Development of Green Public Procurement Criteria for Hydronic Central Heating Generators

TECHNICAL BACKGROUND REPORT INCLUDING DRAFT CRITERIA PROPOSAL

Working Document

for

2nd AHWG-MEETING FOR THE DEVELOPMENT OF GPP CRITERIA FOR HYDRONIC CENTRAL HEATING GENERATORS

Elena Rodriguez Vieitez, Oliver Wolf

December 2011

JRC
EUROPEAN COMMISSION

Institute for Prospective Technological Studies

Development of Green Public Procurement Criteria for Hydronic Central Heating Generators

2nd Technical Background Report

Working Document

for the 2st AHWG Meeting on GPP

TIME: 17th January 2012 9:30-18:00
PLACE: European Commission
Brussels

Elena Rodriguez Vieitez, Oliver Wolf

DG JRC (IPTS) 2011

Table of contents

Abbreviations

AHWG	– Ad-Hoc Working Group
BAT	– Best Available Techniques
BED	– Boiler Efficiency Directive
BREF	– Reference Document on Best Available Techniques
CE	– Conformité Européene – European Conformity
CEN TC	– European Committee for Standardization Technical Committee
CHP	– Combined Heat and Power
CEN TC	– European Committee for Standardization Technical Committee
CLP	– Classification, Labelling and Packaging of substances and mixtures
CO	– Carbon Monoxide
CO_2	– Carbon Dioxide
dB(A)	– A-weighted decibel (sound pressure level)
EPA	– United States Environmental Protection Agency
EPBD	– Energy Performance of Buildings Directive
ErP	– Energy-related Product
EuP	– Energy-using Product
etas, η_s	– Seasonal space heating energy efficiency
etason	– Seasonal space heating energy efficiency in on-mode
GHG	– Greenhouse Gas (emissions)
GPP	– Green Public Procurement
GWP_{100}	– Global Warming Potential (effect estimated over 100 years)
HC	– Hydrocarbons
"Heating generator"	– Hydronic central heating generator
ISO	– International Standardisation Organisation
kWh	– Kilowatt-hour
LCA	– Life-cycle assessment
MS	– Member State
NO_x	– Nitrogen Oxides (often measured as NO_2 – nitrogen dioxide)
PAH	– Polycyclic Aromatic Hydrocarbons
PBB	– Polybrominated biphenyls
PBDE	– Polybrominated diphenyl ethers
PM	– Particulate Matter
POP	– Persistent Organic Pollutants
RoHS	– Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Directive
SEDBUK	– Seasonal Efficiency of Domestic Boilers in the UK
SO_x	– Sulphur Dioxides
TEWI	– Total Equivalent Warming Impact
TWh	– Terawatt hours = 10^9 kWh
VOC	– Volatile organic compounds
WEEE	– Waste Electrical and Electronic Equipment

Introduction

This document serves as an input to discussing Green Public Procurement criteria for hydronic central heating generators at the 2nd Ad Hoc Working Group meeting on 17th January, 2011.

Green Public Procurement (GPP) is defined in the Commission Communication "Public procurement for a better environment"[1] as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured." This is a voluntary instrument, which public authorities can use to provide industry with incentives for developing and marketing more environmentally sound products[2].

The primary goals of establishing GPP criteria for **hydronic central heating generators** (also referred to as "**heating generators"** in this document) are to **increase the energy efficiency** during operation and to **reduce greenhouse gas emissions**, as the **use-phase** has been identified to contribute the most to the environmental impacts caused by this product group. In addition to energy efficiency and greenhouse gas emissions, other environmental impact parameters and environmental improvement potentials are taken into account when developing the criteria, such as: lower air emissions related to energy production and consumption, lower resource consumption, potentially higher resource efficiency management (with respect to the issue of recycling and recyclability), etc. Finally, the products covered by the GPP criteria should also bring public customers direct cost savings when evaluated using a life-cycle cost perspective (e.g. lower overall costs due to lower energy bills).

The document consists of the following chapters. Chapter 1 briefly presents the project background and motivation for this study. Chapter 2 introduces and discusses the product definition and scope, and a summary of the overall comments from stakeholders to date. Chapter 3 presents the proposed GPP criteria, which will be the focus of the discussion at the 2nd Meeting of the Ad Hoc Working Group on the 17th of January, 2012, followed by a summary of the proposed criteria in Chapter 4. Chapter 5 contains units and conversion factors. A summary of the technical analysis in support of the abovementioned proposed GPP criteria is presented in an Appendix (Chapter 6). The corresponding technical background report is available at the project's website[3]. This technical analysis is based on a life-cycle analysis of different heating technologies. The technical background report includes a summary of the life-cycle analysis methodology and results, a discussion on toxic and/or hazardous substances, and a discussion on environmental improvement potential that the Ecolabel/GPP criteria for this product group may bring with respect to the heating technologies currently existing and used in the market today.

1. PROJECT BACKGROUND

The European Commission's Directorate General for the Environment has initiated a project directed towards developing a joint evidence base for the EU policy making in the area of hydronic central heating generators. This study is being carried out by the Joint Research Centre Institute for Prospective Technological Studies (JRC-IPTS) and VHK consultancy, in cooperation with all the interested parties.

---

[1] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Public procurement for a better environment, COM (2008) 400, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0400:FIN:EN:PDF
[2] GPP website http://ec.europa.eu/environment/gpp/what_en.htm
[3] "Development of European Ecolabel and Green Public Procurement Criteria for Hydronic Central Heating Generators. Draft Report. Policy Analysis", Nov. 2011, Van Holsteijn en Kemna BV (VHK), http://susproc.jrc.ec.europa.eu/heating/stakeholders.html

The purpose of this pilot project is to develop the EU Ecolabel and Green Public Procurement criteria for **hydronic central heating generators**.

The preliminary results of the study are available at the project's website (http://susproc.jrc.ec.europa.eu/heating/) and the proposals for the future GPP criteria, which can be feasible for the product group under study, are presented in the current working document. This document has been prepared as a basis for discussion of the criteria proposal during the 2nd Ad-Hoc Working Group meeting for GPP. The main goal of this meeting is focused on discussing the GPP criteria development for hydronic central heating generators. It is intended to present the aspects related to life cycle of heating generators which could be considered for the criteria development and to discuss the potential criteria with the stakeholders.

The preliminary results of the study show that the main environmental aspects associated to heating generators are related to their use phase i.e. the consumption of energy and associated greenhouse gas emissions during operation.

It is in general recognised that the energy efficiency of different heating technologies depends not only on the technical characteristics of the main unit, but also on how the heating generator is installed, in which type of building, and in which climate. This is especially so for heat pumps, where the energy efficiency is critically sensitive to all these issues. The GPP criteria will take these issues into account, and as part of the criteria will provide advice to the consumer and to the installer on how to best install the generators.

Regarding the choice of heating technologies, the public procurer may not always be totally free to select the most environmentally preferable technology in a given situation. For example, the particular building/neighbourhood might have access to district heating only. The GPP criteria here assume in principle that the public procurer has total freedom for choosing heating technology, fuel, etc. The GPP criteria should be seen as a guidebook for green public procurement, but then the specific purchasing situation may provide other constraints to select the appropriate heating generator choices for the specific situation.

While the first working documents referred to "heating systems", it was decided to rename the product group "heating generators", which is considered a better description of the product definition and scope as will be explained in Chapter 2, developed in consistency with Ecodesign Lots 1 and 15, and in consultation with stakeholders.

The Green Public Procurement website at the European Commission[4] contains a number of documents and toolkits that facilitate member states to develop national GPP criteria. Studies commissioned by DG ENV have found that individual member states frequently follow the EU GPP criteria to develop their own national GPP criteria, which helps them minimize costs and duplication of efforts.

A study commissioned by DG ENV on the "Collection of statistical information on GPP in the EU"[5] analysed the uptake of EU GPP in seven member states: Austria, Denmark, Finland, Germany, Netherlands, Sweden and United Kingdom. The study found a high uptake of GPP requirements in these member states, that were similar to the ones developed in EU GPP criteria. These seven countries are also the ones with the most developed national plans on public procurement in the EU. The study also mentions that one of the important objectives of the EU GPP program should be to identify how to account for CO_2 emissions in GPP, and the financial impacts of GPP.

[4] GPP website: http://ec.europa.eu/environment/gpp/what_en.htm
The GPP training toolkit: http://ec.europa.eu/environment/gpp/toolkit_en.htm

[5] "Collection of statistical information on Green Public Procurement in the EU: Report on methodologies", Ecofys, Significant, and PricewaterhouseCoopers (2007)

A review of the existing studies on GPP programs in the EU, including member states public procurement programs, indicates that only a few criteria sets exist for heating generator products[6], despite of the significant environmental impact and improvement potential of this product group. GPP criteria for heating generators are only available for cogeneration units (at the EU level and in the UK). Criteria also exist on electricity and district heating, but these two groups are out of the scope of the heating generators product group. The report showed however that the EU GPP criteria on the first 10 product/service groups (not including heating generators) developed by the Commission were very much used by member states' GPP programs.

1.1 Market considerations

Public authorities are major consumers in Europe, spending about **19% of the EU's gross domestic product**. Therefore, any shift of public spending towards products with lower environmental impacts has the potential to make an important contribution to EU sustainable production and consumption. Green public procurement also has the potential to influence the market by providing industry with incentives for developing more environmentally-friendly technologies and products.

The technical report associated with this study and available at the project website[7] describes a detailed market analysis for heating generators, which is dominated by gas/oil boilers (representing around 90% of the total sales in 2010), followed by heat pumps (6.6%) and biomass boilers (3.3%). The report also includes estimates of future trends in which the EU Ecolabel and GPP criteria influence the current market. A stock model was built to quantify savings on energy consumption and emissions. The "Business-as-usual" scenario is set up as a stock model calculation, which calculates the effects of changes in the stock ("STOCK") through changes in sales and product characteristics of new products entering the stock ("NEW"). The analysis is quantitative because the model calculates for the years 2010-2030[8] the environmental aspects of the stock (energy consumption and environmentally relevant emissions).

1.2 Cost considerations

In the development of Green Public Procurement criteria, one of the most important aspects to take into account is a life-cycle cost analysis of the best environmentally-performing products with respect to average products in the market. Cost considerations (using a life-cycle perspective) are especially important in public procurement because of the need to justify public spending. Member states should be encouraged to make choices that are a good value in the long-term and compatible with wider policies.

Heating generators are one of the products where life-cycle impacts depend the most on the use-phase (mostly use-phase energy consumption). Therefore, purchase costs are only a minimal part of the total life-cycle cost of the products. A number of available studies on cost considerations in GPP[9] have also concluded that higher purchasing prices are usually compensated for by lower operating costs, especially for products with high energy efficiency. A typical example is found e.g. in high-efficient

6 "Assessment and Comparison of National Green and Sustainable Public Procurement Criteria and Underlying Schemes in Ten Countries", AEA, November 2010, http://ec.europa.eu/environment/gpp/studies_en.htm

7 In: "Development of European Ecolabel and Green Public Procurement Criteria for Hydronic Central Heating Generators. Draft Report. Product definition, market analysis and technical analysis " (June 2011), and "Development of European Ecolabel and Green Public Procurement Criteria for Hydronic Central Heating Generators. Draft Report. Policy analysis " (Nov. 2011), http://susproc.jrc.ec.europa.eu/heating/stakeholders.html

8 Preceding years, as of 1990 (or even 1980 for certain products/aspects), are also calculated, but this is mainly done to produce a realistic stock as of 2010.

9 "Costs and Benefits of Green Public Procurement in Europe", Öko-Institut e.V. and ICLEI, 2007

heating installations. During the whole life cycle of the heating installation, the mentioned study found that approximately 95% of the total costs were determined by operating costs. It is therefore concluded that public procurement decisions based only on the purchase price will likely lead to misinvestment.

The technical background report associated with this study[10] presents a detailed life-cycle cost analysis of heating generators, and a summary of key conclusions is presented here.

The total life-cycle costs of the different heating generator options (including purchase, maintenance and running costs) are found to be very susceptible to current energy costs. In particular, some studies[11] have shown that governmental decisions on energy tariffs may render a boiler option from positive economic effects to negative economic effects. Especially electric heat pumps and cogeneration boilers appear sensitive to such effects.

Heat pumps were found to be still relatively expensive boiler options, especially if the necessary works for the complete installation (realisation of heat source system and heat sink / emitter/system) are incorporated.

Specific data on life cycle costs for different heating generators evaluated can be found in Part 3.3 (“Improvement potential”) of the technical background report available at the project website[12]. Table 1 (from the technical report) gives the life-cycle costs at LLCC and BAT levels. It shows savings at LLCC level of up to 16% for the smaller size classes (up to L) and 30-46% for the largest sizes. The savings at BAT level indicate that, apart from the smallest XXS level, the BAT-solutions do not save as much as LLCC-solutions but are still more economical than the base case.

Table 1. Life cycle costs and savings LLCC- and BAT- levels versus base case level.

Size-Class	**BaseCase lifecycle costs**	**LLCC lifecycle costs**	**BAT lifecycle costs**	**LLCC** savings	**LLCC saving in %**	**BAT saving**	**BAT Savings in %**
XXS	€ 9.085	€ 8.716	€ 10.943	€ 369	4%	-€ 1.858	-20%
S	€ 14.172	€ 12.313	€ 13.352	€ 1.859	13%	€ 820	6%
M	€ 18.750	€ 15.797	€ 16.859	€ 2.953	16%	€ 1.891	10%
L	€ 24.119	€ 20.259	€ 21.262	€ 3.860	16%	€ 2.857	12%
XL	€ 57.697	€ 37.851	€ 38.668	€ 19.846	34%	€ 19.029	33%
XXL	€ 108.111	€ 65.623	€ 73.738	€ 42.488	39%	€ 34.373	32%
3XL	€ 272.770	€ 164.057	€ 190.187	€ 107.943	40%	€ 81.813	30%
4XL	€ 904.288	€ 487.237	€ 495.964	€ 417.051	46%	€ 408.324	45%
Calculated with Ecoboiler Integrated model version 5a							

[10] In: "Development of European Ecolabel and Green Public Procurement Criteria for Hydronic Central Heating Generators. Draft Report. Product definition, market analysis and technical analysis " (June 2011), http://susproc.jrc.ec.europa.eu/heating/stakeholders.htm

[11] magazine VV+, March 2010, p.178

[12] In: "Development of European Ecolabel and Green Public Procurement Criteria for Hydronic Central Heating Generators. Draft Report. Product definition, market analysis and technical analysis ", June 2011, http://susproc.jrc.ec.europa.eu/heating/stakeholders.html

The BAT (Best Available Technology) or BNAT (Best Not yet Available Technology) levels are mostly based on heat pump technology sometimes with an add-on benefit from solar installations. Some explanations were added in the study:

- Heat pumps cannot be universally applied. Especially 'geothermal' or 'vertical' ground-source heat pumps require special permissions from the waterworks and/or the commune, etc.
- Specialist installers and special equipment are necessary and (as yet) not abundant.
- The efficiency of the heat pump is highly dependent on the lay-out and installation.
- Often a heat pump is a base-load device, which means that a hybrid device (e.g. with a conventional boiler) may often be an economical solution to capture both base and peak loads.
- The energetic benefits are highly dependent on the climate, especially with air-based heat pumps and of course with solar energy.
- As a result of the above, the pay-back time will vary widely per country and circumstance.

Even larger savings are possible by adding complementing equipment: thermostats with better response can improve the central heating efficiency by optimizing the boiler heat output to the (expected) heat demand, heat pumps using ambient heat and/or solar thermal systems reduce the fossil fuel or electric energy input. The model was extended to incorporate these technologies as well. More detailed cost data can be found in the technical background report.

2. PRODUCT DEFINITION AND SCOPE

A "product group" is defined as a set of products that serve similar purposes and are similar in terms of use, or have similar functional properties, and are similar in terms of consumer perception. This definition is consistent with the life-cycle analysis approach in this study, which compares different technologies where all share a common function: the production of one unit of heat for ambient heating, e.g. 1 kWh of useful heat. The objective of this functional approach to heating generators is to help consumers to make a choice between different kinds of heating technologies that provide heating to a hydronic central distribution system.

A preliminary definition of the product scope is detailed below, mainly based on the product scope of the recent draft **Implementing Measures for the Energy Labelling and Ecodesign of boilers** (May 2011), in line with achieving greater harmonization between different product policy initiatives. These are draft documents that can be found online[13].

The scope of this GPP study is **"water-based central heating generators (or hydronic central heating generators)",** in all relevant combinations, up to a **maximum output power of 400 kW**, a limit proposed in consistency with the Boiler Directive[14] and with Ecodesign Lot 1. **Hydronic central heating generators**, also referred to as **heating generators** in this document, are used to generate heat as part of a hydronic central heating system, where the heated water is distributed by means of circulators and heat emitters in order to reach and maintain the indoor temperature of an enclosed space such as a building, a dwelling, or a room, at a desired level. The operation of the heating generator can be based on a number of processes and technologies, such as:

§ Combustion of gaseous, liquid or solid fossil fuels

§ Combustion of gaseous, liquid or solid biofuels

§ Use of the Joule effect in electric resistance heating elements

[13] http://www.eceee.org/Eco_design/products/boilers/
[14] Boiler Efficiency Directive, 92/42/EEC

- Capture of ambient heat from air, water or ground source, and/or waste heat
- Cogeneration (the simultaneous generation in one process of heat and electricity)
- Solar (auxiliary)
- Hybrid generators: certain combinations of the above

Although it is not explicitly stated in the definitions above, it may be that the circulator is an integral part of the heating generator. For larger heating generators the circulator is usually supplied separately, and therefore the circulator itself will be out of the scope of this criteria development.

Out of the scope are also hydronic central heating generators which can only provide hot water for sanitary use.

Rationale for product scope and definition

From stakeholders' feedback, hydronic central heating generators are considered an appropriate product group because they represent the largest environmental impact within buildings in the EU-27 (and they also represent one of the largest environmental impacts among all kinds of consumer products in the EU-27) not only in terms of energy consumption but also taking into account a number of environmental impact parameters, including greenhouse gas emissions, and other air emissions. In particular, "central hydronic heating generators" account for > 80% of the environmental impact of all types of heating generators in buildings in the EU (which include central and room heating generators, and both hydronic and air-based heating generators).

