States to reach emission targets under EU legislation. In addition, there was no real justification from the current state of development of dedicated water heaters and Least Life Cycle Costs.

ANNEX IV: SCENARIO CALCULATION METHODS AND INPUTS

The calculation method for the scenario analysis is a so-called "stock model". This means that it is derived from accumulated annual sales and redundancy figures for water heaters over the period 1990-2020 (with a start-up period 1960-1990), i.e. it is a model of the numbers and types of water heaters that are installed and working, taking account of new installations, existing installations and replacement of existing installations over the period.

The following parameters are used, as developed in the preparatory study:

– number of households;

– consumer behaviour, e.g. tendency to take longer showers;

– number of water heaters per household; and

– energy efficiency.

The main variable in the scenarios is energy and its derived parameters, and the following outputs are created for the scenarios:

– energy consumption in PJ/annum(a);

– carbon emissions in Mt CO2 equivalent/a, using a multiplier based on electricity and gas shares (see below) and the values from the preparatory study;

– acidifying emissions (e.g. NOx, SO2) in kt SOx equivalent/a;

– economic parameters: purchase price, energy expenditure, maintenance costs and total expenditure in billion EURO per year [2005 Euro, inflation-corrected at 2% per year].

The final outcomes are presented at an aggregated level ("water heater total"). In the intermediate stages, a distinction is made by water heater type and load profile. The following water heater types are used:

– gas storage (GSWH) – water is heated by burning gas and stored in a tank ready for use;

– gas instantaneous (GIWH) – water is heated by gas ready for instant use;

– electric storage (ESWH);

– electric instantaneous (EIWH);

– solar-assisted units (SOL) – heat collected from the sun via solar panels is used to assist in the water heating;

– heat-pump assisted units (HP) – heat from ground or air is used for water heating.

The analysis is restricted to "dedicated" water heaters (DWH). "Combi"-types and cylinders (indirectly fired by gas/oil heaters) involving space heating *and* (sanitary) water functions will be dealt with in a separate impact assessment related to measures implementing the Ecodesign and the Energy Labelling Directives for "heaters".

Model Variables

Variable	Value	Description
SCENARIOS		**BAU** (values from STOCK 5YR+ interpolation for intermediate values)
Target	41%	**Min Only** (fixed value 2015, interpolation from BAU 2008 value)
RealGrow	1.0%	**Min+Lbl** (for 2013: Target + RealGrow; for 2008-2013 interpolation from BAU 2008 value; growth rate 2013-2017)
RealGrow2	0.5%	**Min+Lbl** (growth rate 2018-2025)

AmbGrow	1.4%	**+EPB** (for 2013: Target + AmbGrow; for 2008-2013 interpolation from BAU 2008 value; growth rate 2013-2017)
AmbGrow2	1.4%	**+EPB** (growth rate 2018-2025)
NOx+	0.5%	**NOx** (for 2013: Target + AmbGrow+NOxPlus; for 2008-2013 interpolation from BAU 2008 value; growth rate 2013-2017 as AmbGrow)
NOX SCENARIOS		
	mg/kWh	
NOx175	175	BaU NOx emissions, in mg/kWh
NOx	70-120	Ambitious but realistic, Min+Lbl+EPB, as in proposal, in mg/kWh
NOx90	90	Ambitious, but undifferentiated for fuel, in mg/kWh
NOx70	70	Very ambitious, close to BAT, in mg/kWh
NOx35	35	Very ambitious, sometimes beyond current BAT, in mg/kWh
ECONOMICS		
Baseprice	450	Product price (66%) + Installation costs(33%) incl. VAT 2005 [€]
PriceInc Eur	22	Price increase per efficiency %-point [€/ %]
Rel	0.15	Electricity rate 2005 [€/ kWh electric]
Rgas	0.047	Gas rate 2005 [€/ kWh primary GCV]
Roil	0.061	Oil rate 2005 [€/ kWh primary GCV]
Rmaint	30	Annual maintenance costs [€/ a]
Relinc	2%	Annual price increase electricity [%/ a]
Rgasinc	5.60%	Annual price increase gas [%/ a]
Roilinc	8.20%	Annual price increase oil [%/ a]
Rmaintinc	2%	Annual cost increase maintenance [%/ a]
PriceDec	2.00%	Annual product price decrease [%/ a]
InstallDec	2.00%	Annual installation cost decrease [%/ 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	WH manufacturer turnover per employee [mln €/ a]
OEMfactor	1.24	OEM personnel as fraction of WH manufacturer personnel [-]
WholeWages	0.261	WH wholesale turnover per employee [mln €/ a]
RetailWages	0.1	WH manufacturer turnover per employee [mln €/ a]
ExtraEUfrac	0.6	Fraction of OEM personnel outside EU [% of OEM jobs]
Inflation	2%	Inflation rate [%/ a]
Discount rate	4%	

Average energy efficiency new sales in the stock model 2009-2016												
year -->	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Freeze 2005	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
BaU	31%	32%	32%	32%	32%	32%	32%	33%	33%	33%	34%	34%
Min only	32%	34%	35%	37%	38%	40%	41%	41%	41%	41%	41%	41%
Min+Lbl	33%	35%	38%	40%	42%	43,0%	44,0%	45%	46%	47%	47%	48%
Min+Lbl+EPB	33%	36%	38%	40%	42%	44%	45%	46%	48%	49%	51%	52%
NOx +	33%	36%	38%	40%	43%	44%	45,6%	47%	48%	50%	51%	52%

ANNEX V: SCENARIO OUTPUTS (TABLES)

Table 1. Water Heater STOCK Environmental									
	1990	**1995**	**2000**	**2005**	**2010**	**2013**	**2015**	**2020**	**2025**
net load (kWh/a)	1392	1407	1427	1462	1524	1555	1576	1629	1682
sales (000)	9806	9713	10388	10667	10864	11007	11103	11341	11580
park (000)	182826	208429	218239	227486	235132	238922	241523	248726	254445
Efficiency									
Freeze	27%	28%	28%	30%	30%	30%	30%	30%	30%
BaU	27%	28%	28%	30%	32%	32%	32%	34%	37%
Min only	27%	28%	28%	30%	34%	38%	41%	41%	41%
Min+Lbl	27%	28%	28%	30%	35%	42%	44%	48%	50%
Min+Lbl+EPB	27%	28%	28%	30%	36%	42%	45%	52%	59%
NOx+	27%	28%	28%	30%	36%	43%	46%	52%	59%
kWh/a.unit									
Freeze	5126	5115	5059	4845	5052	5155	5223	5400	5575
BaU	5126	5115	5059	4845	4815	4844	4863	4785	4546
Min only	5126	5115	5059	4845	4496	4075	3844	3974	4102
Min+Lbl	5126	5115	5059	4845	4301	3703	3582	3430	3364
Min+Lbl+EPB	5126	5115	5059	4845	4284	3672	3498	3136	2853
NOx+	5126	5115	5059	4845	4260	3630	3460	3106	2829
TWh primary/a new sales (without corr.)									
Freeze	50	50	53	52	55	57	58	61	65
BaU	50	50	53	52	52	53	54	54	53
Min only	50	50	53	52	49	45	43	45	48
Min+Lbl	50	50	53	52	47	41	40	39	39
Min+Lbl+EPB	50	50	53	52	47	40	39	36	33
NOx+	50	50	53	52	46	40	38	35	33
Sales year energy									
With single point correction (0,93*0,84)									
Freeze	572	581	591	599	613	626	634	665	703
BaU	572	581	591	599	607	612	615	623	628
Min only	572	581	591	599	603	592	578	547	530
Min+Lbl	572	581	591	599	601	581	562	511	467
Min+Lbl+EPB	572	581	591	599	600	580	560	501	437
NOx+	572	581	591	599	600	579	558	497	433
Stock energy in TWh/a WITH CORRECTION									
Freeze	2059	2090	2126	2156	2208	2253	2283	2394	2530
BaU	2059	2090	2126	2156	2186	2204	2213	2243	2260
Min only	2059	2090	2126	2156	2172	2132	2081	1969	1906
Min+Lbl	2059	2090	2126	2156	2162	2093	2024	1840	1680
Min+Lbl+EPB	2059	2090	2126	2156	2161	2090	2016	1802	1573
NOx+	2059	2090	2126	2156	2160	2085	2009	1790	1558
CO2 in Mt (1 PJ= 0,0577 Mt)									
Freeze	119	121	123	124	127	130	132	138	146
BaU	119	121	123	124	126	127	128	129	130
Min only	119	121	123	124	125	123	120	114	110
Min+Lbl	119	121	123	124	125	121	117	106	97
Min+Lbl+EPB	119	121	123	124	125	121	116	104	91
NOx+	119	121	123	124	125	120	116	103	90
Acidification (in kt SOx equivalent)									
Freeze	505	524	540	559	578	595	607	644	687
BaU	505	524	540	559	572	582	588	603	614
Min+Lbl+EPB	505	524	540	559	566	543	533	482	425
EHI_econ	505	524	540	559	566	541	528	476	419
EHI	505	524	540	559	566	542	526	475	418
COM	505	524	540	559	566	541	525	473	417

Table 2. Water Heater STOCK Consumer Economics (not corrected for inflation unless indicated otherwise)									
	1990	1995	2000	2005	2010	2013	2015	2020	2025
Oil share	0%	0%	0%	0%	0%	0%	0%	0%	0%
Oil price	0,019	0,028	0,041	0,061	0,090	0,115	0,134	0,199	0,295
Gas price	0,021	0,027	0,036	0,047	0,062	0,073	0,081	0,106	0,140
El price	0,045	0,049	0,054	0,060	0,066	0,070	0,073	0,081	0,089
Maintenance	22	25	27	30	33	35	37	40	45
Share electricity									
Freeze	78,3%	80,4%	81,7%	83,9%	84,8%	85,8%	86,4%	87,6%	88,8%
BaU	78,3%	80,4%	81,7%	83,9%	84,8%	85,8%	86,4%	87,6%	88,8%
Min only	78,3%	80,4%	81,7%	83,9%	84,8%	85,8%	86,4%	87,6%	88,8%
Min+Lbl	78,3%	80,4%	81,7%	83,9%	84,8%	85,8%	86,4%	87,6%	88,8%
Min+Lbl+EPB	78,3%	80,4%	81,7%	83,9%	84,8%	85,8%	86,4%	87,6%	88,8%
NOx	78,3%	80,4%	81,7%	83,9%	84,8%	85,8%	86,4%	87,6%	88,8%
Avg. Fuel price									
Freeze	0,04	0,04	0,05	0,058	0,07	0,07	0,07	0,08	0,09
BaU	0,04	0,04	0,05	0,06	0,07	0,07	0,07	0,08	0,09
Min only	0,04	0,04	0,05	0,06	0,07	0,07	0,07	0,08	0,09
Min+Lbl	0,04	0,04	0,05	0,06	0,07	0,07	0,07	0,08	0,09
Min+Lbl+EPB	0,04	0,04	0,05	0,06	0,07	0,07	0,07	0,08	0,09
NOx	0,04	0,04	0,05	0,06	0,07	0,07	0,07	0,08	0,09
Avg. Purchase Product (incl. install)									
Freeze	387	395	411	454	454	454	454	454	454
BaU	387	395	411	454	487	496	503	539	604
Min only	387	395	411	454	536	630	692	692	692
Min+Lbl	387	395	411	454	570	714	758	835	890
Min+Lbl+EPB	387	395	411	454	573	722	781	933	1087
NOx	387	395	411	454	577	733	792	944	1098
Avg. Energy costs Eur/a.unit									
Freeze	202	230	258	281	331	364	388	453	529
BaU	202	230	258	281	316	342	361	402	431
Min only	202	230	258	281	295	288	285	334	389
Min+Lbl	202	230	258	281	282	262	266	288	319
Min+Lbl+EPB	202	230	258	281	281	259	260	263	271
NOx	202	230	258	281	279	256	257	261	268
Total purchase costs EU per annum (inflation corrected, in Euro 2005)									
Freeze	5,1	4,7	4,7	4,8	4,5	4,2	4,1	3,8	3,5
BaU	5,1	4,7	4,7	4,8	4,8	4,6	4,6	4,5	4,7
Min only	5,1	4,7	4,7	4,8	5,3	5,9	6,3	5,8	5,3
Min+Lbl	5,1	4,7	4,7	4,8	5,6	6,7	6,9	7,0	6,9
Min+Lbl+EPB	5,1	4,7	4,7	4,8	5,6	6,8	7,1	7,8	8,4
NOx	5,1	4,7	4,7	4,8	5,7	6,9	7,2	7,9	8,5
Total running costs (energy+maint) (inflation corrected, in Euro 2005)									
Freeze	35,8	38,0	39,8	41,5	43,4	44,8	45,7	48,7	52,1
BaU	35,8	38,0	39,8	41,5	43,0	43,9	44,5	46,1	47,3
Min only	35,8	38,0	39,8	41,5	42,8	42,7	42,3	41,3	41,1
Min+Lbl	35,8	38,0	39,8	41,5	42,6	42,1	41,3	39,1	37,1
Min+Lbl+EPB	35,8	38,0	39,8	41,5	42,6	42,0	41,2	38,5	35,2
NOx	35,8	38,0	39,8	41,5	42,6	42,0	41,1	38,2	35,0
Consumer expenditure (inflation corrected, in Euro 2005)									
Freeze	40,9	42,7	44,5	46,3	47,8	49,0	49,8	52,5	55,6
BaU	40,9	42,7	44,5	46,3	47,8	48,6	49,1	50,6	52,0
Min only	40,9	42,7	44,5	46,3	48,0	48,6	48,5	47,1	46,5
Min+Lbl	40,9	42,7	44,5	46,3	48,2	48,8	48,2	46,1	44,0
Min+Lbl+EPB	40,9	42,7	44,5	46,3	48,2	48,8	48,3	46,3	43,7
NOx	40,9	42,7	44,5	46,3	48,2	48,8	48,2	46,2	43,5