From previous workshops of the AHWG it was agreed to apply a common benchmark approach in order to make different heating technologies comparable. This approach received the support from the majority of stakeholders. There was also support to develop GPP in consistency with other product policy schemes, especially the EU Ecolabel, but also Ecodesign and other member states' labels.

The proposed scope for GPP reflects also the discussions that took place during the 2nd AHWG workshop on Ecolabel of heating generators. All types of technologies and fuels, except for coal, are in principle acceptable, but the heating generators will need to meet common energy efficiency and greenhouse gas emissions benchmarks. As an example, the scope includes liquid fuel boilers, including both fossil oil and bio-oil. However, it will be highly unlikely that a boiler fuelled with only fossil oil will meet the required benchmarks. Instead, the liquid fuel will likely need to include at least some percentage of bio-oil in order to meet the criteria.

Following the same arguments as for oil, stakeholders suggested also including biogas fuels as part of the scope. Therefore, the scope will make a reference to "gas fuel boilers" and not to "natural gas boilers". Gas fuel boilers (gas boilers) will include both fossil gas and biogas.

Regarding solid fuel boilers, it was discussed at previous workshops the issue of whether coal should be allowed as part of the scope. Several stakeholders specifically requested to exclude coal entirely. It should be noted that coal has, among fossil fuels, one of the highest emissions of greenhouse gases per kWh useful heat output, above 600 g CO_2 equivalents/kWh heat output for the base case analyzed in the life-cycle analysis in the accompanying technical background study (available at the project's website), compared to ~30-50 g CO_2 equivalents/kWh heat output for biomass boilers. The environmental performance of coal heating generators is therefore much lower than biomass heating generators. Coal is also excluded from the scope of Ecodesign Lot 1, and very few existing ecolabels include coal-fired systems among their scope. Given these arguments and feedback from the Competent Bodies requesting to exclude coal, it is proposed to exclude coal from the scope and to focus instead of developing the criteria for biomass boilers. Although solid fuels boilers (in Ecodesign Lot 15) cover a range of fuel types such as anthracite, log wood, manufactured mineral fuels, biomass e.g. wood chips/pellets and coal, the scope of the GPP specification is limited to **biomass**, such as **wood pellets and wood chips**. This reflects the available ecolabel standards for solid fuel boilers, which focus on those using these types of biomass, for example the Blue Angel and Nordic Swan.

2.1 Description of products included in the scope

The scope of heating generators considered for Ecolabel and GPP criteria development in the current project covers heating generators in domestic, commercial or industrial premises with the primary aim of heating indoor spaces, in order to reach and maintain the indoor temperature of an enclosed space such as a building or a dwelling at a desired level.

Nevertheless, due to the different functions fulfilled by some of the products (e.g. the provision of domestic sanitary water, or ambient cooling in the case of reversible heat pumps), it is proposed to exclude heating generators whose primary aim is to provide domestic sanitary water, also to exclude heat pumps if their primary aim is to provide cooling, and finally to exclude those heat pumps that do not transfer heat to a water medium (i.e. to exclude heat pumps that are not hydronic).

As in Ecodesign Implementing Measures, the scope is suggested for "self-standing" heating generators, without taking into consideration their combination with other parts such as controls[15].

A hydronic central heating generator constitutes a part of a set of several elements, including pipe work, the heating generator itself, radiators, heat exchangers, hot water storage cylinders and insulation. The exact nature of the different elements will depend on the type of distribution of the heating. Heating in any house or building is a key component of the overall building energy efficiency, and the heating generator unit is the main element that will influence the overall environmental impact of the system. The most common devices for achieving the heat distribution are circulators, which pump the hot water to the final emission points.

The product group "hydronic central heating generators", also called "heating generators" shall comprise the following types of heating generator technologies:

§ **Central heating boilers (CH boilers)** are devices designed to provide hot water mainly for ambient heating, with a variety of energy sources (natural gas, oil, biomass, electricity, etc.), and different technologies such as condensing or non-condensing technologies. Condensing boilers recover the latent heat of evaporation contained in the water vapor of flue gases, and are significantly more energy efficient. Only boilers whose only or primary function is to provide ambient heating are part of the scope. If they provide sanitary hot water as a secondary function, they are called central heating combi-boilers (CH combis) and they are also part of the scope.

§ **Heat pumps** are used to extract heat from a variety of sources: ground rock, ground water, surface water, air, etc. They also have a large variety of applications. Heat pumps can be used to heat water as hydronic central heating generators, typically providing heat delivery by under-floor heating.

§ **Combined heat and power (CHP),** or **cogeneration units** are based on the "simultaneous generation of thermal energy and electricity and/or mechanical energy". The heat distribution takes place by the direct use of exhaust gases, steam or hot water. Micro-CHP units are defined as those with < 50 kWe capacity, and small-scale CHP as those with < 1 MWe capacity. CHP units may be powered by a variety of energy sources.

§ **Solar thermal assisted technologies** are also used as part of the solution, but in combination with other heating technologies.

[15] Draft implementing measures on ecodesign and energy labelling for boilers of March 2011

Typical sources of energy depend on the specific heating technology, but may include electricity, solar thermal, heat transfer from ground, water, or air by heat pump technology, liquid fuels, natural gas, biogas, wood, biomass, etc., and combinations of energy sources. Solar thermal heating appears to be on the increase for ambient heating and hot water provision in buildings.

This study analyzes the feasibility of developing a common benchmark to horizontally address and compare different hydronic central heating technologies as one single product group. The product group "hydronic central heating generators" represents a very large group. As presented in Table 7 of the Draft Task 1 Report on the "Development of EU Ecolabel and GPP Criteria for Heating and Cooling Systems" (IPTS, 2010), the group of hydronic central heating generators accounts for roughly 86% of the total use-phase primary energy consumption by heating generators (central and space heating generators together) in the EU, therefore representing most of the environmental impact of all types of heating generators taken together.

The most cited performance parameter of the boiler is the (nominal) power output in kW[16]. The scope of boilers is set to a maximum of 400 kW consistently with the Boiler Directive[17]. The heating capacity is an essential parameter for correct sizing of boiler to the building load. The heating capacity of boilers should be sufficient to cover the space heating need of a dwelling or building on the coldest day of the year or rather the last decade (as defined in relevant test standards). On the other days the boiler will function in part load.

For that reason, the test standards, discussed in the technical background report for the present study distinguish between heating energy efficiency not only at full load, but also at 30% part-load and —on occasion— in stand-by/zero load. As will be argued in the following chapters, this is still a very crude approximation of what happens in real-life. Various studies have shown that the average load over the heating season is more in the range of 10%. This not only due to the outdoor temperature variations over a heating season, but also due to over-sizing and —for a combi-boiler or boiler heating an indirect cylinder— due to sizing of the boiler primarily for the water heating function. Furthermore, the fixed low return (or average) boiler water temperatures for part-load operation, which are a very important parameter for flue gas energy losses and latent heat recovery, are rarely achieved in real-life. Therefore, many boiler tests describe part load tests.

A summary of scope of the product group is presented in Table 2.

A first assessment of Prodcom sales data (more detailed analysis presented in the technical background report) showed an annual production of 6.9 million boilers in 2009. Considering the limited value of import and export (respectively some 230 and 807 million euro) it can be concluded that most of the EU production is meant for the EU market.

Lot 1 study estimated in 2010 boiler sales of around 6.9 million units, a boiler stock of approximately 110.9 million boilers and an annual primary energy consumption of 10.5 PJ. The CO_2 emissions were estimated to be some 600 Mton, and SOx emissions are some 700 kton. The screening analysis shows that central heating boilers are among the product groups with the highest energy-consumption in Europe. Development of environmental policies, like EU Ecolabel or Green Public Procurement criteria, appears feasible, also given the current proposals for Ecodesign requirements for 'boilers' and Energy labeling of 'boilers'.

[16] The **maximum nominal power output** refers to the energy output expressed as kW thermal energy at nominal conditions. Nominal conditions are standardised test conditions (also known as standard rating conditions) for certain set system parameters (flow rate of medium, etc.). Nominal power output is not the same as nominal power input, because the boiler introduces generator losses (except for heat pumps, where the nominal power input in electric kW is lower than the power output in kW of heat, since the renewable energy input is not counted). However, for smaller boilers (e.g. <50 kW) the nominal rating often refers to OUTPUT power.

[17] Boiler Efficiency Directive, 92/42/EEC

Table 2. Summary of scope of product group.

Component of heating system	Fuel	Nominal power output	Working principle
- Gas/liquid boiler	Gas (natural, propane, biogas) or liquid (oil, bio-oil)	4-400 kW	Combustion
- Biomass boiler	Biomass (logs or pellets)	4-400 kW	Combustion
- Heat pump boiler	Electricity	4-50 kW (indicatively)	Electric compressor, driving a vapour cycle
	Gas (possibly in combination with waste heat and/or solar heat)		Gas driven engine, driving a compressor for a vapour compression cycle
			Gas-fired combustion, driving a sorption process
- CHP or cogeneration boiler	Gas (natural, propane, biogas) or liquid (fossil oil, bio-oil)	4-400 kW	Micro: external combustion (Stirling engine)
			Mini: internal combustion (piston engine driving a generator)
			Other: fuel cells, based on electrochemical principles
Solar thermal	Solar energy in combination with electric energy for pumps/controls (needs other heat generator to fulfil heating demands in all circumstances)	Not applicable (sized depends on location, budget and application)	Capturing and storage of solar irradiation

3. GREEN PUBLIC PROCUREMENT CRITERIA

The Communication on Green Public Procurement states that the GPP criteria shall be determined on a scientific basis considering the whole life cycle of products. In the frame of the project a number of base cases have been defined and a preliminary environmental evaluation of various stages of the product life has been completed, as described in the technical background document available on the project's website[18]. Within data uncertainties and methodological limitations, the analysis allowed for identifying the main issues contributing to the environmental impacts.

Based on the life-cycle analysis conducted in the frame of the study and on the analysis of the European and non-European labelling schemes, the key issues to be considered in the process of EU Ecolabel and GPP criteria development are proposed and presented in the following chapter, and outlined below:

[18] http://susproc.jrc.ec.europa.eu/heating/stakeholders.html

1. **Energy efficiency:** Energy efficiency will be tested and evaluated in terms of the "seasonal space heating energy efficiency" (such as in Energy Label and Ecodesign Implementing Measures), and the rated capacity depending on the climate zone, for all types of heating generators except for biomass boilers[19]. These magnitudes were developed during the Ecodesign Lot 1 preparatory study after several rounds of consultation with the expert group. Expert feedback strongly suggested that the energy efficiency criterion should strictly follow Ecodesign Lot 1.
2. **Greenhouse gas emissions:** The calculation of greenhouse gas emissions (GHG) is mainly based on CO_2 emissions, together with refrigerant leakage (if applicable). The effect of refrigerant leakage depends on the assumption of leakage rate, and on the global warming potential (GWP) of the refrigerant substance. The overall calculation of GHG emissions is expressed in grams CO_2 equivalent per kWh of heat output produced.
3. **Refrigerant:** Criteria on refrigerants used in heat pumps are needed because some refrigerants have environmental impacts related to ozone depletion and climate change due to possible leakage of refrigerant, mainly during use-phase or end-of-life.
4. **Other air emissions:** Air emissions of different substances have impacts on environment (example acidification), and on health (indoor air quality). Indicators evaluated in the life-cycle analysis include: NOx and SOx emissions (acidification potential), volatile organic compounds (VOC), persistent organic pollutants (POP), heavy metals (HM) in air, polycyclic aromatic hydrocarbons (PAH), particulate matter (PM), organic carbon (OGC), and carbon monoxide (CO). Some of these indicators are grouped in a few air emission parameters that are usually part of Ecolabel criteria for heating generators.
5. **Sound power level:** Sound power level (or noise) is an issue mainly identified in heat pumps and cogeneration units. Because of some different opinions and methodologies for testing, and scarcity of data, a quantitative measure for sound power level is not always possible.
6. **Preventing the use of hazardous substances and mixtures[20]**. The composition of materials should not contain hazardous substances (hazardous substances can be released during different life cycle phases of the product). The criterion is developed on the basis of Ecolabel Regulation 66/2010, Articles 6(6) and 6(7). We might need to further investigate possible substances derogations based on Article 6(7).
7. **Product design for sustainability:** This criterion is related to the promotion of reuse, recycling, and generally a sound end-of-life management, and it can be measured using parameters such as: design for recycling, design for repair/warranty and spare parts, etc.
8. **Installation, user information, and information appearing on the ecolabel:** This criterion includes consumer information/user instructions for installation, operation and end-of-life management, and the information appearing on the Ecolabel indicating the main environmental benefits of using the purchased product.

After discussion at the 1st and 2nd AHWG workshops for Ecolabel and from the feedback received, it was proposed to group the criteria areas into two blocks, which are:

Common benchmark criteria:

1. Minimum energy efficiency
2. Greenhouse gas emissions limit

[19] Which follow international standard EN 303-5

[20] Annex I of the Ecolabel Regulation (No. 66/2010) specifically requires the "analysis of the possibilities of substitution of hazardous substances by safer substances, as such or via the use of alternative materials or designs, wherever technically feasible, in particular with regard to substances of very high concern as referred to in Article 57 of Regulation (EC) No 1907/2006".

Additional criteria:

3. Refrigerant and secondary refrigerant
4. Nitrogen oxides (NOx) emissions limit
5. Organic carbon (OGC) emissions limit
6. Carbon monoxide (CO) emissions limit
7. Particulate matter (PM) emissions limit
8. Sound power level
9. Hazardous substances and mixtures
10. Substances listed in accordance with Article 59(1) of Regulation (EC) 1907/2006
11. Plastic parts
12. Product design for sustainability
13. Installation and user information

Table 3. Applicability of the different criteria to each of the heating generator technologies

Heating generator technology / Criteria	Gas or liquid fuel boiler	Biomass boiler	Gas-driven hydronic heat pump	Electrically-driven hydronic heat pump	Cogeneration
1- Minimum energy efficiency	X	X	X	X	X
2 – Greenhouse gas emissions	X	X	X	X	X
3 – Refrigerant and secondary refrigerant			X	X	
4 – Nitrogen oxides (NOx) emissions limit	X	X	X		X
5 – Organic carbon (OGC) emissions limit		X			
6 – Carbon monoxide (CO) emissions limit	X	X	X		X
7 – Particulate matter (PM) emissions limit		X			X
8 – Noise	X	X	X	X	X
9 – Hazardous substances and materials	X	X	X	X	X
10 – Substances listed in accordance with Article 59(1) of Regulation (EC) 1907/2006	X	X	X	X	X
11- Plastic parts	X	X	X	X	X
12- Product design for sustainability	X	X	X	X	X
13 – Installation and user information	X	X	X	X	X

Table 3 above shall be used to identify the criteria that are applicable to each of the heating generator technologies within the scope of this product group. In the case of a hybrid heating generator product, it shall comply with all the criteria areas applicable to each of the heating technologies of which it is comprised.

Criteria on the refrigerant and secondary refrigerant are needed in order to address environmental impacts (emissions of climate-change and ozone-layer depletion substances to the atmosphere, and emissions of toxic substances from the secondary refrigerant to the underground).

Depending on the fuel used the following air emissions can be potentially released by heating generators: carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxides (SO_x), volatile hydrocarbons (HC), methane (CH_4), volatile organic compounds (VOCs), and particulate matter (PM). Volatile hydrocarbons and VOCs are typically measured as total organic carbon (OGC). These air emissions have been modelled in the associated technical report, for 12 base cases. In particular, the technical background report includes estimates of air emissions of persistent organic pollutants (POP), heavy metals (HM) in air (expressed in mg Ni), polycyclic aromatic hydrocarbons (PAH), particulate matter (PM, example PM10, PM2.5) also called soot values, total carbon and organic carbon (OGC), carbon monoxide (CO), and volatile hydrocarbons (HC).

The quantity and environmental impacts of these air emissions will vary depending on the fuel used, the heating generator technology, and the use of any appropriate abatement measures. For example, emissions of nitrogen oxides (NO_x) and sulphur dioxides (SO_x) from heating generators can contribute towards acidification, in particular of sensitive ecosystems through acid rain or dry deposition. The main environmental and health impacts of each of the air emissions will be described in detailed in the criteria on air emissions (Criteria 4 through 7).

The results of the environmental impact analysis are disaggregated by impact categories, and do not provide an evaluation on what environmental impacts are more or less serious. So for example, if GHG emissions are considered a priority, then biomass boilers will be more desirable than fossil fuel boilers. However, if other air pollution indicators are considered important, then biomass combustion is not as "clean" as good gas or oil combustion, as will be explained below. Certain local and national policies limit therefore the emissions allowed for biomass boilers.

The life cycle analysis offers support to conclude that air emissions are very different depending on the heating technology. Therefore it is necessary to set specific technology-dependent limits for each of the air emissions that are relevant for each of the heating technologies. The following main conclusions from the technical analysis are relevant to the criteria on air emissions:

- Acidification - Here the NOx and SOx emissions by biomass boilers and EU electricity production appear most significant, while the cogeneration units achieve a net reduction of acidifying emissions.
- VOC - The manual stocked wood log boiler performs the worst regarding the emissions of VOCs, this relates to both combustion efficiency and type of fuel.
- POP - Here the automatic stocked pellet boiler performs the worst, which is mainly due to the type of fuel (pellets).
- Heavy metals (to air) - Again it is the pellet boiler that performs the worst, but here the electric heat pump has significant emissions as well.
- PAH - The biomass boilers emit the most PAHs but the differences in the group are less apparent than in other impact categories
- PM - As regards particle emissions the biomass boilers perform the worst, especially in the case of manual stocked wood log boiler.

The common benchmark approach will be composed of two parameters, energy efficiency and greenhouse gas (GHG) emissions. A specific limit value will be fixed for each of the two common-benchmark parameters, independent of heating generator technology, and any product applying for the heating generator Ecolabel shall meet both these two limits.