Table 2. Water Heater STOCK Consumer Economics (not corrected for inflation unless indicated otherwise)									
Table B3. Water Heater STOCK Business Economics (inflation corrected, in Euro 2005)									
	1990	1995	2000	2005	2010	2013	2015	2020	2025
Avg. Product Price [Euro 2005]									
Freeze	347	321	302	302	273	257	247	223	202
BaU	347	321	302	302	293	281	274	265	269
Min only	347	321	302	302	323	357	377	340	308
Min+Lbl	347	321	302	302	343	405	412	411	396
Min+Lbl+EPB	347	321	302	302	345	409	425	459	483
NOx+	347	321	302	302	347	415	431	464	488
Avg. Install [Euro 2005]									
Freeze	174	160	151	151	137	129	123	112	101
BaU	174	160	151	151	146	141	137	133	134
Min only	174	160	151	151	161	178	188	170	154
Min+Lbl	174	160	151	151	171	202	206	205	198
Min+Lbl+EPB	174	160	151	151	172	204	213	229	242
NOx+	174	160	151	151	174	208	216	232	244
Avg. Energy/unit new sales [Euro 2005]									
Freeze	272	280	285	281	299	310	317	335	353
BaU	272	280	285	281	285	291	295	297	288
Min only	272	280	285	281	266	245	233	246	260
Min+Lbl	272	280	285	281	255	223	217	213	213
Min+Lbl+EPB	272	280	285	281	254	221	212	194	181
NOx+	272	280	285	281	252	218	210	193	179
INDUSTRY Turnover [€ bln 2005]									
Freeze				1,7	1,6	1,5	1,5	1,4	1,3
BaU				1,7	1,7	1,7	1,6	1,6	1,7
Min only				1,7	1,9	2,1	2,2	2,1	1,9
Min+Lbl				1,7	2,0	2,4	2,5	2,5	2,5
Min+Lbl+EPB				1,7	2,0	2,4	2,5	2,8	3,0
NOx+				1,7	2,0	2,5	2,6	2,8	3,0
WHOLESALER Turnover [€ bln 2005]									
Freeze				0,5	0,5	0,5	0,4	0,4	0,4
BaU				0,5	0,5	0,5	0,5	0,5	0,5
Min only				0,5	0,6	0,6	0,7	0,6	0,6
Min+Lbl				0,5	0,6	0,7	0,7	0,8	0,7
Min+Lbl+EPB				0,5	0,6	0,7	0,8	0,8	0,9
NOx+				0,5	0,6	0,7	0,8	0,8	0,9
INSTALLER Turnover [€ bln 2005]									
Freeze				7,5	7,6	7,6	7,6	7,7	7,7
BaU				7,5	7,7	7,8	7,8	8,0	8,2
Min only				7,5	7,9	8,2	8,4	8,4	8,4
Min+Lbl				7,5	8,0	8,5	8,7	8,9	9,0
Min+Lbl+EPB				7,5	8,0	8,5	8,7	9,2	9,5
NOx+				7,5	8,0	8,6	8,8	9,2	9,6
VAT on product (excl. Energy) Turnover [€ bln 2005]									
Freeze				1,9	1,8	1,8	1,8	1,8	1,8
BaU				1,9	1,9	1,9	1,9	1,9	2,0
Min only				1,9	2,0	2,1	2,2	2,1	2,1
Min+Lbl				1,9	2,0	2,2	2,3	2,3	2,3
Min+Lbl+EPB				1,9	2,0	2,2	2,3	2,4	2,6
NOx+				1,9	2,0	2,2	2,3	2,5	2,6
ENERGY SECTOR Turnover [€ bln 2005], incl. VAT and other taxes									
Freeze				34,7	36,3	37,6	38,5	41,2	44,5
BaU				34,7	36,0	36,8	37,3	38,6	39,8
Min only				34,7	35,7	35,6	35,1	33,9	33,5
Min+Lbl				34,7	35,6	34,9	34,1	31,7	29,6
Min+Lbl+EPB				34,7	35,6	34,9	34,0	31,0	27,7
NOx+				34,7	35,6	34,8	33,8	30,8	27,4
ALL SECTORS Turnover [€ bln 2005] (=consumer expenditure inflation corrected)									
Freeze				46,3	47,9	49,0	49,8	52,5	55,6
BaU				46,3	47,8	48,6	49,1	50,6	52,1
Min only				46,3	48,1	48,6	48,6	47,2	46,5

Table 2. Water Heater STOCK Consumer Economics (not corrected for inflation unless indicated otherwise)									
Min+Lbl				46,3	48,2	48,8	48,2	46,1	44,1
Min+Lbl+EPB				46,3	48,3	48,8	48,3	46,3	43,7
NOx+				46,3	48,3	48,8	48,3	46,2	43,5
Table B4. WH STOCK Social-Economics									
	1990	1995	2000	2005	2010	2013	2015	2020	2025
INDUSTRY									
MANUFACTURER Personnel [000]									
Freeze				10	10	9	9	8	8
BaU				10	10	10	10	10	10
Min only				10	11	13	14	13	12
Min+Lbl				10	12	14	15	15	15
Min+Lbl+EPB				10	12	15	15	17	18
NOx+				10	12	15	16	17	18
OEM Total Personnel [000]									
Freeze				13	12	11	11	10	9
BaU				13	13	12	12	12	12
Min only				13	14	16	17	16	14
Min+Lbl				13	15	18	18	19	18
Min+Lbl+EPB				13	15	18	19	21	22
NOx+				13	15	18	19	21	23
of which OEM Personnel in EU [000]									
Freeze				5	5	5	4	4	4
BaU				5	5	5	5	5	5
Min only				5	6	6	7	6	6
Min+Lbl				5	6	7	7	7	7
Min+Lbl+EPB				5	6	7	8	8	9
NOx+				5	6	7	8	8	9
WHOLESALER									
Personnel Wholesaler [000]									
Freeze				2	2	2	2	2	1
BaU				2	2	2	2	2	2
Min only				2	2	2	3	2	2
Min+Lbl				2	2	3	3	3	3
Min+Lbl+EPB				2	2	3	3	3	3
NOx+				2	2	3	3	3	3
INSTALLER									
Personnel [000]									
Freeze				75	76	76	76	77	77
BaU				75	77	78	78	80	82
Min only				75	79	82	84	84	84
Min+Lbl				75	80	85	87	89	90
Min+Lbl+EPB				75	80	85	87	92	95
NOx+				75	80	86	88	92	96
ALL SECTORS									
Personnel x 1000									
Freeze				101	99	98	98	97	96
BaU				101	102	102	102	103	106
Min only				101	107	113	117	115	112
Min+Lbl				101	109	120	123	125	126
Min+Lbl+EPB				101	110	121	124	133	140
NOx+				101	110	122	125	134	140

ANNEX VI: EMPLOYMENT EFFECTS

The summary table on page 11 shows that SME share in employment is estimated to be 50% for industry and 80% for installers.

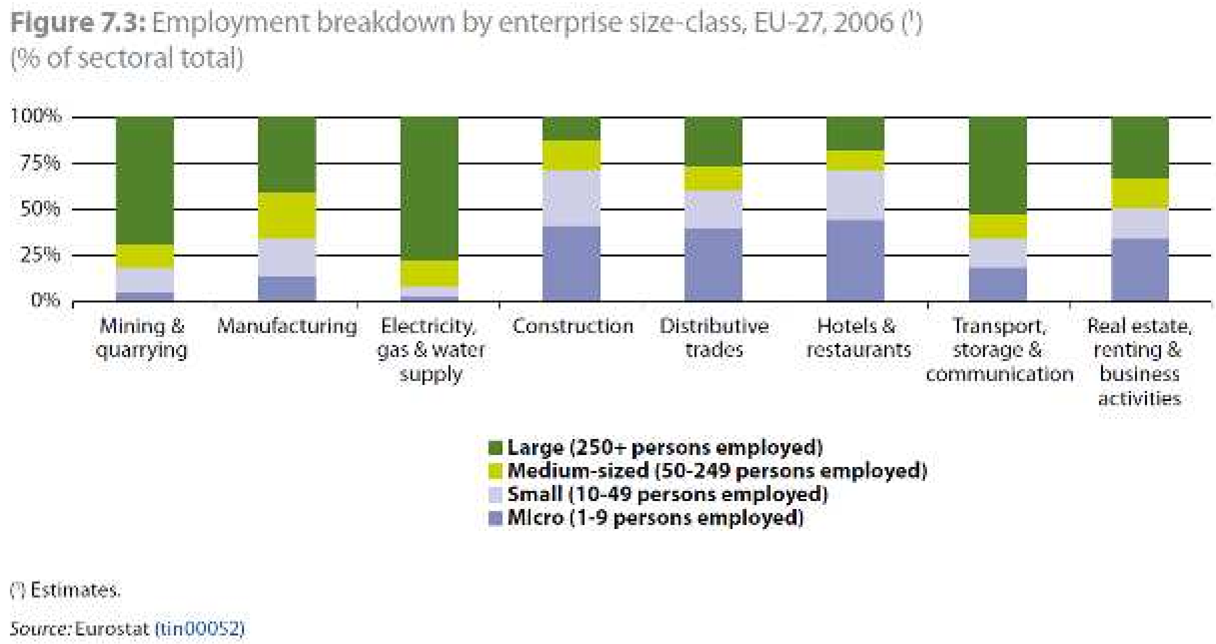
Eurostat 2007 data show that the EU-27 construction-subsector 'Building Installation' (installers) provides almost 3.5 million jobs to 759 000 enterprises (see table). On average this is 4.6 jobs per enterprise. This is below the construction industry average of 4.8 jobs per enterprise.

Table. **Structure of the construction industry EU-27, 2007 (source: Eurostat 2010)**

	Number of enterprises	Number of persons employed	Turnover	Value added	Apparent labour productivity (per person employed)	Gross operating rate (2)	Invest. rate (2)
	(1 000)		(EUR million)		(EUR 1 000)	(%)	
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	:

(1) Including estimates.
(2) 2006.

The figure below shows that SMEs (up to 249 jobs/enterprise) constitute over 80% of the employment (and added value) of the construction industry. Thus it is concluded that the estimate in the IA report of 80% of installer jobs being related to SMEs is plausible.



Picture source: Eurostat, Statistical Yearbook 2010.

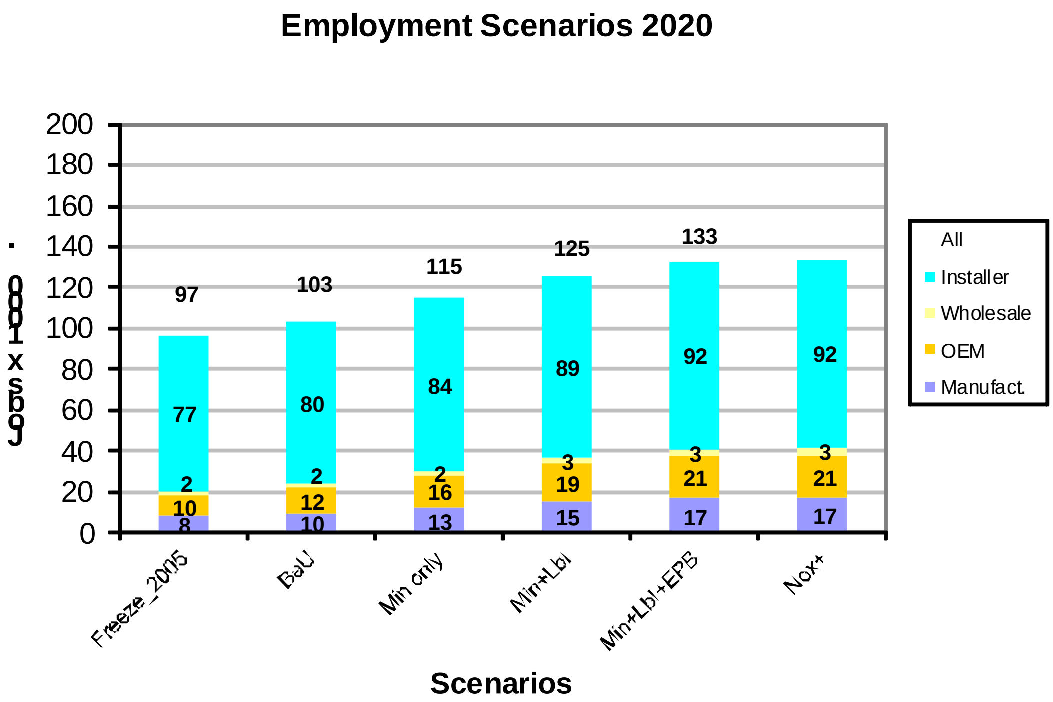
The figure also shows that ca. 60% of manufacturing jobs can be partitioned to SMEs. This share is appropriate, and probably even low, for OEMs. But the conservative estimate in the

IA report is based on the fact that the EU market is dominated by around 6 to 8 large enterprises (for example Merloni, Bosch, Remeha group).

The partitioning of employment effects between EU and extra-EU is very rough and necessarily based on anecdotal information. EU trade and production statistics are too poor and incomplete in this respect to be a basis of partitioning. It is difficult to estimate the effect of the water heater measure on creating or keeping jobs in the EU. Manufacturers of water heaters based in Europe may also have manufacturing facilities outside the EU and vice versa. Nowadays, components can come from all over the world. From the effects of other ecodesign measures it can be concluded that in general ecodesign measures tend to create or keep jobs in the EU as ecodesign requirements lead to higher quality end products.

The largest growth in employment will take place amongst installers. It is important to consider the location of these jobs. If the extra jobs are attributed to the Member States on the basis of their population (which is a reasonable predictor of demand) they would be distributed as below.

Figure VI.2 Employment scenarios

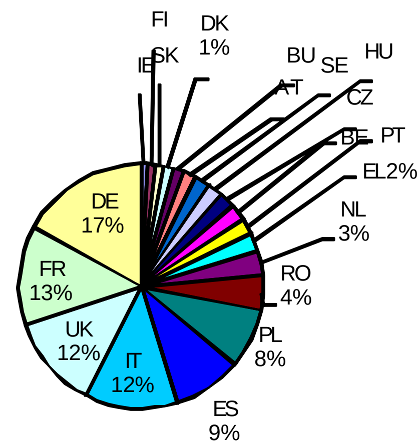


However if the distribution of employment is based on the current location of employment in electric and non electric water heater manufactures[56] the split would be as shown below.

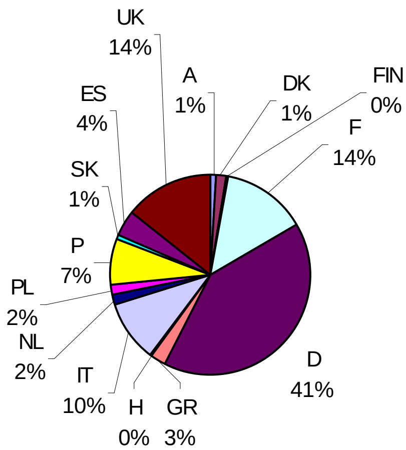
Figure VI.3 Extra jobs

[56] Task 2 of “Eco-design of Water Heaters" study for the European Commission, DG Transport and Energy, 2007.

25.000 extra EU Jobs
(partitioned by population 2006)



Manufacturing Jobs
Based on reported production 2004



ANNEX VII: EMISSIONS

The impact analysis involved 4 different levels of efficiency requirements (scenario 1 to 4, with numbers as specified in Annex III) and 3 levels of NOx requirements (scenarios 5a, 5b and 5c). The outcomes are visible in section 5 and the various annexes. An extensive discussion of these outcomes in the main body text was not given because most of the outcomes are self-explanatory. This Annex aims to clarify several issues related to emissions.

Only NOx has been taken into account.