1. A minimum value of **energy efficiency** will be set so as to include the wood boiler (the least efficient of all biomass boilers). A minimum limit of **90%** energy efficiency is proposed. A lower value of 80% was proposed during the 1st AHWG meeting, but it was considered too low by the majority of stakeholders.
2. The maximum on **greenhouse gas (GHG) emissions** will be set so at to include only the best condensing natural gas boilers. Two options are proposed. In Option 1, a maximum limit of 220 g CO_2 equiv./kWh useful heat, as a seasonal mean value, is proposed. In Option 2, two limits are given, 180 and 220 g CO_2 equiv./kWh useful heat, in order to accommodate some of the different heating technologies and market considerations.

The following criteria are proposed for the Green Public Procurement for heating generators. The criteria are classified as core, comprehensive and award.

Different environmental areas are addressed i.e. energy efficiency, greenhouse gas emissions, other air emissions, etc. The common benchmark criteria (minimum energy efficiency and maximum GHG emissions limit) are considered, from an LCA point of view, the key environmental impact parameters, and therefore are include as both core and comprehensive. An overview of all the proposed GPP criteria is presented in Table 4.

The list in Table 4 covers criteria which were developed based on current GPP criteria and others which are based on the EU Ecolabel criteria proposal heating generators as well as on other ecolabel and GPP criteria from member states. In this chapter we will present, for each criteria area, proposed parameters, specific limit values and testing methods. The rationale for the development of the parameters and values was based on the presented life-cycle environmental assessment performed, and information from other existing ecolabels and GPP criteria in different individual member states, or European Commission GPP criteria when available.

Stakeholders should feel free to comment on every issue that they consider relevant and send us their remarks and further proposals for consideration before the 2nd AHWG for GPP criteria development on the 17th of January 2012. Stakeholders are also welcome to submit written comments after the 2st AHWG meeting regarding the criteria areas and specific limit values.

In general, “award criteria” can be used for two purposes: in the first place when a purchaser is not sure that the market will be able to supply products or services that comply with all requirements, and in the second place when a purchaser wants to stimulate the suppliers to come forward with offers that are richer in functionality or promise a better performance. If used in that way, award criteria can be regarded as a method of stimulating innovation.

Table 4. Overview of Green Public Procurement criteria for heating generators.

	Criterion	Criterion type			Key area and aspect addressed
		Core	Comprehensive	Award	
1	Minimum energy efficiency	X	X		Energy efficiency
2	Maximum greenhouse gas emissions (GHG) limit	X	X		Climate change contribution due to type of fuel used and also dependent on energy efficiency
3	Refrigerant and secondary refrigerant	X	X		Environmental (e.g. climate change) and health (subsurface water quality) risks
4	Nitrogen oxides (NOx) emissions limit	X	X		Environmental and health risks (e.g. acidification); air quality
5	Organic carbon (OGC) emissions limit	X	X		Environmental and health risks; air quality
6	Carbon monoxide (CO) emissions limit	X	X		Environmental and health risks; air quality
7	Particulate matter (PM) emissions limit	X	X		Environmental and health risks; air quality
8	Noise			X	Health and quality of life
9	Hazardous substances and mixtures		X		Environmental and health risks
10	Substances listed in accordance with Article 59(1) of Regulation (EC) 1907/2006		X		Environmental and health risks
11	Plastic parts			X	Environmental and health risks
12	Product design for sustainability			X	Resource efficiency; facilitate recycling; sound end-of-life management
13	Installation and user information	X	X		Needed for best environmental performance of product (energy efficiency, GHG emissions, etc.), environmental information and awareness

3.1 Criterion 1 – Minimum energy efficiency

3.1.1 Formulation as core and comprehensive criterion

The energy efficiency of the hydronic central heating generator shall at a minimum be 90%.

Type of heating generator	**Minimum energy efficiency**
All types of hydronic central heating generators, regardless of technology.	90%

It is proposed by the IPTS that, for all types of heating generators – except for biomass boilers – the unit for measuring energy efficiency shall follow the definition of **"seasonal space heating efficiency" (η_s, or "etas")**, as developed in the Ecodesign Implementing Measures for boilers and described in Annex II of the accompanying technical background report[21]. The energy efficiency for biomass boilers shall be measured following the international standard EN 303-5.

The "seasonal space heating efficiency" is generally defined as the ratio between the space heating demand pertaining to a designated heating season provided by a boiler, and the annual energy consumption required for its generation, expressed as percentage. According to the methodology developed in Ecodesign Lot 1, the seasonal space heating efficiency, "etas", shall be calculated as the seasonal steady-state space heating efficiency, corrected by contributions accounting for turndown ratio, temperature control, auxiliary electricity consumption, standby heat loss, ignition flame energy consumption, and in addition for cogeneration boilers the seasonal electric efficiency.

For heat pumps, the seasonal space heating efficiency (etas) is obtained through the seasonal coefficient of performace (SCOP) (and corrected by the primary energy factor 2.5 in order to convert to "etas"), and following the methodology developed in Ecodesign Lot 1 and described in the Draft Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for boilers, available online[22].

3.1.2 Verification

The following verification is proposed for this criterion:

Products holding a relevant Type 1 Ecolabel or that demonstrate compliance with relevant Type 1 Ecolabel criteria will be deemed to comply. Other appropriate means of proof will also be accepted.

If following the EU Ecolabel for heating generators, the verification is as follows:

[21] See Annex II: Working documents Ecodesign/Energy Labelling. In: "Development of European Ecolabel and Green Public Procurement Criteria for Hydronic Central Heating Generators. Draft Report. **Policy Analysis**", Nov. 2011, http://susproc.jrc.ec.europa.eu/heating/stakeholders.html

[22] Draft Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for boilers, http://www.eceee.org/Eco_design/products/boilers/WD_ecodesign_March_2011

The applicant shall declare the product's compliance with the energy efficiency requirement and specify the minimum energy efficiency of at least 90% of the product submitted for labelling procedure together with the testing procedure indicated in respective EN standards for the given kind of product (see Table 5). For all types of heating generators – except for biomass boilers - the testing shall be conducted following the methodology of seasonal space heating efficiency of Ecodesign Lot 1 and the corresponding testing standard. For example, gas/oil boilers are tested at two loads, 100% and 30%; air-source heat pumps are tested at 6-8 points, and water- or brine-source heat pumps at 4-5 points (see technical background document).

A mean value of three energy efficiency measurements shall not exceed the respective minimum efficiency established by this criterion, irrespective of heating generator technology. The testing shall be performed by laboratories that meet the general requirements of EN ISO 17025 or equivalent.

A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

Table 5. EN standards for energy efficiency relevant for the product group "hydronic central heating generators".

Number	Title
Gas boilers	
FprEN 15502-1: July 2010	Gas-fired heating boilers – Part 1: General requirements and tests (CEN)
Biomass boilers	
EN 303-5	Heating boilers - Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300 kW - Terminology, requirements, testing and marking
Gas-driven heat pumps	
prEN 12309 – 2: 2000	Gas-fired absorption and adsorption air-conditioning and/or heat pump appliances with a net heat input not exceeding 70 kW
Electrically-driven heat pumps	
prEN 14825: June 2010	Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling – Testing and rating at part load conditions and calculation of seasonal performance.
EN 14511: 2007	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling.
Cogeneration	
prEN 50465: 2010 Draft ed. 2.	Gas appliances – Combined Heat and Power appliance of nominal heat input inferior or equal to 70 kW (CEN)

Note: The efficiency of heat pumps was traditionally tested using EN 14511. For testing at different loads and to obtain the SCOP and seasonal space heating efficiency, prEN 14825 is used. The testing method proposed, prEN 14825: June 2010 has been already revised; the most updated standard will be used in the final GPP criteria document.

3.1.3 Rationale

Rationale for the criterion, and for setting the specific limit value of 90%

The technical analysis conducted in the frame of this study, together with a review of other product policy initiatives showed that one of the most important parameters with the highest associated environmental benefits is improvements in energy efficiency. Improvements in energy efficiency will result in significant resource saving (reduced primary resource depletion due to energy production), decreased greenhouse gas and other pollutant emissions related to energy generation and use, as well as economic benefits for the users reducing their energy bills and thus lower life cycle costs. Given the importance of this criterion, it is proposed to be used both as core and comprehensive criterion for GPP.

All the reviewed ecolabels and GPP criteria include as primary criteria area the energy efficiency criterion (e.g. Nordic Swan and Blauer Engel). Improvements in energy efficiency result in raw material savings, reduced emissions for the fuel life cycle from exploration, extraction, refining, processing, transportation and storage, and a reduction in direct emissions of CO_2 from the combustion of the fuel.

From the technical analysis conducted in this study, some conclusions regarding energy efficiency were reached:

- Biomass boilers, and especially the small automatic biomass boilers, have the lowest nominal efficiency.
- Regarding the electricity component of the primary energy used, the highest electricity consumption was obtained for the electrically-driven heat pumps (as was expected). The electricity consumption was negative (meaning net electricity production) for the cogeneration boiler.

For all types of heating generators, except for biomass boilers, the efficiency in this study is based on the "seasonal space heating efficiency" as defined in the Ecodesign Implementing Measures for boilers, and it is expressed in terms of the gross calorific value, as decided by the Commission in consultation with stakeholders during the Lot 1 study on boilers[23]. Seasonal efficiency provides a weighted average of boiler efficiencies at different loads e.g. 30% and 100% to take into account the variation in operating loads in response to seasonal and heating demand fluctuations. Feedback from stakeholders has shown strong support for the use of seasonal space heating efficiency as the criterion for energy efficiency.

With the minimum energy efficiency set at 90%, the following is an estimate of the percentage of heating generator products of each type of technology which will be able to meet the criterion:

- For gas boilers, it will be required that they meet the Energy Label Class A (90-98%), representing the top ~22% of the market of gas boilers.
- For biomass boilers there is no energy label. The 90% minimum efficiency required is identical to the requirement to obtain a Blue Angel label. This confirms that the proposed minimum efficiency requirement is a reasonable benchmark to select the best performing biomass boilers. The Blauer Engel label for biomass boilers (wood pellet boilers, RAL-UZ-112) is a successful label with 16 vendors and more than 60 products with licenses.
- For heat pumps, this benchmark will mean that all of them comply and therefore that the Ecolabel criteria should not require measuring efficiency, also saving money in testing. This is consistent with the Blauer Engel heat pump label, which relies only on the TEWI calculation. The current Ecolabel criteria will require the testing and report of the efficiency (etas) of the heat pumps because it is in any case a requirement of Ecodesign implementing measures, and it is needed to calculate the greenhouse gas emissions following the TEWI formula as will be seen in Criterion 2.

[23] It is important to be aware of the means of measuring boiler efficiency when comparing different types of boilers. Efficiency can be based on the net or gross calorific value of the fuel, and will therefore vary depending on the methodology used. Gross calorific value (used in the seasonal space heating efficiency) is the heat released when a certain fuel is burned completely with oxygen at constant pressure and when the products of combustion are returned to ambient temperature, in kWh.

§ For cogeneration, as well as for oil/gas boilers, it will be required that heating generators meet the Energy Label Class A (90-98%), representing ~20% of the market of cogeneration boilers, which is also reasonable.

Stakeholders pointed out that the methodology followed to measure energy efficiency in biomass boilers uses net calorific value (NCV) instead of gross calorific value (GCV) which is used by the seasonal space heating efficiency methodology of Ecodesign Lot 1. Since a methodology to calculate energy efficiency for biomass boilers is not yet available in terms of GCV, it is proposed by the IPTS to allow the efficiency for biomass boilers to be tested using the international standard EN 303-5, that is, in terms of NCV. In addition, the minimum efficiency value set by the Blauer Engel criteria for biomass boilers at 90% is also based on NCV. It should be noted that the limit of 90% in terms of NCV (biomass boilers) would in fact correspond to a lower efficiency, around 79-80% if expressed in GCV. However, this limit corresponds to the best available technologies for biomass boilers, and it is therefore considered appropriate to set it as proposed.

The following figure (Figure 1) provides an estimate of the conversion between energy efficiency based on GCV and NCV. In previous versions of this working document, the benchmark for energy efficiency was set at 90% GCV for all heating technologies. However, a benchmark at 90% GCV would become difficult for biomass boilers: for GCV 90% the NCV efficiency must be 97% (pellet boilers), 100% (solid wood boilers) or ~110% (chips - assumes recovery of latent heat in flue gas). It is therefore suggested that the 90% efficiency limit should be better based on NCV, also because it is better adapted to European test practice, following EN 303-5.

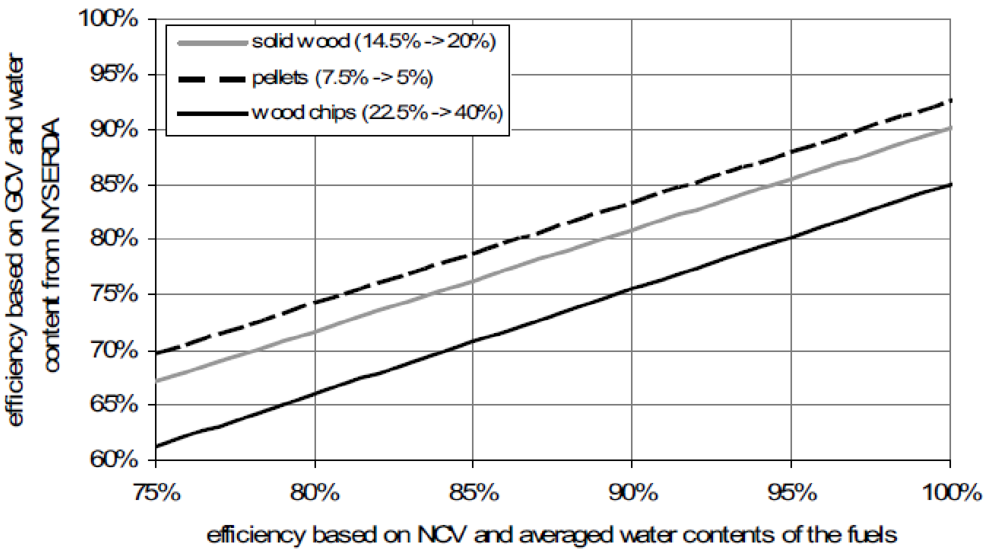

Figure 1. Conversion between energy efficiency based on gross calorific value (GCV) vs. net calorific value (NCV). The conversion ratio is assessed by Nyserda[24].

[24] http://nyserda.ny.gov/en/Page-Sections/Research-and-Development/Energy-Resources/Biomass-Research/~/media/Files/EIBD/Research/Environmental/10-01_european_wood_heating_technology_survey.pdf

Additional feedback received from stakeholders is as follows:
The great majority of responses regarding energy efficiency concluded that a lot of effort has already been devoted to the development of the seasonal space heating efficiency in Ecodesign and Energy Label and there is wide agreement from stakeholders that this concept should be directly used by the Ecolabel, as it is considered very good and arrived at after extensive consultation. The seasonal approach is also already used in the EU Ecolabel of heat pumps. However, it was also mentioned that Ecodesign Lot 1 methodology is not complete yet. Some stakeholders expressed that, since the energy efficiency methodology is not completed, it is not possible to discuss where to specifically set the threshold for the energy efficiency parameter for the EU Ecolabel for hydronic central heating generators. The JRC-IPTS responded that the current Ecolabel criteria development cannot wait for a final decision of Ecodesign; we need to continue with our work and develop a proposal now for the EU Ecolabel using the best available formula for energy efficiency from the Draft Implementing Measure of Ecodesign Lot 1, and from the EN 303-5 standard for biomass boilers. An updated formula could be considered in future revisions of the EU Ecolabel criteria.

Some existing labels include additional parameters related to energy efficiency of a heating generator, in particular criteria for maximum heat radiation losses via the surface of the boiler, and maximum auxiliary power demand. It is to be noted that both effects are included within the seasonal space heating efficiency ("etas" or η_s) calculation developed in Ecodesign Lot 1 in consultation with stakeholders. Since the energy efficiency criterion in the current Ecolabel is based on the "etas", then those two effects are already taken into account, and no separate criterion is required, which leads to more simplified Ecolabel criteria.

Table 6a. Comparison of energy efficiency of different product policy schemes

Heating generator technology	Ecodesign implementing measures	Energy label
Gas boiler	4-15 kW rated input, 75% 15-70 kW rated input, 86% 70-400 kW rated input: § 88% (at full rated input) § 96% (at 30% rated input)	> 130% (A+++) 114-130% (A++) 98-114% (A+) 90-98% (A)
Biomass boiler	N/A	N/A
Hydronic heat pumps	Heat pump* with GWP > 150, 86% Heat pump* with GWP < 150, 73% Low-T heat pump with GWP > 150, 111% Low-T heat pump with GWP < 150, 94%	> 155% (A+++) 139-155% (A++) 123-139% (A+) 115-123% (A)
Cogeneration	86% (15-70 kW input)	> 130% (A+++) 114-130% (A++) 98-114% (A+) 90-98% (A)

*With exception of low temperature heat pumps.
N/A means that there are no Ecodesign or Energy Label criteria for that particular type of heating generator.

Table 6b. Comparison of energy efficiency of different product policy schemes

<table>
<tr><td>Heating generator technology</td><td>EU Ecolabel</td><td>Blauer Engel</td><td>Nordic Ecolabel</td><td>Austrian Ecolabel</td><td>GPP</td></tr>
<tr><td>Gas boiler</td><td>N/A</td><td>100-104%
(70 kW)</td><td>N/A</td><td>N/A</td><td>101% (C, 70 kW)
88% (C, 120 kW)</td></tr>
<tr><td>Biomass boiler</td><td>N/A</td><td>≤12 kW
90% (full load)
89% (30% load)

>12 kW
90%</td><td>83-85%
(50 kW)

88-90%
(300 kW)</td><td>Manual:
$71.3 + 7.7 \log Q_N$
84% (50 kW)
90% (300 kW)

Automatic:
90%</td><td>83-85% (50 kW)
88-90% (300 kW)</td></tr>
<tr><td>Gas-driven hydronic heat pump</td><td rowspan="2">124%
(air/water)

172%
(brine/water)

204%
(water/water)</td><td>Gas: 120%</td><td rowspan="2">80%
(if refrigerant not HFC)

90% (if refrigerant HFC, GWP < 1000)

92% (if refrigerant HFC, GWP < 2000)</td><td>N/A</td><td rowspan="2">124% (air/water)

172% (brine/water)

204%
(water/water)</td></tr>
<tr><td>Electrically -driven hydronic heat pump</td><td>No min. efficiency required</td><td>N/A</td></tr>
<tr><td>Cogeneration</td><td>N/A</td><td>87-89% (gas)
83-85% (liquid)</td><td>N/A</td><td>N/A</td><td>75-80%</td></tr>
</table>

Footnotes to Tables 6a and 6b:

§ About the biomass boilers (Blauer Engel), the criteria in this table correspond to the most updated version (available in German) from 2011, **UZ-112-2011**

§ Q_N is the nominal heat output

§ η_K is the efficiency at nominal heat output

§ C means condensing, non-C means non-condensing

Additional feedback reflected that most heating products have models which could be potentially labelled. There is a risk to put some products out of the market with the common energy efficiency benchmark. As the common benchmark for energy efficiency is drafted, the energy efficiency limit will be almost meaningless for heat pumps because they are all very efficient. While this statement is correct, we should point out that by adding the greenhouse gas emission limit, only the most efficient heat pumps will be able to meet the overall common benchmark criteria.