Around 85% of energy use related to dedicated water heaters is electric (status 2010, 88% in 2025 baseline). This means that the reduction of hydrocarbons (HC) and CO and others is indirect (i.e. these are emissions by power generation and distribution) and is covered by measures aiming at reducing the use of electricity.

The other 15% of energy is used by fossil-fuel fired dedicated water heaters. Within this group, the share of oil-fired products is negligible (<0.1% of total), which means that the emission of HC other than CH4 and of particulate matters is negligible.

NOx is the only direct emission with an impact on acidification (expressed in kt SO2-equivalent).

Heat pump water heaters are actually entering the water heater market. Therefore it is too early to assess greenhouse gas emissions due to refrigerant leakage. However, the impact of refrigerants should be addressed in the review of the ecodesign regulation.

The relationship with standards.

The preparatory study reports on comparative laboratory tests between steady-state and on-off cycling of gas-burners, which show that on average for the various burner types 80% of overall CO emissions and 97% of CH4 emissions occur during burner start-up and shut-down (VHK 2007, preparatory Study Lot 2, Task 4, page 8). For gas-fired instantaneous water heaters (GIWH) and gas-fired storage water heaters (GSWH) the situation is assumed to be similar, which would mean that only 20% of actual CO emissions and 3% of CH4 would be covered by steady-state tests.[57] PM10 of liquid and gaseous water heaters was not considered significant in the preparatory study.

Unfortunately, the current EN standards for GIWHs and GSWHs do not cover CO, CH4 or other hydrocarbons tests and the Member State type-approvals and national regulations on emissions usually cover only NOx and CO. The tests for national type approvals only involve steady-state testing, thus covering only a fraction of real-life emissions.

More realistic testing of CO and hydrocarbons emissions at cycling-conditions is technically possible, but -apart from the much higher costs- is complex in terms of accuracy and reproducibility (tolerances). These issues need to be solved before it can serve as a basis for legal requirements.

The situation above has prompted the Commission to propose only NOx limits in the current regulation and to foresee mandates to the European Standardisation organizations (ESOs) to develop realistic testing methods for other emissions.

Health and environmental impact of emissions

[57] Note that for NOx emissions the steady-state tests do represent a fairly accurate representation of real-life emissions.

The CO_2 equivalent is expressed in GWP-100 and NOx is expressed in SO_2-equivalent (in line with the ecodesign methodology (MEEuP) for the conversion NOx-SO_2).

As regards the health and (fire) safety hazards of using open combustion systems in habitable rooms, as is typically the case with GIWHs, the problem has been recognised by regulators for many years. At EU level the GAD (Gas Appliances Directive) has been working on improvements and progress has been made, for example by means of extra safety devices and the addition of flue ducts (instead of fully open, type A) for larger units. And the regulation, as it is proposed, will induce further progress: The efficiency requirements will effectively eliminate the use of pilot flames; both the efficiency limits and the NOx-requirements will lead to improvements in the combustion process (e.g. pre-mix burners) and will -wherever infrastructure allows- promote the transformation from open to closed systems.

However, making closed combustion systems mandatory, and thereby eliminating most of the GIWHs and GSWHs, is judged as disproportional and not prudent. It would force all consumers into using the electric alternatives or (oversized) combi-heater solutions. Both would have a negative impact on energy use and (indirect) emissions, especially if the pilot-flame is eliminated from the GIWHs. Furthermore, there is a negative impact in terms of affordability, another important consideration in the ecodesign process. GIWHs are popular especially in Southern Europe (Spain, Portugal) in dwellings without space heating or only local space heating, typically in low-income households. Also in the North, where the product is rare, it is still typically used in low-income households. Experience has shown that an outright European ban of a complete product group should be an ultimate measure that can be expected to meet broad public resistance. It should only be undertaken if large potential gains can be achieved, which does not seem the case here looking at the figures in the tables.

ANNEX VIII: OUTCOME OF THE CONSULTATION PROCESS

The positions of main stakeholders on crucial features of the Commission services' working documents can be summarised as follows.

Member States

The **Member States** support in general the suggested energy efficiency levels for ecodesign and the approach for energy labelling. The level of ambition for ecodesign requirements and the approach for an energy efficiency grading for the energy label based on primary energy consumption were in general considered appropriate, and the suggested time scales are supported. In particular, the level of ambition of ecodesign requirements for electric water heaters with load profiles up to and including XL (approx. 300 litres storage volume) should correspond to best available technology solutions for electric storage water heaters without input of renewable energy sources, while water heaters with larger load profiles should use renewable energy sources. Several Member States asked to consider fuel-specific ecodesign requirements for energy efficiency in order to ensure ambitious levels also for fossil-fuel fired water heaters. There is some controversy on the way to take into account "smart control" as a means for reducing the energy consumption of water heaters. Some Member States argue that smart controls are equivalent to (large) insulation.

The product energy efficiency ranking is introducing the energy efficiency classes A-G and is using, together with the dealer label, the entire range of energy efficiency classes up to A+++, in order to achieve an ambitious scheme for promoting water heaters which use renewable energy input, while ensuring effective market transformation also in those cases where the use of renewable energy sources is not justified, that is for load profiles up to and including load profile "S". Energy efficiency ranking based on primary energy is preferred by most MS, although some MS have argued that the energy efficiency ranking should be based on insulation, as fuel switch by end-users is unlikely. The value of 2,5 for the EU average conversion coefficient describing the efficiency of producing and distributing electricity, thereby achieving comparability of electricity and gas consumption, was considered as appropriate, although some Member States would prefer a smaller value, while other Member States would prefer a larger value.

As far as ecodesign requirements for NOx are concerned, the UK, Ireland and several other Member States (including Germany requested to set ecodesign requirements for NOx emissions from water heater using liquid fuels at a level that corresponds to best available kerosene based technology. Some other Member States have requested to ensure that national levels set e.g. under the National Emissions Ceiling Directive should be considered. There was a consensus that the transition period for ecodesign requirements on NOx emissions should be shortened to three years instead of five years, with the exception of fuel heat pump water heaters and solar water heaters newly entering the market requiring five years to be able to comply with NOx requirements. Additionally, Germany pointed out that heat pump water heaters equipped with internal combustion engines cannot cope with the NO_x requirements designed for external combustion.

Manufacturers/suppliers and installers

The general approach to set mandatory requirements in the framework of ecodesign, and energy labelling legislation is in general supported by industry[58] associations such as the European Committee of Domestic Equipment Manufacturers (CECED), the Association of the European Heating Industry (EHI), and the European Solar Thermal Industry Federation (ESTIF). The proposed levels and timing of the ecodesign requirements for energy efficiency are accepted, although some associations would prefer a larger value for bonus associated to the "smart control" technology. Some industry associations such as Marcogaz argue that the conversion coefficient should be larger than 2.5, while other associations such as Eurelectric argue that it should be smaller. The Commission pointed out that the value should be in line with the conversion coefficient of 2,5 reflecting the estimated 40 % average EU generation efficiency, as established in Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services[59].

The maximum levels for NOx emissions suggested during the stakeholder consultation were considered to be too ambitious in particular for kerosene-based water heaters mainly used in the UK and in Ireland. In general NOx emissions are intrinsically higher for more efficient high temperature combustion, and ambitious NOx emissions may result in a loss of efficiency.

These concerns are reflected in the levels and timing for the ecodesign requirements set out in the regulation.

The energy efficiency ranking for the energy label is based on primary energy consumption is accepted, although some industry stakeholders would prefer energy efficiency rankings differentiated according to fossil fuels and electricity.

ESTIF does not support a dedicated energy label for solar parts of water heaters, which are not "self-standing" water heaters, but are parts to be combined with electricity or fossil fuel fired water heaters. Furthermore, ESTIF and retailers' associations raised concerns that an energy label for water heaters that would be exclusively based on the performance of the water heater as being placed on the market would lead to competitive disadvantages for manufacturers of solar parts, in particular SMEs, and installers offering systems composed of parts placed on the market separately, as such an approach would benefit mainly "large" manufacturers offering several types of water heaters, including combinations/bundles of "conventional" water heaters and solar parts.

In order to avoid competitive disadvantages, the energy labelling regulation requires providing information to the end-user on the energy efficiency of packages of water heaters and solar parts which were placed on the market separately. Taking into account concerns raised by installer associations as to the feasibility of such an approach in practical and in legal terms, it is required that suppliers of electric and fossil fuel water heaters provide a label and fiche that enables installers to calculate the energy efficiency of their combinations with solar collectors and solar storage tanks, and to present the resulting efficiency to the end-user together with the offer. The calculations relevant for that fiche can also be used for packages offered by a single supplier/dealer. This approach is supported by installer associations and by suppliers.

Environmental and Consumer NGOs in general welcome ecodesign and energy labelling legislation. The suggested time scales and the timing for upgrades of ecodesign requirements

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58 See e.g. contributions of ORGALIME and CECED to the consultation of Directive 92/75/EEC, available on http://ec.europa.eu/energy/demand/legislation/domestic_en.htm#consultation; "CECED vision on Energy Efficiency" of 1st July 2007, available on www.ceced.eu;

59 OJ L 114, 27.4.2006, p. 64.

and energy efficiency classes are supported, although for some size classes the ecodesign requirements should be more ambitious, and a review should be done quickly to move towards best available technology. The unified ranking for fossil-fuel fired and electric water heaters is supported, in particular if the energy consumption in terms of "final" electricity and gas/oil consumption is made transparent to the end-user.

In addition, environmental NGOs stress that NOx levels should become effective much earlier than suggested in the working documents, and the levels should be decreased in a revision of the regulation towards levels obtained by best available technology. Furthermore, information on sound power levels should be displayed on the label to the end-user and refrigerants of heat pumps should be covered by ecodesign requirements as they can contribute to global warming in case of leakage.

ANNEX IX: ADMINISTRATIVE BURDEN

As a consequence of the structure and procedures prescribed in the Ecodesign Framework Directive, the main carriers of any administrative burdens, Member States and industry, are part of the process (from the preparatory study to the end of the impact assessment process) for developing measurement methods to be used for testing and information to be provided. This was subject of discussions in several stakeholder meetings, at least one Consultation Forum meeting and at least one Regulatory Committee meeting.

Any related mandates for standardisation activities are also discussed with Member States in the 98/34 Committee. Market surveillance is discussed in the ADCO group to minimise the burden and realise an exchange of best practice and results. Industry is heavily involved in the work in the European Standardisation Organisations that is to produce the standards linked to any ecodesign measure.

Administrative burden for Member States and the Commission

The administrative burden regarding the implementation of labelling for water heaters will be very different for every Member State as the procedure differs a lot in each Member State. In some Member States the products will be tested by the government which will involve an estimated cost of €2 500 - €3 000 per model family. In other Member States action is only undertaken when a consumer association is complaining about the non-compliance of a product with a label.

The administrative burden for a Member state on legislative level should be much less than when amending the existing Energy Labelling Directive (200 hours of work), negotiating changes at the Directive (€75 000) or when it should be transposed into national legislation (€150 000). As the implementation of measures for water heaters will not involve any changes at the Framework directive for Ecodesign these costs should not increase. We only see some legislative work for Member States when the technical standards should be adapted but this should not involve more than 200 hours of work per Member State.

On the other hand, the administrative cost for the Commission will be higher as the Commission has to implement a new product under the Framework Directive. Referring to the ‘Impact assessment study on a possible extension, tightening or simplification of the framework directive 92/75 EEC on energy labelling of household appliances' it was estimated that this will require more administrative work than the amendment of existing directives. An indicative cost of €720 000, based on twice the time for amendments, was suggested.

Administrative burden for manufacturers and retailers

Manufacturers and retailers may face higher administrative costs in testing and providing labels. These costs are likely to vary considerably between manufacturers depending on the number of models subject to testing and the degree of testing already carried out for other purposes.

This could take manufacturers between three and four months per product. On the other hand, most of this work will already have to be carried out in the course of product development and quality control. Talking about water heaters and labelling means that the technical details (like the levels of NOx, sound power or energy efficiency) of the product should be known and that should not be a problem. So we estimate that this cost for manufacturers is rather small and marginal (less than 0.1%) if compared to their turnover.

This estimate has been reached as follows.

Business-as-usual requires manufacturers –under the Gas Appliance Directive requirements, national type approvals, voluntary benchmarks (SOLKEYMARK), standards and CE-marking- to do performance and emission tests, go through the approval procedure, keep the test results on file, publish validated test data in the product fiche/ manual, mention certification on their website, possibly with (a link to) a copy of the certificate, etcetera. In this sense, the information requirements under Ecodesign measures do not constitute a substantial change.

Extra costs will be incurred for capacity building (training costs, learning curve) and possibly more accurate and sophisticated lab-equipment due to some of the new test procedures required (e.g. tapping pattern). In part, a periodical update of test standards is not unusual and will be part of baseline projections for personnel costs. The extra investments in measurement equipment could be construed as ‘administrative burden’. Assuming that the 10 largest manufacturers each would invest around € 0.2 million extra for their in-house laboratories and that 10 test houses, serving SMEs, each would also invest € 0.2 million extra, the sector would invest € 4 million extra. At a 10 year write off and EU sales of around 10 million units per year, this comes down to € 0.04- € 0.05 per unit extra. In term of end-user prices this comes down to € 0.10 per unit extra.

The mandatory energy label that is foreseen to be supplied under the delegated regulation is new. The new label is a full colour label, where both variable and fixed data are printed on the same label[60]. Industry costs for blank label, printing, ink, handling, etc. is estimated at around € 0.10[61]. In terms of consumer end-prices this comes down to around € 0.20 per water heater. To this, extra retailer costs have to be added. This includes the application of labels on showroom models at retail level. At 1 minute per label, integrated hourly tariff of € 50/hour, 1 out of 10 products sold being showroom models, this comes down to € 0.08. Furthermore, the label rating has to be added to print publicity and website, estimated at around € 0.02 per product. The increase in consumer end-price due to the retail efforts (including 20% VAT) is thus estimated at around € 0.12.

All in all, strictly looking at the cost side and not the commercial benefits of adding energy labels, the measure would cost the end-user around € 0.42 extra (€ 0.10 + € 0.20 industry and

[60] The old label under 92/75/EC consisted of a colour offset print of the fixed data, often for several language versions, plus a BW thermal transfer print of the variable data (the ‘strip’) which then had to be applied manually by the retailer.

[61] This is comparable to the “old” labels under 92/75/EC, which had lower printing costs but higher handling costs.

€ 0.12 retail). At an average end-user product price incl. VAT of € 450 (see also Annex V) this constitutes an end-user price increase of around 0.1%.

This is a rough estimate, but it is in line with the findings of the energy label evaluation studies under the SAVE program showing that the cost aspect of the labelling measure is not critical.

The costs for dealers for completing the dealer fiche and label is considered low, as these fiches and labels have only to be completed, based on the product fiches provided by the part suppliers, if a package of water heater and solar-only system is offered to the end-users, supporting the necessary sales conversation of the dealer.