Some stakeholders offered sceptic views on the proposal to establish a common benchmark criterion for energy efficiency. In this view, efficiency should be technology-specific in order to separate better products from worse ones, within a given technology. The argumentation for this position is based on the opinion that a consumer chooses first a given technology/fuel, and afterward picks the brands or models for that pre-selected technology/fuel. Thus in this view, the Ecolabel should be developed technology by technology, to offer information about the best performing products within a given technology.

Other stakeholders expressed that energy efficiency largely depends on the type of fuel. For example, biomass contains water, and this lowers the caloric value when combusted, when compared to fossil fuels. So, a fossil-fuelled boiler is always more efficient than a biomass boiler.

According to other stakeholders, energy efficiency should not be part of the criteria, and the common benchmark approach should be done based only on greenhouse gas emissions. It should be noted that this approach has been found in the Blauer Engel criteria for heat pumps, where the greenhouse gas emissions are calculated using the TEWI approach (which includes also the effect of the energy efficiency of the heat pump in its mathematical expression).

According to some of the feedback received, the development of the Ecolabel criteria should take into account the mandatory energy label classes of a heating generator product, and use this scale as a "first pass filter" for Ecolabel qualification. This means that a heating generator product would only be allowed to apply for the Ecolabel if the product was in the top one or two classes on the energy label, after which a broader range of environmental criteria would be looked at for Ecolabel qualification. This would ensure that the Ecolabel takes into account mandatory Ecodesign and Energy Label criteria, while at the same time being differentiated by incorporating additional and broader environmental performance parameters.

Some experts doubt that the Ecolabel should include a requirement on the energy efficiency, as there is already an Energy Label. There should not be an overlap between these two schemes. Nevertheless, if energy efficiency needs to be a parameter, it should strictly follow the approach of DG-ENER (Lot 1). As a conclusion, it is proposed by IPTS to include a criterion on energy efficiency requirement, which will be consistent with Ecodesign and Energy Label. Energy efficiency is also needed to calculate the greenhouse gas emissions, as will be seen in Criterion 2.

Finally, some stakeholders expressed that if biomass fuels are used, the contracting authority should ensure that the fuel used conforms to certain quality standards or that it is from an accredited renewable source. In addition, stakeholder feedback expressed that for biomass generators, it is important to require that the fuel meets certain quality criteria to guarantee the best possible combustion performance which will lead to high energy efficiency and low air emissions. In Austria, Germany and Nordic countries there are international standards and even ecolabel criteria for wooden chips, pellets (wood and bark), energy crops and straw (for example, ÖNORM M 7133, ÖNORM M 7135, DIN plus, and EN 12946). Stakeholders are welcome to submit their opinion on whether this requirement should be included in the current Ecolabel development, possibly as a soft criterion (e.g. provision of information to the consumer on the best types of fuels to be used, how to store in the proper conditions for optimum combustion and energy efficiency, etc.).

<u>Rationale for verification</u>

Some ecolabelling schemes require third party testing and a certification process, which covers independent measurements in certified laboratories; while other rely just on the producers' "Declaration of Conformity" with the required criteria (sometimes supported by testing results), and signed and dated by authorised personnel. Both of these approaches have their advantages and disadvantages. Usually, external certification is considered as more reliable, ensuring the high quality of the tests conducted; nevertheless they are more costly, which can constitute a potential barrier for SMEs in applying for a label. Given the importance of the energy efficiency criterion, it is proposed by the IPTS to require third party verification of the energy efficiency criterion.

Questions to stakeholders:

Do you agree with the approach for core and comprehensive criteria and the proposed value of the minimum energy efficiency set at 90%, justified by the reasons given above (related to the market coverage and the estimated environmental improvement potential that such a benchmark will bring, and comparison with other ecolabels, GPP, and product policy schemes)?

Which methods in the stakeholder's opinion can suit best for measuring the energy efficiency of a heating generator?

For biomass boilers, should there be also an additional criterion on quality of the biomass fuel, which is a key factor influencing efficiency? Should it be added as a soft criterion (e.g. information to consumers)?

3.2 Criterion 2 – Greenhouse gas emissions limit

3.2.1 Formulation as core and comprehensive criterion

The applicant shall demonstrate that the greenhouse gas emissions, expressed in grams of CO_2-equivalents per kWh of heating output calculated using the Total Equivalent Warming Impact (TEWI) formulas defined below, shall not exceed the value(s) established in this criterion. Two options are proposed for discussion.

OPTION 1:

Type of heating generator	**Max. greenhouse gas emissions (g CO_2-equivalents per kWh of heating output)**
All types of hydronic central heating generators, regardless of technology, except biomass boilers	220 g CO_2-equivalents per kWh of heating output
Notes: Results from the technical analysis indicate that all biomass boilers emit much lower GHG emissions and therefore a limit is not needed.	

OPTION 2:

Type of heating generator	**Max. greenhouse gas emissions (g CO_2-equivalents per kWh of heating output)**
Gas/liquid fuel boiler and gas-driven hydronic heat pumps	220 g CO_2-equivalents per kWh of heating output
Electrically-driven hydronic heat pump	180 g CO_2-equivalents per kWh of heating output
Cogeneration	220 g CO_2-equivalents per kWh of heating output
Notes: Results from the technical analysis indicate that all biomass boilers emit much lower GHG emissions and therefore a limit is not needed	

The greenhouse gas emissions will be calculated following the TEWI formulas below (different formulations, for gas/oil boilers, electrically-driven heating generators, gas-driven heating generators, cogeneration, and hybrid generators).

Each TEWI formula consists of two parts, one dependent only on the efficiency of the heating generator (expressed in terms of the seasonal space heating efficiency, η_s) and the carbon intensity of the fuel (represented by $\beta_{elec.}$ and β_{gas}, for electricity and natural gas, respectively), and the second part (which has a value different than zero only for heat pumps) dependent on the greenhouse gas emissions due to refrigerant leakage. The GHG emissions from the refrigerant leakage depend on the global warming potential (GWP_{100}) of the refrigerant, and the refrigerant leakage during use-phase (expressed as an annual leakage rate, ER, in % of the total mass of the refrigerant per year) and at end-of-life (expressed as a percentage of the total mass of the refrigerant, α).

The following TEWI formulas, which provide the GHG emissions in CO_2-equiv per kWh of heat output shall be used:

$$\frac{\text{TEWI}}{\text{kWh heat output}}\left(\frac{\text{gCO}_2-\text{equiv.}}{\text{kWh heat output}}\right)=\frac{\beta_{gas}}{\eta_s}$$, for gas boilers

$$\frac{\text{TEWI}}{\text{kWh heat output}}\left(\frac{\text{gCO}_2-\text{equiv.}}{\text{kWh heat output}}\right)=\frac{\beta_{oil}}{\eta_s}$$, for oil boilers

$$\frac{\text{TEWI}}{\text{kWh heat output}}\left(\frac{\text{gCO}_2-\text{equiv.}}{\text{kWh heat output}}\right)=\frac{\beta_{elec}}{2.5\,\eta_s}+\frac{GWP_{100}\times m\,(ER\times n+\alpha)}{P\times h\times n}$$, for electrically-driven heat pumps

$$\frac{\text{TEWI}}{\text{kWh heat output}}\left(\frac{\text{gCO}_2-\text{equiv.}}{\text{kWh heat output}}\right)=\frac{\beta_{gas}}{\eta_s}+\frac{GWP_{100}\times m\,(ER\times n+\alpha)}{P\times h\times n}$$, for gas-driven heat pumps

The parameters in the formulas above are described in the following table:

Parameter	Description of parameter	Units	Constant value or test to be performed in order to obtain the parameter
$\beta_{elec.}$	Carbon emissions of electricity	[g CO_2-equiv./$kWh_{elec.}$]	384
β_{gas}	Carbon emissions of gas	[g CO_2-equiv./kWh_{gas}]	202
η_s	Seasonal space heating efficiency	[-]	To be tested and declared by the applicant (Criterion 1)
GWP_{100}	Global warming potential (effect over 100 years)	[-]	According to Annex I of the F-gas regulation
m	Refrigerant mass	[g]	To be declared by the applicant
ER	Refrigerant loss per year	[%/yr]	A value of ER = 2.5%/yr shall be used.
n	Lifetime	[yr]	A value of n = 15 shall be used.
α	Refrigerant loss at end of life (disposal loss)	[%]	A value of α = 5% shall be used.
P	Design load	[kW]	To be tested and declared by the applicant.
h	Full load operating hours	[h/yr]	2000

Notes:

§ The value of $\beta_{elec.}$ = 384 g CO_2-equiv./ $kWh_{elec.}$ corresponds to the average EU-27 carbon intensity of electricity (corresponding to the period 2010-2020, as used in the MEErP methodology of 2011). The corresponding value used in Ecodesign Lot 1 (MEEuP methodology of 2005) was equal to 458 g CO_2-equiv./ kWh_{elec}

$$\frac{TEWI}{kWh\ heat\ output}\left(\frac{gCO_2 - equiv.}{kWh\ heat\ output}\right) = \frac{\beta_{gas}}{\eta_{thermal}} + \frac{\eta_{cogen} * \beta_{elec}}{2.5\ \eta_{thermal}}$$, <u>for cogeneration units</u>

In the formula for cogeneration units, the η_{cogen} and $\eta_{thermal}$ are obtained as:

$\eta_{thermal}$ = etason - F(1-5)

η_{cogen} = F(6), where F(6) is a negative value

The factors F(1-5) and F(6) are used in the derivation of the seasonal space heating efficiency η_s , as developed in Annex II of the accompanying technical background report[25]. F(1-5) applies to the thermal part of the heating generator, F(6) is only relevant for cogeneration and it serves to correct for electricity production. In the cogeneration TEWI formula, β_{elec} is divided by 2.5 to convert to electric savings instead of primary savings.

For a hybrid heating generator, the following formula is proposed:

$$\frac{\text{TEWI}}{\text{kWh heat output}} \left(\frac{\text{gCO}_2 \text{ - equiv.}}{\text{kWh heat output}} \right) = \frac{\%\text{gb} * \beta_{gas}}{\eta_{gb}} + \frac{(1 - \%\text{gb}) * \beta_{elec}}{2.5 \ \eta_{hp}} + \text{GHG}_{direct}$$

with the corresponding parameters:

Parameter	**Description of parameter**	**Units**	**Constant value or test to be performed in order to obtain the parameter**
%gb	The share of gas boiler of the total heat output (fraction with no units)	[-]	Declared by the applicant
$\beta_{elec.}$	Carbon emissions of electricity, corresponding to the electrically-driven heat pump part	[g CO_2-equiv./$kWh_{elec.}$]	384
β_{gas}	Carbon emissions of gas, corresponding to the gas boiler part	[g CO_2-equiv./kWh_{gas}]	202
η_{gb}	Seasonal space heating efficiency of the gas boiler part for the typical operating conditions (outside temperature below +3°C)	[-]	To be tested and declared by the applicant (Criterion 1)
η_{hp}	Seasonal space heating efficiency (in primary energy, hence the correction by 2.5 to secondary) of the heat pump part for the typical operating conditions (outside temperature temperature above +3°C)	[-]	To be tested and declared by the applicant (Criterion 1)
GHG_{direct}	Contribution of direct emissions (annual plus end-of-life refrigerant leakage) from the heat pump part	[kg.CO_2eq./kWh heat output]	According to Annex I of the F-gas regulation
Notes: § The value of $\beta_{elec.}$ = 384 g CO_2-equiv./ $kWh_{elec.}$ corresponds to the average EU-27 carbon intensity of electricity (corresponding to the period 2010-2020, as used in the MEErP methodology of 2011). The corresponding value used in Ecodesign Lot 1 (MEEuP methodology of 2005) was equal to 458 g CO_2-equiv./ kWh_{elec}			

[25] Annex II: Working documents Ecodesign/Energy Labelling. In: "Development of European Ecolabel and Green Public Procurement Criteria for Hydronic Central Heating Generators. Draft Report. **Policy Analysis**", November 2011, http://susproc.jrc.ec.europa.eu/heating/stakeholders.html

Explanation for the formula for hybrid heating generators:
The heat output of the hybrid generator is first split up into a gas boiler and a heat pump part. This can be based on an approach involving a bivalent point, i.e. the outside temperature below which the gas boiler takes over from the heat pump. The calculation for the gas boiler part is then fairly straightforward. The calculation for the heat pump part includes a correction of 2.5 to convert the efficiency on primary energy basis to secondary energy (electricity) since the specific carbon emissions apply to kWh_{elec}. Finally, the contribution corresponding to the direct emissions (annual plus end-of-life refrigerant leakage) from the heat pump part is added.

3.2.2 Verification

The applicant shall provide the calculated GHG emissions following the proposed TEWI formulas above. A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

The applicant's statement shall include the following information:

- Type of refrigerant and its global warming potential value, GWP_{100}.
- Nominal filling quantity of the refrigerant, grams.
- Calculation of grams of CO_2-equivalent in grams/kWh of heat output, following the TEWI formulas provided.
- Calculation and verification data with respect to the seasonal seasonal space heating efficiency, as provided in Criterion 1.

3.2.3 Rationale

The key importance of the greenhouse gas emissions limit together with the energy efficiency have been confirmed by the literature review, other labels and environmental policies, and stakeholders' feedback. For example, based on the technical analysis and previous work from member states ecolabels (Pettersson, private comm..), there should be at least a common benchmark for greenhouse gas emissions limit, given in maximum amount of grams of CO_2 per kWh of heating output[26], or per kWh of primary energy input[27].

Comments received from stakeholders during and after the 1st workshop have offered support for the TEWI approach to calculating the greenhouse gas emission benchmark. The TEWI approach for the GHG emissions was developed in consultation with Blauer Engel. TEWI was first applied in the Blauer Engel criteria for "Energy-Efficient Heat Pumps using an Electrically Powered Compressor" (RAL-UZ 121). For other types of heat pumps, such as the current Blauer Engel criteria for "Energy-Efficient Heat Pumps using Absorption and Adsorption Technology or operating by use of Combustion Engine-Driven Compressors" (RAL-UZ 118), the approach does not include a TEWI requirement among the criteria, but instead a criterion on energy efficiency, among others. However, the Blauer Engel criteria for heat pumps are under revision. The revision consists in the development of criteria that will be applicable both to electrically-driven and gas-driven heat pumps, and therefore it is a good basis to use as guidance for the EU criteria for heating generators. In the ongoing Blauer

[26] The background document for the development of EU Ecolabel for heat pumps establishes that the global warming impact of heat pumps must not be greater than 210 g CO_2/kWh useful heat as an average during a year.
[27] Electricity production is considered to have a conversion efficiency of 40% (in the conversion of primary energy to electricity).

Engel criteria development, a GHG emissions TEWI-based formula is proposed in terms of CO_2-equivalent emissions per unit of kWh of heating output, which is consistent with the type of GHG emissions criterion that is proposed by the IPTS.

In addition to a review of other labels, the proposal by IPTS is also based on the technical analysis available at the project's website. The technical analysis provided evidence of the major differences between e.g. biomass boilers and fossil fuel boilers (see for example Figs. 6 and 7 in the Annex of this document). Biomass boilers, while having less energy efficiency, have nevertheless much lower GHG emissions than other boilers, since the CO_2 production of combustion is considered to be zero (except in the production phase of wood pellets). As discussed in the technical analysis, the greenhouse gas emissions from biomass boilers are the lowest, and the heat pump achieves a reduction of 20% compared to the gas condensing boiler.

Feedback from some stakeholders has suggested an approximate limit of 220 g CO_2 per kWh of heating output, calculated using the TEWI approach as detailed above. This limit is established in order to reduce the environmental impacts of the heating generator, regardless of the technology. In this sense, the criterion is performance-based and not technology-based. As a consequence of setting this common GHG emissions benchmark, a different percentage of each type of technology might be able to meet the benchmark. For example, biomass boilers would this benchmark easily, based on evidence from the life cycle analysis (technical background report on the project's website). For heat pumps and condensing boilers, the benchmark will allow for selecting the best performing units for each type of technology. Finally, and also from the technical background report (and Figs. 6 and 7) in the Annex), it is straightforward to conclude that coal combustion technologies will not be able to meet the GHG emissions benchmark. Since the performance of coal combustion technologies is found to be significantly worse than the established GHG emissions benchmark, it is proposed by IPTS not to develop Ecolabel criteria for these systems, as this will impose unreasonable and unnecessary burdens to the Commission, and a waste of resources for an option that will lead to no environmental benefit. Several member states ecolabels specifically exclude coal boilers from the scope.

Rationale for Option 1:
Results from the technical analysis confirm that best available technology for gas boilers is able to achieve maximum greenhouse gas emissions of around 217 grams of CO_2-equiv./kWh heat output; this was the rationale to set the benchmark at 220 grams of CO_2-equiv./kWh heat output. The technical analysis has also confirmed that this benchmark corresponds also to approximately the best available technologies for gas-driven heat pumps. It is likely that a greater percentage of gas-driven heat pumps compared to gas boilers will be able to meet this benchmark.

The technical analysis on biomass boilers has shown that, regardless of whether manual or automatic, or fed with wood, wood pellets, or wood chips, biomass boilers emit less than 50 grams of CO_2-equiv./kWh heat output. Compared to the other heating technologies, these emissions are significantly lower, and therefore it is proposed by the IPTS that a GHG emissions limit is not needed for biomass boilers, and a specific calculation by the Ecolabel applicants might add unnecessary burden.

Rationale for Option 2:
For electrically-driven heat pumps, the technical analysis has shown that best available technologies are able to achieve GHG emissions on the order of less than 180 grams of CO_2-equiv./kWh heat output. However, some uncertainties in the calculations may exist due to different estimates of annual and end-of-life disposal rates. Differences in GHG emissions among different types of electrically-driven heat pumps are mainly due to the different seasonal efficiencies, but also on the type of refrigerant, and how leak-tight the heat pump unit is. It is therefore proposed for the IPTS to establish a GHG limit of 180 grams of CO_2-equiv./kWh heat output to accommodate for the market reality of heating generators.

The rationale to add a separate GHG limit of 180 grams CO_2/kWh heat output for electrically-driven heat pumps is as follows. Setting this limit is very realistic for this type of technology, and setting a higher limit will not lead to pushing the market to best environmental performance. On the other hand, if the limit of 180 grams CO_2/kWh heat output was to be set also for gas condensing boilers and gas-driven heat pumps, it will in practice almost drive these technologies out of eligibility for an Ecolabel. The market reality is that there are a variety of factors depending on location, climate, availability of ground or water sources to set-up certain heat pump technologies, availability of biomass fuels, etc., It is therefore not always possible for the consumer to have access to electrically-driven heat pumps and biomass boilers. If the Ecolabel for heating generators allows also the inclusion of best performing gas boilers and gas-driven heat pumps, it is less discriminative for the market, while still providing valuable environmental benefits. The Ecolabel criteria will be revised in future years to accommodate for corresponding market and technological changes.

Since the uncertainties in the GHG emissions (due to refrigerant leakage) are higher than the uncertainties in the GHG emissions from e.g. gas boilers, it is proposed by the IPTS to require a stricter criterion, proposed to be 180 grams CO_2/kWh heat output.

As proposed in earlier versions of the criteria, Option 1 presented only one horizontal GHG emissions limit (same for all technologies) of 220 grams CO_2-equiv./kWh of heat output. In response to stakeholder feedback, the following graph represents how the GHG emissions change with respect to the energy efficiency, for different technologies. In the x-axis, the seasonal space heating efficiency h_s is represented; in the y-axis, the GHG emissions in kg CO_2/kWh of heat output.

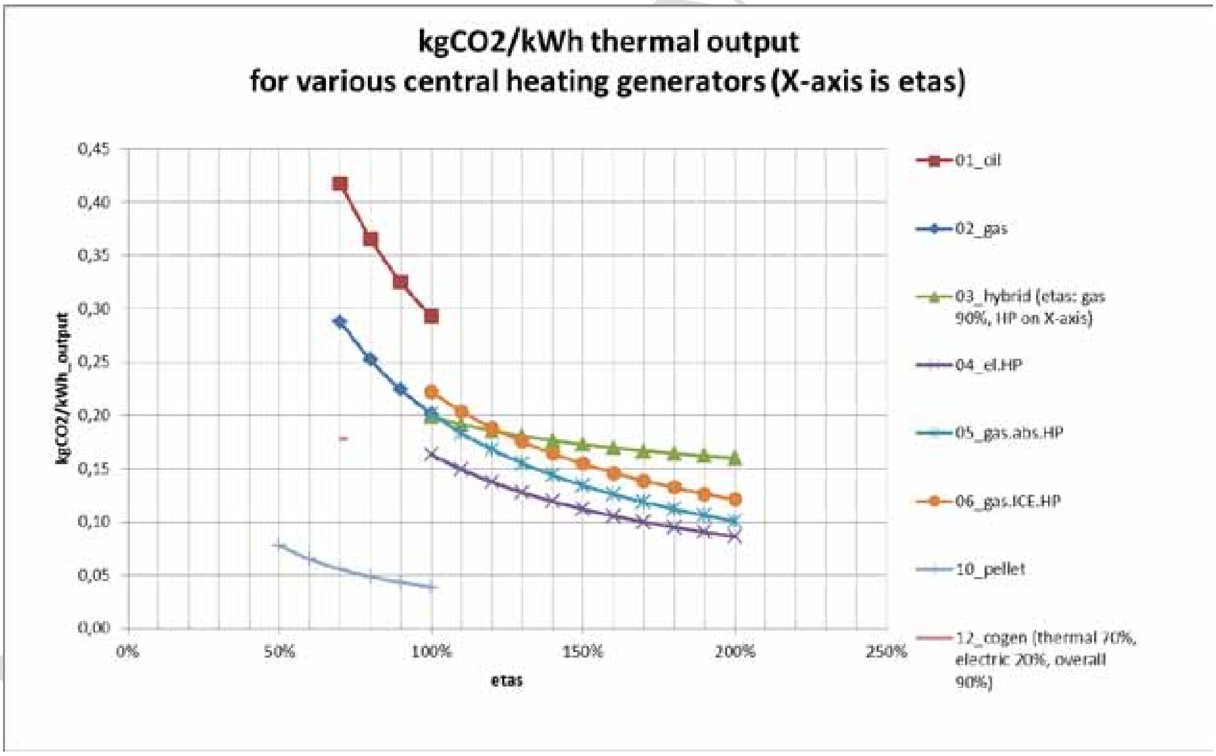

Figure 2. Greenhouse gas (GHG) emissions for different seasonal space heating efficiency, for different heating generator technologies.

In Fig. 2, the efficiency of the gas and oil fuel boilers ranges from 70-100%; beyond 100% would correspond to a gas/oil fuel boiler coupled with a heat pump (forming a hybrid), or with solar thermal.

The 03_hybrid boiler requires a bit explanation: The gas boiler part h_s is constant at 90%, the heat pump part efficiency varies according to the x-axis, from 100% to 200%.

The heating generators with efficiencies beyond 100% that are represented in Fig. 2 are heat pumps (04_electric HP, 05/06_gas HP). The 06_gas internal combustion heat pump emits more GHG emissions than a gas boiler between with h_s 100-120% because of the direct emissions of the refrigerant.

The only biomass boiler represented in this graph is the 10_pellet boiler. This is the biomass boiler emitting most GHG, the other biomass boilers have lower GHG emissions.

Fig. 2 shows that at 0.22 kg CO_2/kWh only average/poor efficiency gas and oil boilers are excluded. For heat pumps a level of 0.15 is an option (fairly easy for electric, more stringent for gas internal combustion (ICE) heat pumps) - there is an element of direct emissions (refrigerants) that plays a role as well.

Fig. 3 represents the GHG emissions for cogeneration heating generators as a function of the share of electric output. This figure (Fig. 3) corresponds to an overall efficiency of 90%, where the x axis represents the % share of electricity production. Data assumes the 2015 electricity mix.

Varying the ratio thermal/electric efficiency (while keeping overall efficiency constant at 90%) it can be observed that, at around 36% electric efficiency the cogeneration unit CO_2 emissions are equal to that of an electric heat pump of 140% efficiency (Fig. 3). If the overall cogeneration efficiency is only 80%, the electrical efficiency needs to be at least 15% to achieve a lower TEWI than for the reference gas boiler at h_s = 90%.

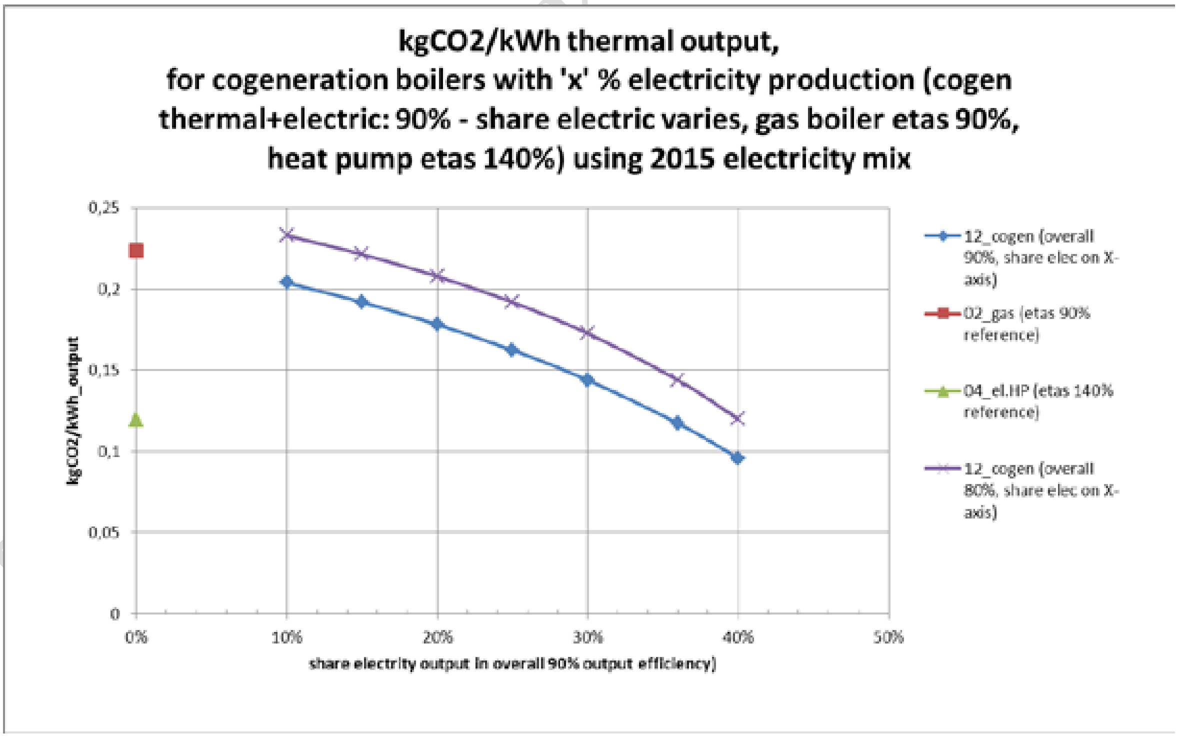

Figure 3. Greenhouse gas (GHG) for cogeneration heating generators as a function of the share of electric output.

Regarding liquid fuel boilers, Fig. 4 represents the greenhouse gas emissions for liquid fuel boilers as a function of % of bio-oil in the liquid fuel mix. A significant share of EU boiler stock/sales is still oil-fired (allegedly some 30% of sales in Germany are still oil fuel boilers). Options for oil boilers to reduce CO_2 emissions exist, by using renewable energy (combining oil boilers with heat pumps, as in gas-hybrid boilers, combining oil boilers with solar thermal systems, or allowing a % share of bio-oil. One option for the oil boiler to reduce CO_2 is by changing the oil-mix to include more renewable derived oil. In Fig. 4, if a constant h_s of 90% is assumed for thermal efficiency, the changing share of bio-oil in the fuel mix (horizontal x-axis) reduces the TEWI score (the specific CO_2 value per kWh fuel input is reduced). At some 31% renewable oil the TEWI score becomes equal to that of a gas boiler at etas 90% (at some 0.22 kgCO2/kWh). At some 65% bio-oil, the TEWI becomes comparable to that of an electric heat pump at 140% etas (SCOP 3.5 = average score).

As regards bio-oil, sources[28] state that normal oil-boilers can use some 5% share of bio-oil. Ongoing tests may prove that the share can be increased to a maximum of 20%. However, beyond 20% it is certain that components of the boiler need to be modified in order to cope with the different properties of bio-oil.

It is therefore suggested to allow the calculation of CO_2 levels on the basis of bio-oil, only if the boiler can cope with mixtures > 50% bio-oio. This will separate the bio-oil boilers from the current non-modified boiler that can tolerate up to 5/10% bio-oil. The calculation can then proceed with a reduced specific CO_2 factor - for bio-oil only.

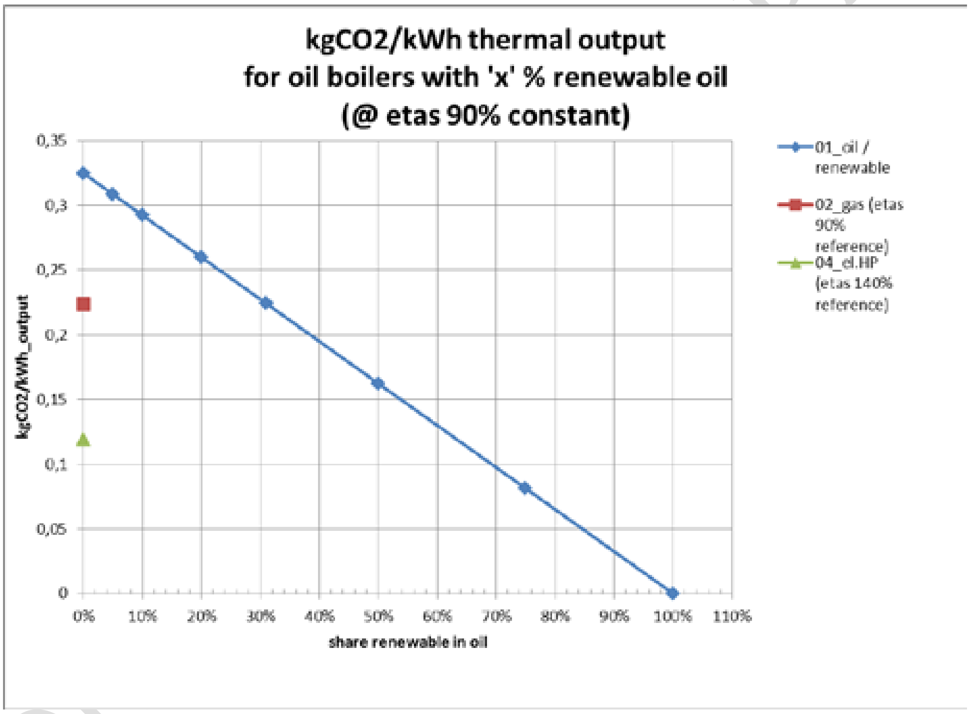

Figure 4. Greenhouse gas (GHG) for liquid fuel boilers as a function of % of bio-oil in the liquid fuel mix.

Further discussion and feedback was received regarding the appropriateness of the specific values of carbon intensities of specific fuels. The CO_2 emissions per boiler are characterised by the 'carbon intensity' of the specific fuel (or in case of electricity, the production including transport/distribution).

[28] www.IWO.de

The specific emission values include upstream processes such as the winning, processing and -if applicable- transport of these energy carriers and are expressed on the basis of kWh energy INPUT (not thermal output, the ratio is the seasonal efficiency). Most values are based upon the [DEFRA 2011] calculation of specific CO_2 emissions, except from electricity, which uses the Ecoreport vales from [MEErP 2011]. The factors for 03_gas hybrid and 12_cogeneration are derived from the respective gas input and electric input/output factors.

The emission factor is expressed as emissions per kWh fuel combusted. Since this is mainly dependent on the amount of carbon contained in the fuel, the factors do not change over time (unless a change in upstream factors is taken into account, but in this analysis this is neglected). For electricity the change in time is relevant as the average electricity production is becoming 'cleaner' over the years.

Table 7. Specific CO_2 emission factors.

Specific CO2 emission (kg CO2 eq. per kWh input)		1990	1995	2000	2005	2010	2015	2020	2025	2030
01_oil boiler	per kWh energy input					0,292				
02_gas boiler	per kWh energy input					0,202				
03_gas hybrid	calculated per kWh gas/electric energy input combined					0,336				
04_elec.HP	kWh electricity as input	0,584	0,52	0,458	0,426	0,394	0,384	0,374	0,365	0,36
05_gas abs. HP	per kWh energy input					0,202				
06_gas ICE HP	per kWh energy input					0,202				
07_coal boiler	per kWh energy input					0,392				
08_small/wood manual	per kWh energy input					0,019				
09_small/wood autom.	per kWh energy input					0,019				
10_small/pellet	per kWh energy input					0,039				
11_large/chips	per kWh energy input					0,016				
12_cogeneration	calculated per kWh energy input, excl. correction for electric power output					0,202				

Feedback from the 2nd workshop on Ecolabel is summarized below:

The TEWI methodology was considered a good approach by the majority of stakeholders.

Option 1. Option 1 proposed one GHG emissions value, common to all heating technologies, and set at 220 grams of CO_2-equiv./kWh of heat output. Advantages of Option 1 are: simplicity, setting the same playing field to all different technologies. Disadvantages are: the common value is not ambitious enough for many of the heat pump technologies and it was considered by some stakeholders as not pushing the heat pump market forward (and even setting it backwards). Several industry stakeholders (e.g. from heat pump associations and industries) supported Option 1.

Option 2. Option 2 proposed two levels for GHG emission values, depending on the heating technology: 220 grams of CO_2-equiv./kWh of heat output for gas fuel boilers, gas-driven hydronic heat pumps, and cogeneration; and 180 grams of CO_2-equiv./kWh of heat output for electrically-driven hydronic heat pumps. The main advantage of this option is that it will allow the selection of the best heat pumps and will help to push innovation forward in the heat pump market. The main disadvantage is added complication to the set of criteria, and raising questions as to the scientific rationale to set different GHG emissions limit for different heating technologies. Several stakeholders, including from NGOs and from some of the Competent Bodies supported Option 2, mainly because of the possibility to increase innovation in the heat pump market, and offering incentive and helping push the heat pump technology towards improved performance.

<u>Additional option proposed</u>. Some members of the Competent Bodies, supporting Option 2 overall, also added the suggestion to even increase the differentiation of GHG emission limits for different heat pump technologies. Therefore, these stakeholders defend Option 2 with the additional mentioned adjustments (in their view, it is good to have a general level on primary energy efficiency in Criterion 1, and that Criterion 2 should be defined to select the technologies which are actually most climate friendly). Regarding heat pumps, Competent Bodies stakeholders said that many heat pump products in the market are much better than the figures proposed, and so that greater differentiation of GHG limits would be preferable. More specifically:

§ The threshold for electric heat pumps (180 grams of CO_2-equiv./kWh of heat output) is far too loose. It is equivalent to an SCOP ≈ 2.1…2.2. That would drive the market backwards. Those heat pumps would not be able to compensate conversion losses of electricity generation (primary energy factor 2,5). There would be no positive impact on choosing natural refrigerants. As an example, the new (ongoing development) Blauer Engel criteria have an SCOP of about 3.7 for air-water-HP and about 4.2 for brine-water-HP, roughly corresponding (in the Blauer Engel calculations) to a TEWI of 104-109 g/kWh for air-to-water heat pumps, and 91-97 g/kWh for brine-to-water heat pumps.