In addition, self-certification is supported, to reduce costs. Compared to heaters, there is no established third party certification for water heaters and there is no justifiable risk of not achieving a high environmental improvement potential due to inaccuracies in declaring the energy efficiency as a potential saving per water heater is six orders of magnitude smaller than a potential saving per heater. Due to these reasons a third party certification for water heaters is not supported.

Manufacturers of solar thermal components (mostly SMEs) are pleased with the fact that the proposed label allows for a modular approach, where test results can be used for any water heater and solar panel combination, avoiding separate testing of all combinations where solar panels could be used and thus keeping costs low.

Regarding the relation with the EPBD, the impact of the options will be considered both with and without energy labelling/building system requirements in the EPBD, in order to

– verify that the requirements of the Ecodesign Directive are fulfilled,

– assess the impact of ecodesign, energy labelling/EPBD, and the combination thereof.

Impact on compliance costs for existing legislation such as the EPBD

The proposed measures under the Ecodesign and Energy Labelling Directive will reduce compliance costs as compliance will be for the whole internal market. In the past industry had to deal with national and even regional requirements increasing compliance costs and effectively barring industry from expanding the geographical coverage and effectively reducing competition. This is one of the important reasons why the industry supports the proposed measures.

There are no expected costs from the ecodesign or energy labelling measures related to the EPBD as Member States will base their EPBD measures on the efficiency requirements and the energy labels of the appliances. On the contrary, the proposed ecodesign measures - once they are implemented - are expected to simplify and streamline some complex heating installation aspects in the current EPBD, and thus will lower the EPBD compliance costs, because a part of the cost on the demonstrating of the compliance will then be moved to the equipment-manufacturers.

ANNEX X: SUB-OPTIONS FOR TIMING UNDER THE BEST POLICY OPTION (§4.7)

Sub-option 1: tier 1 requirements for water heaters after 1 year, tier 2a requirements for storage tanks and water heaters with small load profiles after 3 years, tier 2b requirements for water heaters with large load profiles after 5 years

After the second Consultation Forum in July 2008 there was broad consensus on the key issues, the target values and the fact that only certain minor details e.g. regarding testing would require some attention. Most of these details were dealt with in the second half of 2008.

As can be deduced from trade fairs and the development of product catalogues, this was the starting point -for the vast majority of producers- to take into account the imminent Ecodesign requirements and optimise their new products for the coming energy label rating. For example, insulation thickness and insulation quality of storage water heaters were improved, smart controls were introduced, electric heat pump water heaters were introduced in the catalogues of more than 10 suppliers at affordable mass-volume production prices, new gas-fired water heaters without pilot flame (but with electronic ignition) were brought on the market.

Although many manufacturers have maintained the older products in their catalogues, trying to maximise profits while awaiting legislation, it can be observed that most have been working hard to already transform their product lines over the last 3 years.

Although it can never be excluded that there might still be a company for which the Ecodesign measure may contain unforeseen elements, a further delay by using a less-than-ambitious timing of measures would have a considerable negative impact for the vast majority of the companies that have already made the transformation and which have counted on a (much earlier) introduction of measures to recuperate their investments.

Taking into account the considerable delay due to stakeholder consultations, procedures and unforeseen circumstances, all manufacturers have had time to prepare for the currently proposed measure, which is confirmed by the already on-going market transformation and the reactions of the industry to the proposal.

Therefore, the approach envisaged in the proposal (sub-option 1) -previously seen as ambitious- is now more than fair.

Sub-option 2: no tier 1 transition, tier 2 requirements for all water heaters and storage tanks after 1 year

If the proposal would go for faster adoption of the tier 2 minimum efficiency criteria, e.g. 1 year, of course accumulated energy and CO_2 savings would be higher by 2020. However it could create problems for manufacturers as well as for their supply chain who in their redesign planning have taken into account a transition period after adoption of the measure. As the ecodesign requirements will also be copied in the measure for combi-heaters for their sanitary hot water function, this could especially create problems for manufacturers that produce both oil and gas fired dedicated water heaters and combi-heaters. Such problems should be avoided under the Framework ERP Directive. Furthermore, manufacturers of large water heaters require time to replace water heaters using electricity by water heaters using fuel or renewables.

Sub-option 3: tier 1 requirements for water heaters after 1 year, tier 2 requirements for water heaters and storage tanks after 5 years

If the proposal would allow a longer transition period for stricter requirements, e.g. 5 years, industry would easily be able to comply but it is likely that part of the redesign work has already been done as industry has been expecting the measure for some years. It is unlikely that industry will need such a long period to comply, especially taking into account what has been happening in the past 3 years in anticipation of the measures. Furthermore it would extend the review too much into the future. It would also lead to much less accumulated energy and CO2 savings until 2020, and Member States would not benefit from NOx reductions that they need to comply with European emission Directives. Consumers would continue to pay unnecessarily more for water heating based on life cycle cost. In addition, manufacturers would lose the incentive to improve competitiveness in the world market with efficient products.

The market transformation in anticipation of the ecodesign measure during the unforeseen delays has not been part of the quantitative modelling. Therefore a more quantitative approach on the effects of timing compared to the original scenarios would not be relevant. However, the requirements for tier 1, after 1 year, can easily be met by all water heater manufacturers. Tier 2 and its requirements, taking effect after 3 years, have not been seriously questioned either by the associations of manufacturers, which also include SMEs, or by individual SMEs, except for large water heaters. In combination with the observed market transformation already taking place this warrants the conclusion that the proposal with sub-option 1 is reasonable. This will also guarantee that after three years the main savings will become apparent.

ANNEX XI: THE ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE AND THE ENERGY EFFICIENCY OF WATER HEATERS AND OF HEATERS

Under Directive 2002/91/EC on the energy performance of buildings (EPBD), Member States must apply minimum requirements as regards the energy performance of new and existing buildings, ensure the certification of their energy performance and require the regular inspection of heaters systems in buildings.

While these systems have an important energy saving potential (up to 40-60% of their total energy use) and the current Directive is estimated to result in 10 % energy savings, it has proven very difficult to quantify the real impact of the current EPBD for the whole Union because of highly disaggregated nature of the sector, the complementary nature of energy improvements with other policy objectives, slow transposition, and lack of proper monitoring. To address some of these issues the recast EPBD (Directive 2010/31/EU) includes the requirement for Member States to establish energy performance requirements for technical building systems (including heating and hot water systems). However, with the transposition deadline of 9 July 2012, it is too early to quantify the actual impact of these measures on the energy efficiency of these systems.

The proposed ecodesign measure will provide harmonised minimum efficiency requirements for heater and water heater products placed on the market (so not for the existing heater and water heater stock already installed). The ecodesign and labelling measures are supported by a measurement and calculation methodology at product level which has been accepted by Member States and stakeholders. The methodology in combination with the requirements will help Member States in setting up heating and hot water system requirements in respect of the proper installation, and the appropriate dimensioning, adjustment and control and the overall energy performance of the technical building systems which are installed in existing buildings and that include heaters and water heaters. The EPBD addresses maintenance and inspection aspects of the heater or water heater once it is installed, which the ecodesign and labelling measures cannot do.

The EPBD also can promote replacement of the heater and water heater stock through the building label which raises awareness whereas, as stated above, the proposed measures on heaters and water heaters can address only efficiency of new products placed on the internal market.