§ For carbon emissions of gas it should be checked if they are based on NCV or GCV. Upstream processes (mining, transport, refining etc.) should be included in the calculation of the total GHG equivalent. A calculation using Gemis 4.7 (<http://www.oeko.de/service/gemis/en/index.htm>) gives 246 grams CO_2-eq/kWh based on NCV, corresponding to 224 grams CO_2-eq/kWh based on GCV.

§ Carbon emissions of oil should be added.

§ The assumed refrigerant loss rate at the end of life (5%) seems very low. For example, the Blauer Engel criteria have set (from agreement with stakeholders) an end-of-life leakage rate of 20%. Blue Angel representatives requested evidence for choosing 5%.

Overall: The TEWI methodology is accepted by the majority of stakeholders as the right approach to calculate GHG emissions. There are still some different views on what option is best (Option 1 or 2).

<u>Questions to stakeholders</u>:

Do you agree with the proposed limit for greenhouse gas emissions as core/comprehensive, calculated following the TEWI approach, similar to the methodology developed by the Blauer Engel label?

Do you have comments regarding the suitability of the assumed leakage rates for the refrigerant (annual and end-of-life)?

What option is preferable (Option 1 or 2)?

3.3 Criterion 3 – Refrigerant and secondary refrigerant

3.3.1 Formulation as core and comprehensive criterion

Refrigerant

The global warming potential (GWP_{100}) of the refrigerant shall not exceed a GWP_{100} value > 2000 over a 100 year period.

Notes:

- § Global warming potential (GWP_{100}) means the measure of how much 1 kg of the refrigerant applied in the vapour compression cycle is estimated to contribute to global warming, expressed in kg CO_2 equivalents over a 100 year time horizon.
- § GWP_{100} values considered will be those set out in Annex I of Regulation (EC) No 842/2006 of the European Parliament and the Council[29].

Secondary refrigerant

(Note: Not applicable to all types of heat pumps within this product group)

The secondary refrigerant, brine or additives must not be substances classified as environmentally hazardous or constituting a health hazard as defined by Council Directive 67/548/EEC[30] concerning environmental hazard and its subsequent amendments.

3.3.2 Verification

The names of refrigerant(s) used in the product shall be submitted with the application, along with their GWP_{100} values according to the Regulation above. The GWP_{100} values of refrigerants shall be calculated in terms of the 100-year warming potential of one kilogram of a gas relative to one kilogram of CO_2.

The GWP_{100} values for the refrigerants shall be taken from the following sources:

- § GWP values considered will be those set out in Annex 1 of Regulation (EC) No 842/2006 of the European Parliament and of the Council[31].
- § For fluorinated refrigerants, the GWP values shall be those published in the third assessment report (TAR) adopted by the Intergovernmental Panel on Climate Change (2001 IPCC GWP values for a 100 year period)[32].
- § For non-fluorinated gases, the GWP values are those published in the First IPCC assessment over a 100 year period[33].

[29] OJ L 161, 14.6.2006, p. 1.
[30] OJ 196, 16.8.1967, p. 1.
[31] OJ L 161, 14.6.2006, p. 1.
[32] IPPC Third Assessment Climate Change 2001. A Report of the Intergovernmental Panel on Climate Change: http://www.ipcc.ch/pub/reports.htm
[33] Climate Change, The IPPC Scientific Assessment, J. T. Houghton, G. J. Jenkins, J. J. Ephraums (ed.) Cambridge University Press, Cambridge (UK), 1990.

- For refrigerants not included in the above references, the IPCC UNEP 2010 report on Refrigeration, Air Conditioning and Heat Pumps, dated February 2011, or newer, shall be used as a reference[34].

- GWP_{100} values for mixtures of refrigerants shall be based on the formula stated in Annex I of the Regulation 842/2006.

For the secondary refrigerant(s) only

The name(s) of the secondary refrigerant(s) used shall be submitted with the application.

3.3.3 Rationale

Refrigerants are of environmental concern. They are present only in heat pumps.

For the main refrigerant, greenhouse gas emissions are possible if the refrigerant has a high global warming potential (GWP_{100}) and if it leaks. In addition to the main refrigerant, some heat pumps – in particular certain types of ground-source heat pumps – may have a secondary refrigerant which is circulated through pipework to the ground. The criterion proposed for this secondary refrigerant is meant to avoid the leakage of hazardous (toxic) substances such as glycol to the underground.

Since the Montreal's protocol (1987) highlighted the destructive capacity of certain types of refrigerants on the ozone's layer, and since the Kyoto's protocol (1997) indicated that most of them considerably contribute to climate change, international efforts have been directed to study alternative refrigerant substances, to improve system containment and to investigate the potential for using lower amounts (charge reduction). Table 8 is a summary of refrigerants, some with ozone-depleting (CFCs, HCFCs) and climate change impacts, others (natural refrigerants) with very low impact; many of them banned or regulated by international treaties and European legislation.

Table 8. Different types of refrigerants.

CFCs Chlorofluorocarbons	HCFCs Hydrochlorofluorocarbons	HFCs Hydrofluorocarbons	Natural refrigerants
R-11 R-12 R-502 …	R-22 R-123 R-124 R-401A R-402A …	R-134A R-125 R-404A (blend) R-407C (blend) R-410A (blend) …	R-717 (ammonia) R-290 (propane) R-718 (water) R-744 (CO_2) …
Prohibited for new appliances, extension and modifications.	Prohibited for new appliances, extension and modifications.	Permitted in the EU. Regulation EC 842/2006 has to be followed.	Permitted for all kinds of appliances.

[34] This reference, applicable for refrigerants not included in the above references, is provided in the Draft Commission Regulation for implementing ecodesign requirements for air conditioners and comfort fans, published on 18 July 2011. The Draft Regulation can be accessed at: http://register.consilium.europa.eu/pdf/en/11/st13/st13029.en11.pdf

EC Regulation 2037/2000 on Ozone Depleting Substances, which came in effect in October 2000, affects all phases of the manufacture and use of air-conditioning equipment and specifically prohibits or restricts the use of CFCs and HCFCs – proven ozone-depleting substances.

Now that EC regulation 2037/2000 bans the use of ODS (ozone depleting substances) as refrigerants, the main opportunity for reducing environmental impact is through reducing the emission of greenhouse gases by improving in-use energy efficiency and avoiding fugitive emissions of refrigerants. Therefore the purchase of the most energy efficient units using refrigerants with low GWP should be a priority.

From 1 January 2010, only recycled hydrochlorofluorocarbons (HCFCs) can be used in the maintenance and servicing of refrigeration and air-conditioning equipment existing at that date; from 2015 they will be prohibited all together.

Fluorinated gases, F-gases, are manufactured refrigerants. The most common ones are hydrofluorocarbons, also known as HFCs. They were developed in the 1990s to replace the ozone-depleting substances (CFCs and HCFCs), which were phased-out globally as they depleted the ozone layer.

The F-Gas Regulation (EC Regulation No 842/2006) on certain fluorinated gases was adopted in 2006 and aims to reduce emissions of F-gases by preventing leaks from the systems where they are used. Operators are responsible for putting in place **arrangements for the proper recovery** of F-gases by certified personnel to ensure their recycling, reclamation or destruction from the cooling circuits of refrigeration, air-conditioning and heat pump equipment

Regarding the main refrigerant, several ecolabels include criteria on:

(a) A limit for the GWP_{100} of the refrigerant.

(b) Requirements on reduced leaking rates from the heat pump units.

(c) Sometimes, requirements for completely leak-free units.

(d) Also sometimes, different energy efficiency limits are established depending on whether GWP_{100} is above or below a certain limit.

These or similar requirements on the main refrigerant could in principle be considered as potential EU ecolabel criteria for heating generators.

Table 9 contains specific GWP_{100} limits proposed by different product policy schemes. A GWP_{100} limit value of 2000 seems reasonable to reduce environmental concerns of refrigerants, while allowing a significant portion of the heat pump market to be included. Lowering the GWP_{100} of the refrigerant is only realistically possible for some types of heat pumps, such as the gas-absorption heat pump (GAHP) which may use natural refrigerants (of zero GWP_{100}).

In the table comparing the limits established by different labels, it can be seen that some labels establish different efficiency limits depending on the GWP_{100} of the refrigerant. However, since the EU criteria for heating generators establishes an efficiency limit that most heat pumps are able to comply with, it does not make sense to adopt the different efficiency limits depending on the GWP_{100}. In addition, the relationship between energy efficiency and the GWP_{100} of the refrigerant is partly addressed already by Criterion 2 (GHG emissions). Following the formulas for the GHG calculations, a low GHG emissions value can be achieved for example by increased energy efficiency (for refrigerants with higher GWP_{100} values) or by using refrigerants with lower GWP_{100} values (if the heat pump unit has lower energy efficiency).

Table 9. Examples of limit values for the Global Warming Potential (GWP_{100}) of the refrigerant over a 100-year period ($GWP100_{100}$), as established in different product policy schemes.

	GWP of refrigerant over 100 year period, GWP_{100}
Ecodesign implementing measures (mandatory)	No GWP_{100} limit Lower energy efficiency allowed if $GWP_{100}<150$
EU Ecolabel	**$GWP_{100} < 2000$** If $GWP_{100} > 1000$: Higher energy efficiency required If $GWP_{100} < 150$: Energy efficiency requirement reduced by 15%
Nordic Ecolabel	**$GWP_{100} < 2000$** If $GWP_{100} > 1000$: Higher energy efficiency required If $GWP_{100} < 150$: Energy efficiency requirement reduced by 15% If $GWP_{100} > 100$: Unit must be leakage-free
GPP	**$GWP_{100}<2000$** If $GWP_{100}<1000$: Higher COP efficiency required If $GWP_{100}<150$: COP efficiency requirement reduced by 15%

There is currently a lot of discussion on the phase out of all gases that contain fluorine, known as F-gases, which includes perfluourinated carbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) of which HFCs make up approximately 90%. There is a gradual shift to Hydrocarbons (HC) and Carbon Dioxide (CO_2) as replacement refrigerants.

Carbon dioxide (CO_2) has a Global Warming Potential (GWP_{100}) of 1 whereas HFC134a, the most widely used, has a GWP_{100} of 1430 over a 100-year horizon, according to the IPCC's 4th Assessment Report[35]. Another frequently used refrigerant is R-410A.

The Danish Government now charges a stringent tax on all HFCs with plans to phase these out all together. This groundbreaking piece of legislation is placing pressure on other European countries with the result that they may well follow suit. For R-134a the tax is approximately €14/kg[36]. Currently the F-gas legislation governs the use of HFCs, PFCs and SF_6 in all their applications.

Feedback received during and after the 2nd AHWG workshop on the Ecolabel (Brussels, 29th November 2011) can be summarized as follows.

Stakeholders from the Competent Bodies generally supported Criterion 3, and also setting its value around 2000. These experts said that Criterion 3 is very important and should not be eliminated. This criterion should be used to push forward the use of more environmentally-friendly refrigerants. It was noted however that there has been a revision of the GWP values of refrigerants. Therefore if we decide to pick 2000 as the limit, then – according to the revised GWP values, this level would correspond to 2100 instead. Therefore the limit should be stated at 2100 using the most updated GWP values.

Regarding the specific value of 2000, some stakeholders said that 2000 is not ambitious enough. Some experts from the Competent Bodies however said that heat pumps are increasingly built to be leak-

[35] IPCC 4th Assessment Report: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-ts.pdf

[36] http://www.care-refrigerants.co.uk/hmpg/hmpgdisplaylev2.asp?where=lev2&catid=4&catid2=21

tight and therefore that the limit at 2000 should be sufficient. Other industry stakeholders proposed to establish two levels for this Criterion, one for sealed and one for non-sealed heat pumps.

Industry stakeholders (heat pumps) expressed a preference to exclude the GWP requirement, based on the consideration that Criterion 2 using TEWI should be enough, because it already includes the refrigerant leakage. It was also mentioned that the refrigerant A48 is an efficient refrigerant and should not be excluded by the Ecolabel/GPP.

Overall, there were some differences in opinion regarding the need to establish Criterion 3, in view that refrigerant leakage is already included as part of Criterion 2. However, a significant part of stakeholders defended keeping Criterion 3, and that the level at 2000 is considered reasonable and ambitious enough. If we kept Criterion 3, and upon consultation from industry, it seems like the level set at 2000 is reasonable, as it does not exclude any of the major refrigerants commonly used in heat pumps. While Criterion 2 already includes the consideration of the refrigerant leakage, it is true also that there are some uncertainties and differences (expressed during the discussion of Criterion 2) regarding the correct assumption for the refrigerant leakage rate. The fact that these uncertainties in leakage rates exist further supports the need for Criterion 3. The IPTS therefore proposes to keep Criterion 3 as formulated, with a revision to use the most updated GWP value as the threshold. Finally, Criteria 2 and 3 should be viewed together, and the specific GWP limit value in Criterion 3 is dependent on the final formulation of Criterion 2.

Questions to stakeholders:

Do you agree with introducing the core/comprehensive GPP criterion setting a limit for GWP_{100} of 2000 for the refrigerant in the heat pump?

3.4 Criterion 4 – Nitrogen oxides (NOx) emissions limit

3.4.1 Formulation as core and comprehensive criterion

The content of nitrogen oxides (NOx) in the exhaust gas must not exceed the limit values indicated in Table 10, for each of the heating technologies. The units shall be given in mg/kWh of energy input or in mg/m_N^3.

Table 10. Criteron on nitrogen oxides (NOx) emissions limit.

Heating generator technology	NOx emissions
Gas/liquid fuel boiler	45 mg/kWh of heat input
Biomass boiler	Pellet/wood-log boilers: 150 mg/m_N^3 Wood chip boilers: 190 mg/m_N^3
Gas-driven hydronic heat pump	110 mg/kWh of heat input
Sorption (absorption and adsorption) hydronic heat pump	45 mg/kWh of heat input
Electrically-driven hydronic heat pump	No limit
Cogeneration	120 mg/kWh (gas) 500 mg/kWh (liquid; internal combustion or Stirling)

3.4.2 Verification

Products holding a relevant Type 1 Ecolabel or that demonstrate compliance with relevant Type 1 Ecolabel criteria will be deemed to comply. Other appropriate means of proof will also be accepted.

If following the EU Ecolabel for heating generators, the verification is as follows:

The NOx emission data – related to dry exhaust gas – are to be determined as standard emission factors according to the international standards included in Table 11.

A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

Table 11. EN-standards for NOx emissions relevant for the product group "hydronic central heating generators".

Number	Title
Gas boilers	
FprEN 15502-1: July 2010	Gas-fired heating boilers – Part 1: General requirements and tests (CEN) §8.13. NOx (classification, test and calculation methods)
Biomass boilers	
EN 303-5	Heating boilers - Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300 kW - Terminology, requirements, testing and marking
Gas-driven heat pumps	
prEN 12309 – 2: 2000	Gas-fired absorption and adsorption air-conditioning and/or heat pump appliances with a net heat input not exceeding 70 kW
DIN 4702, Part 8	Central heating boiler; determination of the standard efficiency and the standard emissivity

Electrically-driven heat pumps	
prEN 14825: June 2010	Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling – Testing and rating at part load conditions and calculation of seasonal performance.
EN 14511: 2007	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling.
Cogeneration	
prEN 50465: 2010 Draft ed. 2.	Gas appliances – Combined Heat and Power appliance of nominal heat input inferior or equal to 70 kW (CEN)

3.4.3 Rationale

NOx air emissions are produced during the combustion of the fuels and have associated environmental impacts, mainly related to acidification of land and water, and they can also irritate respiratory airways and lead to impairment of the immune system. NOx emissions are the result of chemical reactions between air molecules triggered by the specific combustion conditions, in particular by the reaction between the oxygen and nitrogen molecules in the air. This occurs only when there is enough air around, when the temperature is high enough (above 1200 ^{o}C) and when there is enough time ("residence time") for the reaction to take place at this high temperature.

Stakeholders expressed that there are differences regarding the formation of NOx emissions depending on the heating generator technology. NOx emissions depend on the boiler technology itself in the case of gas boilers, but these emissions are more dependent on the type of biomass fuel for the case of biomass boilers. Nevertheless, NOx emissions tests are generally considered overall appropriate as one of the relevant air emissions criteria.

NOx criteria given in several product policy schemes are presented in the table below. Energy label is not included in this table, because this policy scheme does not include limits for air pollutants, but it is only restricted to energy efficiency. The NOx limit is never applicable to electrically-driven hydronic heat pumps. NOx limits are however established for gas-driven heat pumps. GPP criteria (unpublished) for boilers has proposed the same limit as in mandatory Ecodesign criteria (Table 12). However, from feedback received from stakeholders during the 2nd AHWG workshop for Ecolabel, it was decided that the NOx limit should be stricter than for Ecodesign, and a value of 45 mg/kWh is proposed for gas/liquid boilers, the same as in Blauer Engel criteria (ongoing development).

<u>A summary of the stakeholder feedback during and after the 2nd workshop for Ecolabel is as follows</u>:

Experts from the Competent Bodies said that the limit value should be stricter than for Ecodesign, and suggested using 45 mg/kWh, as agreed in recent development of Blauer Engel criteria. Representatives from NGOs and other stakeholders also agreed with a stricter NOx value for gas/liquid fuel boiler compared to Ecodesign. No distinction should be made between condensing and non-condensing boilers, and a single limit value for both types of boilers should be set. It was suggested that the threshold used for pellet boilers is applied to wood log boilers as well. Limit values for NOx should be also established for gas heat pumps. The proposed limit for liquid cogeneration is too ambitious; 500 mg/kWh limit is proposed. Suggestions have been taken and used to update already the IPTS proposal.

Table 12. Comparison of NOx emission limits in different product policy schemes[37]

Heating generator technology	Ecodesign implementing measures	EU Ecolabel	Blauer Engel	Nordic Ecolabel	Austrian Ecolabel	GPP
Gas boiler	70 mg/kWh	N/A	60 mg/kWh (34 ppm)	N/A	N/A	60 mg/kWh (C) 70 mg/kWh (non-C)
Biomass boiler	N/A	N/A	Pellet boilers: 150 mg/m_N^3 Wood chip boilers: 190 mg/m_N^3	340 mg/m^3	Automatic: 100-120 mg/MJ (360-432 mg/kWh) (150-180 mg/m^3) Manual (wood only): 120 mg/MJ (432 mg/kWh) (180 mg/m^3)	340 mg/m^3
Gas-driven hydronic heat pump	No limit	No limit	60-250 mg/kWh, 250-2500 mg/m^3	No limit	N/A	No limit
Cogeneration	120 mg/kWh (gas) 200 mg/kWh (liq)	N/A	250 mg/m^3 (gas) 2500 mg/m^3 (liq)	N/A	N/A	No limit

Notes:

- Austrian label for automatic biomass generators. For the NOx limit, two values are given: the lower limit value corresponds to pellets, and the higher limit value to chipped wood.
- In the Blauer Engel, the verification of NOx emissions of the biomass boiler is done at 0 ^oC, 1013 mbar, and 13% O_2.
- C means condensing; non-C means non-condensing

[37] In Table 12 (and also in subsequent tables throughout this document), **"N/A"** means that no criteria has been developed for a specific technology and a given product policy scheme, and **"No limit"** means that criteria exist within a given policy scheme for the product, but a limit for NOx is not part of the criteria.

3.5 Criterion 5 – Organic carbon (OGC) emissions limit

3.5.1 Formulation as core and comprehensive criterion

The organic substance content of the exhaust gas given as total organic carbon (OGC) must not exceed the limit value of 5 mg/m_N^3 (10% O_2), as indicated in Table 13 (this air emissions parameter is only applicable to biomass boilers). The unit of measurement is mg/m^3 of dry gas at 10% O_2 at normal conditions (1 atm, and 0 ^oC).

Table 13. Criteron on organic carbon (OGC) emissions limit

Heating generator technology	Organic carbon (OGC) emissions (mg/m^3, or mg/kWh)
Biomass boilers	5 mg/m_N^3 (10% O_2)

3.5.2 Verification

Products holding a relevant Type 1 Ecolabel or that demonstrate compliance with relevant Type 1 Ecolabel criteria will be deemed to comply. Other appropriate means of proof will also be accepted.

If following the EU Ecolabel for heating generators, the verification is as follows:

A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

The verification will be done following the standard specified in Table 14.

Table 14. EN-standard for organic carbon (OGC) emissions relevant for the product group "hydronic central heating generators"

Number	Title
Biomass boilers	
EN 303-5	Heating boilers - Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300 kW - Terminology, requirements, testing and marking

Note: EN 303-5 is the only standard with specifications on how to test for OGC.

3.5.3 Rationale

The organic carbon (OGC) in the exhaust gas is a measure of formation of volatile organic compounds (VOCs) due to poor or incomplete combustion. The carbon in these compounds comes from the fuel and is an indicator of how much fuel was subject to incomplete combustion. Causes of incomplete combustion are: lack of sufficient air/oxygen, or too low temperature in the fuel to permit oxidation (combustion) to occur. Incomplete combustion also produces CO (Criterion 6), which is an environmental and health hazard. The measurement of OGC therefore serves to identify whether the combustion conditions lead to incomplete combustion, and therefore may lead to the atmospheric release of environmental or health hazards.

A review of other labels shows that organic carbon is only tested for biomass boilers. The proposed limit values in each of the schemes are compared in the table below. There are no Ecodesign or Energy Label implementing measures for biomass boilers yet, and also no EU Ecolabel criteria. In some of the label schemes (e.g. Blauer Engel), OGC is also known as total carbon (total C).

The criteria are being continually revised to accommodate for the changing market. From feedback received from Competent Bodies, the IPTS proposes to establish a limit of 5 mg/m_N^3 (10% O_2) OGC emissions, given the evidence that there are sufficient biomass heating generator models in the market which are able to meet this limit. This limit corresponds to the ongoing revision of Blauer Engel criteria for wood boilers.

Table 15. Comparison of organic carbon (OGC) emission limits in different product policy schemes

Heating generator technology	Ecodesign implem. measures	EU Ecolabel	Blauer Engel	Nordic Ecolabel	Austrian Ecolabel	GPP
Biomass boiler	N/A	N/A	5 mg/m_N^3	25-70 mg/m^3	Automatic: 3-5 mg/MJ (11-18 mg/kWh) (4,5-7,5 mg/m^3) (full load) 3-10 mg/MJ (11-36 mg/kWh) (4,5-15 mg/m^3) (part load) Manual (wood only): 30 mg/MJ (110 mg/kWh) (45 mg/m^3) (full load)	25-70 mg/m^3

3.6 Criterion 6 – Carbon monoxide (CO) emissions limit

3.6.1 Formulation as core and comprehensive criterion

The carbon monoxide (CO) content in the exhaust gas must not exceed the values indicated in Table 16. The units shall be given in mg/kWh of energy input or in mg/m_N^3.

Table 16. Criteron on carbon monoxide (CO) emissions limit

Heating generator technology	CO emissions
Gas/liquid fuel boiler	25 mg/kWh
Biomass boiler	200 mg/m_N^3 (13% O_2)
Gas-driven hydronic heat pump	100 mg/m_N^3 (5% O_2)
Sorption (absorption and adsorption) hydronic heat pump	25 mg/kWh (gas)
Electrically-driven hydronic heat pump	No limit
Cogeneration	100 mg/m_N^3 (5% O_2) (Internal combustion engine, gas) 200 mg/m_N^3 (5% O_2) (Internal combustion engine, liq) 25 mg/kWh (Stirling, gas)

3.6.2 Verification

Products holding a relevant Type 1 Ecolabel or that demonstrate compliance with relevant Type 1 Ecolabel criteria will be deemed to comply. Other appropriate means of proof will also be accepted.

If following the EU Ecolabel for heating generators, the verification is as follows:

A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

The verification will be done following the standard specified in Table 17.

Table 17. EN-standards for carbon monoxide (CO) emissions relevant for the product group "hydronic central heating generators"

Number	Title
Gas boilers	
FprEN 15502-1: July 2010	Gas-fired heating boilers – Part 1: General requirements and tests (CEN)
Biomass boilers	
EN 303-5	Heating boilers - Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300 kW - Terminology, requirements, testing and marking

3.6.3 Rationale

CO is a product of incomplete combustion and it poses environmental and health risks. A CO limit value is applicable in principle to gas boilers, biomass boilers, gas-driven hydronic heat pumps, and cogeneration units. The CO limit is never applicable to electrically-driven hydronic heat pumps (for heat pumps the CO limit is only applicable to gas-driven units).

Some stakeholders expressed that CO is more a health that an environmental issue. However, most stakeholders recognized CO as an environmental issue, for example CO contributes to ozone depletion in summer. Stakeholders emphasized the need for the CO limit. Otherwise, products will try to optimize their performance for low NOx emissions only, leading to significant CO emissions. GPP criteria therefore should include the CO limit as an important requirement, as it relates to both health and environmental issues.

CO criteria given in other product policy schemes are compared in Table 18.

Stakeholders provided feedback during and after the 2nd workshop (29th November 2011). Experts from the Competent Bodies offered specific suggestions for CO limit values, as in the table below. No distinction in limit value should be made between condensing and non-condensing boilers. The distinction needs to be made however between internal and external combustion (as indicated in the table). Gas-engine driven heat pumps should have the same limits as gas condensing boilers, because the technologies are similar. For biomass boilers it was proposed to use a limit of 200 mg/m_N^3 (13% O_2), as enough products can reach this limit.

Technology	Example	Limit
Internal combustion engine	Gas-engine driven heat pump, CHP units	100 mg/m_N^3 (5% O_2) (gas) 200 mg/m_N^3 (5% O_2) (liq)
External combustion ("burner")	Boilers, sorption heat pumps, Stirling CHP units	25 mg/kWh (gas)

Table 18. Comparison of carbon monoxide (CO) emission limits in different product policy schemes.

Heating generator technology	Ecodesign implem. measures	EU Ecolabel	Blauer Engel	Nordic Ecolabel	Austrian Ecolabel	GPP
Gas boiler	No limit	N/A	50 mg/kWh (46 ppm)	N/A	N/A	50 mg/kWh (C) 20 mg/kWh (non-C)
Biomass boiler	N/A	N/A	≤50 kW 80 mg/m_N^3 (full load) 180 mg/m_N^3 (30% load) >50 kW 70 mg/m_N^3 (full load) 150 mg/m_N^3 (30% load)	400 – 2000 mg/m^3	Automatic: 60-150 mg/MJ (216-540 mg/kWh) (90-225 mg/m^3) (full load) 135-300 mg/MJ (486-1080 mg/kWh) (203-450 mg/m^3 (30% load) Manual (wood only): 250 mg/MJ (900 mg/kWh) (375 mg/m^3) (full load) 750 mg/MJ (2700 mg/kWh) (1125 mg/m^3 (50% load)	400 – 2000 mg/m^3
Gas-driven hydronic heat pump	No limit	No limit	50-300 mg/kWh, 300 mg/m^3	No limit	N/A	No limit
Eletrically-driven hydronic heat pump	No limit	No limit	No limit	No limit	N/A	No limit
Cogeneration	No limit	N/A	300 mg/m_N^3 (gas) 300 mg/m_N^3 (liq)	N/A	N/A	No limit

Notes on Table 18.

- Austrian label for automatic biomass generators. For the CO limit, two values are given, for example: 60-150 mg/MJ, 135-300 mg/MJ. In each case, the lower limit value corresponds to pellets, and the higher limit value to chipped wood.
- The biomass boilers Blauer Engel criteria here are the most updated ones. They are somewhat stricter than the previous limits (e.g. instead of 80 it was 90 before; instead of 180 it was 200).The older criteria didn't make different with respect to the capacity of the unit. It was only 90% mg/m^3 full load, and 200 mg/m^3 at 30% part load, regardless of the capacity of the unit.

3.7 Criterion 7 – Particulate matter (PM) emissions limit

3.7.1 Formulation as core and comprehensive criterion

The particle matter (PM) content in the exhaust gas must not exceed the values indicated in Table 19. The units shall be given mg/m$_N^3$.

Table 19. Criteron on particulate matter (PM) emissions limit

Heating generator technology	Particle matter (PM)
Gas/liquid boiler	No limit
Biomass boiler	20 mg/m$_N^3$ (13% O_2) (pellet and wood log boilers) 30 mg/m$_N^3$ (13% O_2) (wood chips boilers)
Gas-driven hydronic heat pump	No limit
Electrically-driven hydronic heat pump	No limit
Cogeneration	1 mg/m$_N^3$ (5% O_2) for internal combustion engines using liquid fuels

3.7.2 Verification

Products holding a relevant Type 1 Ecolabel or that demonstrate compliance with relevant Type 1 Ecolabel criteria will be deemed to comply. Other appropriate means of proof will also be accepted.

If following the EU Ecolabel for heating generators, the verification is as follows:

A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

The verification will be done following the standard specified in Table 20.

Table 20. EN-standards for particulate matter (PM) emissions relevant for the product group "hydronic central heating generators"

Number	**Title**
Gas boilers	
FprEN 15502-1: July 2010	Gas-fired heating boilers – Part 1: General requirements and tests (CEN)
Biomass boilers	
EN 303-5	Heating boilers - Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300 kW - Terminology, requirements, testing and marking
Gas-driven heat pumps	
prEN 12309 – 2: 2000	Gas-fired absorption and adsorption air-conditioning and/or heat pump appliances with a net heat input not exceeding 70 kW
Cogeneration	
prEN 50465: 2010 Draft ed. 2.	Gas appliances – Combined Heat and Power appliance of nominal heat input inferior or equal to 70 kW (CEN)

3.7.3 Rationale

Particle matter, also called dust, is potentially an issue in heating generator technologies such as biomass boilers, gas-driven heat pumps and some types of cogeneration systems.

Particle matter, also called “soot”, which can be measured in the exhaust gases, is produced by incomplete combustion of the fuel. Emission limit values are mentioned in Directive 1999/30/EC, which indicate that the European environmental legislators taken PM emissions very seriously. In fact, the emission limits on a weight bases are four times more stringent than those for NOx.

PM emissions are primarily dependent on the grade of fuel fired in the heating generator. Generally, PM levels from natural gas are significantly lower than those of oils and biomass. Table 21 contains the PM limit values in different policy schemes.

Stakeholders pointed out that there are some problems with the current testing method for particulate matter. In particular, statekeholders stated that measurement methods for PM are not yet harmonized. One of the most common methods appears to be TS 15883 Annex A, but it needs to be supplemented by e.g. an OGC measurement. Several international institutions (such as Austrian Label and Nordic Ecolabel) are working together to find new and more reliable methods for determination. A specific point of discussion concerns the point of measurement for PM. Two options are possible:

- At the chimney, at 300 ^{o}C. The problem is that this is not the situation when people get exposed to the PM.
- The second method is measuring at conditions similar to when people get exposed to PM, which is at 20-30 ^{o}C. At this temperature, a lot of volatile compounds have solidified and particles become bigger, and there are more particles. The test is done in a tube. Several experts consider that this would be preferable to the first option.

Table 21. Comparison of PM values established in different product policy schemes for heating generators.

Heating generator technology	Ecodesign implem. measures	EU Ecolabel	Blauer Engel	Nordic Ecolabel	Austrian Ecolabel	GPP
Gas boiler	No limit	N/A	No limit	N/A	N/A	No limit
Biomass boiler	N/A	N/A	Pellet boilers: 20 mg/m_N^3 (full load) 40 mg/m_N^3 (30% load) Wood chip boilers: 30 mg/m_N^3 (full load) 40 mg/m_N^3 (30% load)	40-70 mg/m^3	Automatic: 15-30 mg/MJ (54-108 mg/kWh) (23-45 mg/m^3) (full load) Manual (wood only): 40 mg/MJ (144 mg/kWh) (61 mg/m^3) (full load)	40-70 mg/m^3
Gas-driven hydronic heat pump	No limit	No limit	Gas: 150 mg/m^3	No limit	N/A	No limit
Eletrically-driven hydronic heat pump	No limit	No limit	No limit	No limit	N/A	No limit
Cogeneration	No limit	N/A	Gas: None Liquid: 150 mg/m^3	N/A	N/A	No limit

Notes to the table:

- § Austrian label for automatic biomass generators. For the PM limit, two values are given: the lower limit value corresponds to pellets, and the higher limit value to chipped wood.
- § The earlier version of Blauer Engel criteria was: 20 mg/m^3 (full load)

Experts from the Competent Bodies proposed, after the 2nd workshop (29th November 2011) setting a limit of 20 mg/m_N^3 (13% O_2) for pellet and wood log boilers, 30 mg/m_N^3 (13% O_2) for wood chips boilers (Wood chips have more bark. Wood chip boilers are larger and have a higher flue gas velocity carrying more ash in the flue gas). There should be a limit of 1 mg/m_N^3 (5% O_2) for internal combustion engines using liquid fuels.

Questions to stakeholders:

Comments from stakeholders on appropriateness of emission limit values for Criteria 4 through to 7 are welcome.

In addition, comments regarding testing methodology, verification are also welcome.

3.8 Criterion 8 – Sound power level

3.8.1 Formulation as award

Additional points will be awarded for:

Declaration of sound power level. The tenderer should declare the sound power level of the heating generator unit. The sound power level shall be tested and stated in dB(A).

Additional points will be awarded if the sound power level is below limits established by the following formulas, as stated in Table 22:

Table 22. Formulas for sound power level

Heating generator technology	Sound power level, in dB(A)
Air-to-water heat pumps	Sound power level: $L_{WAd} \leq 17 + 36 * lg (P_N+10)$ **dB(A)** P_N is the design load Note: This formula allows also larger heat pumps to comply with these limits.
Cogeneration	Sound power level: $L_{pAd,lim} \leq [25+20 * lg (P_{el}+15)]$ **dB(A)** $L_{pCd} \leq L_{pAd,lim} + 20$ **dB(C)**

Implementation note:

Award criteria: Contracting authorities will have to indicate in the contract notice and tender documents how many additional points will be awarded for each award criterion. Environmental award criteria should, altogether, account for at least 10 to 15 % of the total points available.

Where the award criterion is formulated in terms of "better performance as compared to the minimum requirements included in the technical specifications", points will be awarded in proportion to the improved performance.

3.8.2 Verification

A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

Testing shall be performance in accordance with EN 12102. The test report shall be submitted with the application.

3.8.3 Rationale

The sound power level, or noise, from the heating units is a parameter that should be taken into consideration when deciding whether to purchase and where to locate the heating generator units, in order to minimise the noise impact upon the surrounding environment and those living and working in within it.

Noise emissions from central heating products occur mainly from either combustion air / flue gas transport (combustion boilers) or from air transport over evaporators / compressor noise (vapour compression cycle heat pumps). In the Ecodesign Lot 1 calculation methodology noise emissions were included to determine distribution losses, the rationale being that the noisier the boiler is, the further it is installed from the main living areas, thereby introducing distribution losses.

In the current Ecodesign proposals there is an information requirement for all boilers and a maximum noise emission requirement of ~76 dB(A) for heat pumps. From stakeholder consultation, it seems like this measure is not reasonable, as there is an estimated 76% of heat pump products registered by Eurovent existing in the market, which will be excluded from the proposed Ecodesign measure, as reflected in Fig. 5.