Therefore the impact of the EPBD on the energy efficiency of the products concerned is limited. Thus, the EPBD and ecodesign/labelling measures complement each other. However, as the total saving potential in heating systems in buildings is so high the expected impact of energy savings from the EPBD can be as much as 130 Mtoe, corresponding to 6.6% reduction of the total EU primary energy supply by 2020. The indirect effect of the EPBD on e.g. determining the necessary heating capacity and on increased insulation has been taken into account in the baseline scenarios as explained in the IAs.

Detailed information on the relation of EPBD with the proposed measures is contained in nearly 200 pages in the preparatory studies available on http://ecoboiler.org for heaters as well as on http://www.ecohotwater.org for water heaters.

Recent studies confirm the above, for example the study by BPIE on developments and progress in Member States regarding the EPBD[62]. On page 78 it states:

[62] Europe's buildings under the microscope – A country-by-country review of the energy performance of buildings, Buildings Performance Institute Europe (BPIE), October 2011 (page78, 89)

"While no country has directly and fully applied the CEN standards in their methodology procedures, many countries have adopted an approach which is broadly compatible with the CEN methodology. A variety of reasons were cited for not using the CEN standards, including difficulty of converting into practical procedures, timing and copyright issues. Most national procedures are applied as software programmes and many countries (but by no means all) have adopted a CEN based methodology (EN 15603: Energy Performance of Buildings) and/or are using the EN 13 790 monthly calculation procedure, as the basis for the calculation "engine" for simple building. Others allow proprietary dynamic simulation (for more complex buildings), whilst others have developed their own national methods. The assessment of existing buildings (for building code or Certification purposes) is often based on a reduced data-set model.

A detailed assessment of the energy performance requirements is provided in Table 2B7. It can be seen that many different approaches have been applied and no two countries have adopted the same approach. It is important not to attempt to compare the performance requirements set by Member States, given the variety of calculation methods used to measure compliance and major differences in definitions (e.g. definitions of primary and final energy, heated floor area, carbon conversion factors, regulated energy and total energy requirement etc.). The setting of building code requirements with legally binding performance targets, is normally based on either an absolute (i.e. not to exceed) value, generally expressed in kWh/m2a, or on a percentage improvement requirement based on a reference building of the same type, size, shape and orientation. Some countries (e.g. Belgium) express the performance requirement as having to meet a defined "E value" on a 0 to 100 scale, or on an A+ to G scale (e.g. Italy and Cyprus).

Most methodology procedures are applied as software programmes. Software quality assurance accreditation is undertaken in only about half of the countries, a finding which has been drawn by the Concerted Action 2010 Report. About 50% of Member States have already introduced changes to their methodology procedures to either to tighten requirements, achieve greater conformity with CEN standards, and include additional technologies and/or to correct weaknesses/gaps in earlier EPBD methodology procedures.

There is a growing interest in the harmonisation of methodology procedures. This is likely to become an increasingly important issue in the context of the EPBD recast Article 2.2 and Article 9 requirements associated with nearly Zero Energy Buildings (nZEB) and cost optimality (EPBD recast Article 5) since the Commission will need to demonstrate that all Member States are delivering equivalent outcomes. A harmonised approach to setting and measuring nZEB targets and cost-optimality implies that a broadly equivalent methodology will be required. Table 2B8 provides a summary of the certification method used for new buildings."

And on page 89:

"In addition, many observers suggest that the compliance and enforcement of building energy codes is currently undertaken with less rigour and attention to detail, than other building regulation requirements such as structural integrity and/or fire safety. While there are few studies on compliance with building energy codes, there is a growing body of academic research suggesting that as building thermal requirements become more demanding (e.g. in the pursuit of nearly Zero Energy Buildings) there is increasing evidence of a performance gap between design intent (i.e. theoretical performance as modelled using national calculation methods) and the actual energy performance in-use. This suggests one or more of the following issues: the calculation methods are flawed, the enforcement regime is not being undertaken sufficiently rigorously or designers and builders are failing to satisfactorily deliver the outcome intended.

Closing the performance gap between design intent (and regulatory requirement) is likely to become an important issue over the next decade if countries are to deliver the climate and environmental targets related to buildings. The key findings of the PRC/Delft Univ. of Technology review of National Building Regulations[1] found that there was “little attention yet to enforcing sustainable building regulations in most of the various countries analysed”. The report also suggested that, given the highly technical nature of the requirements associated with sustainability and energy, there was a serious shortage of individuals with appropriate expertise to undertake the building control function. This is resulting in poor enforcement of compliance associated with these important issues."

The above confirms the usefulness for EPBD purposes of establishing harmonised efficiency requirements for water heaters in the proposed measures (which, if adopted, will require no transposition, and which will have an established market surveillance), to develop a related measurement methodology and to ask CEN/CENELEC in the Ecodesign horizontal mandate for European standards. It will help Member States in faster implementation and in establishing building codes, it will enable better enforcing, monitoring and comparisons of progress and developments and it will reduce burdens on manufacturers for compliance in the internal market, especially taking into account Article 8 of the EPBD which links the EPBD with ecodesign and labelling. Therefore the proposed measures are not considered to limit Member States flexibility, but rather as useful help to implement the EPBD, save primary energy for 2020 and realise emission ceilings.

ANNEX XII: ACTIONS TAKEN BY MEMBER STATES TO PROMOTE HIGHER EFFICIENCY EQUIPMENT

Information on actions by Member States have taken to promote higher efficiency equipment is contained in task 1 and task 2 of the preparatory studies available on http://www.ecohotwater.org for water heaters. This information reveals that there is a suspended voluntary industrial label on water heaters, complemented by very limited financial programmes, to promote high efficiency water heaters, whereas other third countries such as the U.S., Japan, Australia etc. have had legislation and funding programmes on water heaters for two decades.

The existing initiatives in Member States have been taken into account in the baseline scenario. However, these actions are not considered sufficient to promote higher efficiency equipment in the Union. The proposed ecodesign and labelling measures should therefore introduce harmonised minimum requirements on water heaters (including storage tanks), coupled with dynamic labelling and benchmarks for public procurement and financial incentives.

Since the work on water heaters started, hardly any Member State has worked on national or regional requirements for water heaters as they are expecting the pending EU legislation.

ANNEX XIII: DATA ABOUT INSTALLED STOCK AND PRODUCTION OF WATER HEATERS, AND THE ASSESSMENT OF THEIR CURRENT ENERGY PERFORMANCE.

Water heater market sales and stock data have been retrieved and reported by a specialist subcontractor, BRG Consult, in the preparatory study. BRG Consult is the foremost market research specialist in the water heating sector with over 20 years of experience in data collection and processing as well as scenario building and modelling.

As regards the efficiency numbers used, they were retrieved by the main contractor of the preparatory study, i.e. VHK engineering consultants, with long experience in the sector. Furthermore, as reported in the preparatory study, VHK used numerous sources from field testing to back up their assessment on real-life water heater energy consumption. VHK also developed the integrated measurement and calculation methodology that allows comparing the performance of the appliances (regardless of the technology: gas, electrical, heat pump and solar water heaters), which has been agreed with industry and other stakeholders after extensive technical expert meetings.

The methodology will be published as a Commission communication to assist industry (manufacturers, importers, dealers) and market surveillance authorities instantly after adoption of the measures. The communication will be replaced by (a) harmonised European standard(s), as soon as available from the European Standardisation Organisations under the Ecodesign horizontal mandate. The references of the harmonised standard(s) are published in the Official Journal of the EU. During the preparatory study and impact assessment, several dedicated expert meetings were held on the measurement and calculation methodology. The results used in and for the IA were not disputed. The description in §2.2 on page 10 refers to the situation before the work done on a measure for water heaters.