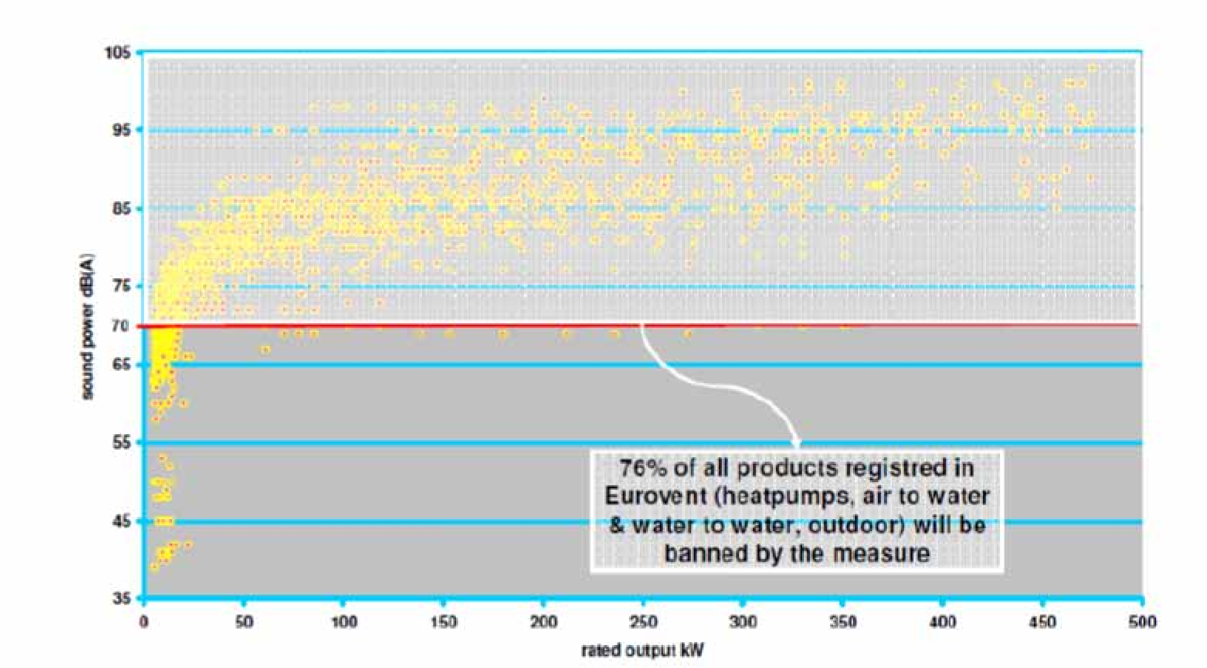

Figure 5. Market data showing that 76% of all heat pump products registered in Eurovent will not be able to meet the Ecodesign sound power level of 70 dB(A). Figure provided by EPEE.

Stakeholders said that noise is becoming an important issue for customers and public procurers, but until now it has not been part of a certification process. One of the difficulties in establishing a quantitative noise limit is that much data is still missing for many types of heating generator technologies. In general, for larger scale appliances, higher limit values would be necessary. The noise level would also depend on the location in the building where the heat generator is installed.

The majority of stakeholders expressed the concern that only limited data on noise is available, and this makes it difficult to establish the noise criterion. In addition, it was expressed that the original

JRC-IPTS proposal (presented at the 2nd workshop on 29th November 2011) was based on Ecodesign. Experts at the workshop pointed out that not everybody agreed with the Ecodesign proposal during the Ecodesign consultation. It was also a general opinion that, if a noise criterion is established, then it should be applicable to all the technologies, not only to heat pumps.

Some stakeholders expressed concerns that there are differences in national requirements set up for noise for heating generator products installed in different countries, and therefore a common EU Ecolabel criterion on noise might be difficult to develop. Other stakeholders expressed that an Ecolabel criterion on noise is meaningful if noise affects people living inside the house; for outside noise there is already national regulation.

In certain Ecolabels, noise requirements for heat pumps are only established for heat pump capacities of up to 20 kW; above 20 kW there are no noise limits. Also, units above 20 kW typically belong to the scope of professional, not residential heating generators. Other stakeholders said also that for large boilers, noise if less of an issue.

Most ecolabels do not require a criterion on noise limit. A few ecolabels require to measure noise and report it, without giving a specific limit.

Air-to-water heat pumps use outside air or ventilation air as heat source. The air flow over the heat exchanger (in heating mode: evaporator side) will result in airborne noise, expressed as sound power level.

For split-package units with an outdoor unit, the effects of such airborne noise is very local and determined by local circumstances (position of outdoor unit, dampening applied etc.).
For single-package units, for instance using ventilation air, the effects may be more prone, since the noise is produced indoors and is related to the ventilation system.
Such effects in outdoor or indoor noise cannot yet be quantified, since they are very susceptible to local circumstances, but the effect is present and should be addressed by manufacturers/procurers.

The table below (Table 23) summarizes the noise requirement for all heating generators, showing that the requirement is only applicable to heat pumps.

Table 23. Comparison of noise limits established in different product policy schemes for heating generators.

Heating generator technology	Ecodesign implementing measures	EU Ecolabel	Blauer Engel	Nordic Ecolabel	Austrian Ecolabel	GPP
Gas-driven or electrically-driven hydronic heat pump	60/65 dB(A), for <6 kW rated capacity 65/70 dB(A), for > 6 kW rated capacity	No limit	No limit	Noise must be tested and reported	N/A	No limit

Questions to stakeholders:

We would like to invite the stakeholders to comment if they consider the issue of sound power level an appropriate criteria area.

Given the scarcity of data, is it reasonable to require only reporting of the sound power level as the GPP criterion, without the requirement to comply with a maximum quantitative value of sound power level?

3.9 Criterion 9 – Hazardous substances and mixtures

3.9.1 Formulation as comprehensive criterion

The following formulation is proposed:

In accordance with Article 6(6) of Regulation (EC) No 66/2010, the product or any article of it shall not contain substances referred to in Article 57 of Regulation (EC) No 1907/2006 nor substances or mixtures meeting the criteria for classification in the following hazard classes or categories in accordance with Regulation (EC) No 1272/2008 of the European Parliament and of the Council ([38]).

List of hazard statements and risk phrases:

Hazard statement ([39])	Risk Phrase ([40])
H300 Fatal if swallowed	R28
H301 Toxic if swallowed	R25
H304 May be fatal if swallowed and enters airways	R65
H310 Fatal in contact with skin	R27
H311 Toxic in contact with skin	R24
H330 Fatal if inhaled	R23/26
H331 Toxic if inhaled	R23
H340 May cause genetic defects	R46
H341 Suspected of causing genetic defects	R68
H350 May cause cancer	R45
H350i May cause cancer by inhalation	R49
H351 Suspected of causing cancer	R40
H360F May damage fertility	R60
H360D May damage the unborn child	R61
H360FD May damage fertility. May damage the unborn child	R60/61/60-61

([38]) OJ L 353, 31.12.2008, p. 1.
([39]) As provided for in Regulation (EC) No 1272/2008.
([40])As provided for in Council Directive 67/548/EEC (OJ 196, 16.8.1967, p. 1).

H360Fd May damage fertility. Suspected of damaging the unborn child	R60/63
H360Df May damage the unborn child. Suspected of damaging fertility	R61/62
H361f Suspected of damaging fertility	R62
H361d Suspected of damaging the unborn child	R63
H361fd May damage fertility. May damage the unborn child	R62-63
H362 May cause harm to breast fed children	R64
H370 Causes damage to organs	R39/23/24/25/26/27/28
H371 May cause damage to organs	R68/20/21/22
H372 Causes damage to organs	R48/25/24/23
H373 May cause damage to organs	R48/20/21/22
H400 Very toxic to aquatic life	R50/50-53
H410 Very toxic to aquatic life with long-lasting effects	R50-53
H411 Toxic to aquatic life with long-lasting effects	R51-53
H412 Harmful to aquatic life with long-lasting effects	R52-53
H413 May cause long-lasting effects to aquatic life	R53
EUH059 Hazardous to the ozone layer	R59
EUH029 Contact with water liberates toxic gas	R29
EUH031 Contact with acids liberates toxic gas	R31
EUH032 Contact with acids liberates very toxic gas	R32
EUH070 Toxic by eye contact	R39-41

The use of substances or mixtures in the final product which upon processing change their properties in a way that the identified hazard no longer applies is exempted from the above requirement.

Concentration limits for substances or mixtures meeting the criterion for classification in the hazard classes or categories listed in the table above, and for substances meeting the criterion of Article 57 (a), (b) or (c) of Regulation (EC) No 1907/2006, shall not exceed the generic or specific concentration limits determined in accordance with the Article 10 of Regulation (EC) No1272/2008. Where specific concentration limits are determined, they shall prevail against the generic ones.

Concentration limits for substances meeting criteria of Article 57 (d), (e) or (f) of Regulation (EC) No 1907/2006 shall not exceed 0.1 % weight by weight.

Derogations: The following substances or mixtures are specifically exempted from this requirement:

Articles with weight below 50 g	All hazard statements and risk phrases
Homogeneous parts of complex articles with weight below 50 g	All hazard statements and risk phrases
Nickel in stainless steel	All hazard statements and risk phrases

3.9.2 Verification

For each article and/or homogeneous part of complex articles with weight over 50 g the applicant shall provide a declaration of compliance with this criterion, together with related documentation, such as declarations of compliance signed by the suppliers of substances and copies of relevant Safety Data Sheets in accordance with Annex II to Regulation (EC) No 1907/2006 for substances or mixtures. Concentration limits shall be specified in the Safety Data Sheets in accordance with Article 31 of Regulation (EC) No 1907/2006 for substances and mixtures.

3.9.3 Rationale

It is important to ensure that the materials and substances used in hydronic central heating generators do not pose a risk to the environment or end-users. Therefore, materials composing the heating generators should not contain hazardous substances, following Ecolabel Regulation 66/2010, Articles 6(6) and 6(7). Specifically, the Ecolabel Regulation states that the 'substitution of hazardous substances by safer substances, as such or via the use of alternative materials or designs, should be considered wherever it is technically feasible'.

Based on research and stakeholder consultation, several substances could be derogated from Article 6(6) based on Article 6(7). At the 2nd workshop on Ecolabel (29th November 2011), the IPTS explained that comments to Criteria 9 and 10 are welcome until mid January, including requests for derogation regarding Criterion 9. Representatives from the Competent Bodies expressed that Criteria 9 and 10 are important, and overall agree with how they are stated. Stakeholders from the Competent Bodies said that the proposed exemption of small parts (≤ than a certain weight) makes Criteria 9-10 more practical.

It was also mentioned that in the Blue Angel criteria for heat pumps, cadmium, lead, mercury, chromium(VI) and flame retardants (PBB and PBDE; according to directive 2011/65/EU) are not allowed. Manufacturers declare conformity. NGO representatives requested following the Blue Angel approach and ban flame retardants and PVC.

Stakeholders asked if there is any document or list of materials available to understand what R/H phrases and derogations apply. This list is not available to the IPTS. Manufacturers are encouraged to contribute with data in this regard.

Recent preparatory studies for Green Public Procurement for certain heating generators, as well as recent EU Ecolabel criteria development (during 2010 and 2011), have also followed the proposed holistic approach of addressing the chemical characteristics of the substances in order to mitigate any potential risks arising from the use of these materials. This is achieved by **using appropriate hazard**

statements and risk phrases in the relevant criteria. By taking this more holistic approach the focus of the criteria is on the chemical and environmental properties of the substances rather than on the chemical family to which they belong and thus does not unduly exclude any one group of chemicals. Feedback received during the past two workshops confirms the interest of a number of stakeholders in following this more holistic approach.

Stakeholders have requested a derogation for Ni. It is considered that a total ban of nickel is not justified. One of the reasons is that the legislation allows for different interpretations. In practice, there is always some level of detectability of nickel, even though its presence does not pose any health or environmental concern.

Questions to stakeholders:

Do you agree with the proposed approach to address hazardous substances and mixtures by referring to general hazard statements and risk phrases, and include this criterion as a comprehensive criterion in GPP?

We welcome comments regarding possible derogations of the mentioned or additional substances.

3.10 Criterion 10 – Substances listed in accordance with Article 59(1) of Regulation (EC) 1907/2006

3.10.1 Formulation as comprehensive criterion

The following formulation is proposed:

No derogation from the exclusion in Article 6(6) may be given concerning substances identified as substances of very high concern and included in the list foreseen in Article 59 of Regulation (EC) No 1907/2006, present in mixtures, in an article or in any homogenous part of a complex article in concentrations higher than 0.1% w/w. Specific concentration limits determined in accordance with Article 10 of Regulation (EC) No1272/2008 shall apply in case it is lower than 0,1% w/w.

3.10.2 Verification

The list of substances identified as substances of very high concern and included in the candidate list in accordance with Article 59 of Regulation (EC) No 1907/2006 can be found here:

http://echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp

Reference to the list shall be made on the date of application.

The applicant shall provide a declaration of compliance with this criterion, together with related documentation, such as declarations of compliance signed by the suppliers of substances and copies of relevant Safety Data Sheets in accordance with Annex II to Regulation (EC) No 1907/2006 for substances or mixtures. Concentration limits shall be specified in the Safety Data Sheets in accordance with Article 31 of Regulation (EC) No 1907/2006 for substances and mixtures.

3.10.3 Rationale

Feedback was received from stakeholders regarding substances of very high concern (SVHCs). It is generally agreed that SVHCs should be banned in Ecolabel products. However, the practical implementation of this idea seems more difficult to do. One of the concerns is that a radical ban of SVHCs could potentially hamper the possibility for some environmentally friendly product to comply with the Ecolabel requirements. Another difficulty arises from the fact that SVHC is a dynamic concept; therefore, a product may be awarded an Ecolabel at a certain date, and then be found that it contains substances that later on are classified as SVHC.

Questions to stakeholders:

We would like to invite the stakeholders to comment on the appropriate formulation of a criterion related to substances of very high concern (SVHC) as a comprehensive criterion in GPP.

3.11 Criterion 11 – Plastic parts

3.11.1 Formulation as award

The following formulation is proposed:

a. If any plasticiser substance in the manufacturing process is applied, it must comply with the requirements on hazardous substances set out in Criteria 9 and 10.

b. Plastic parts of articles or homogeneous parts of complex articles with weight 50 g or more shall not contain a chlorine content greater than 50 % by weight.

c. Plastic parts with weight 50 g or more shall be labelled according to ISO 11469, in order to facilitate recycling.

Implementation note:

Award criteria: Contracting authorities will have to indicate in the contract notice and tender documents how many additional points will be awarded for each award criterion. Environmental award criteria should, altogether, account for at least 10 to 15 % of the total points available.

Where the award criterion is formulated in terms of "better performance as compared to the minimum requirements included in the technical specifications", points will be awarded in proportion to the improved performance.

3.11.2 Verification

The applicant shall provide a declaration of compliance with this criterion, together with related documentation, such as declarations of compliance signed by the suppliers of substances and copies of relevant Safety Data Sheets. The applicant shall provide information on the plasticisers used in the product. The applicant shall provide information on the maximum chlorine content of the plastic parts. A declaration of compliance signed by the plastic and biocides suppliers and copies of relevant safety data sheets about materials and substances shall also be provided to the awarding competent body. All biocides used shall be clearly indicated. The applicant shall provide information on the intentionally added substances used as flame retardants.

3.11.3 Rationale

Plastic parts are addressed in a separate criterion because stakeholders raised several points related to this issue.

Some stakeholders expressed strong concern over the issue of PVC and phthalates content of materials, and that these materials should be substituted. Regarding PVC, some stakeholders expressed that we should talk about chemicals in general; imposing criteria on substances which are emitted at a very low extent, such as PVC, is questionable.

Some industry stakeholders disagreed with the suitability of this criterion; arguments are based on the fact that environmental legislation already imposes strict limits on emissions of dioxins and furans (which are emitted when PVC is incinerated). These experts also stated that PVC is not hazardous.
However, other stakeholders from NGOs and some of the Competent Bodies explained that PVC incineration has associated serious environmental impacts, not only from the emissions of dioxins and furans, but also because other wastes produced during the incineration of PVC. Several existing ecolabels exclude chlorine-containing plastics.

Regarding labelling of plastic parts, there are a number of ecolabels, such as the Blauer Engel for heat pumps, for which plastic parts above 50 g shall be named according to international standards.

Overall, a significant part of the stakeholders raised concern over plastic parts. However, some uncertainties regarding the environmental impacts (especially related to the disposal of PVC parts) still remain. Other European legislation already addresses the issues of disposal of PVC. In summary, a GPP criterion on plastic parts is still proposed, but as “award”.

3.12 Criterion 12 – Product design for sustainability

3.12.1 Formulation as award

The criterion will consist of two parts:

- Promotion of reuse, recycling and generally sound end-of-life management
- Product quality/usability and lifetime extension

Implementation note:

Award criteria: Contracting authorities will have to indicate in the contract notice and tender documents how many additional points will be awarded for each award criterion. Environmental award criteria should, altogether, account for at least 10 to 15 % of the total points available.

Where the award criterion is formulated in terms of "better performance as compared to the minimum requirements included in the technical specifications", points will be awarded in proportion to the improved performance.

3.12.2 Verification

Products holding a relevant Type 1 Ecolabel or that demonstrate compliance with relevant Type 1 Ecolabel criteria will be deemed to comply. Other appropriate means of proof will also be accepted.

If following the EU Ecolabel for heating generators, the verification is as follows:

A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

3.12.3 Rationale

Based on results from the technical analysis, it is concluded to be worth considering end-of-life management issues relating to heating generators, due to significant potential for environmental harm in this lifecycle phase. End-of-life management is also relevant to elements of heating generator that will need to be replaced throughout the life span of the heating generator as a whole. Heating generators consist of materials that can be recovered and recycled, for example plastics and in particular, metals. In addition, it may be the case that a heating generator is replaced before it has reached its natural end of life. It is generally better in life cycle terms to replace an older heating generator before reaching its end-of-life with a new, more efficient one (also with lower GHG emissions).

The criterion on product design for sustainability includes considerations such as: promotion of reuse, recycling and generally a sound end-of-life management. It may in principle include aspects such as: recycled material content, design for recycling, design for repair/warranty and spare parts, criteria regarding easy for reuse/recycle, etc.

Examples from other labels are: the Blauer Engel criterion on recyclable design, Blauer Engel criterion for marking of plastics, guarantee of repairs and maintenance of equipment, product take back requirement. From the GPP preparatory work on heat pumps, the end-of-life management of heat pumps is mainly regulated by the requirements of the WEEE Directive, as such units have to be collected for proper disassembly, treatment and recycling of parts. Much of the components of heat pumps can be recycled with a minimum of treatment, for example plastics and metals. In addition, under the EC F-gas legislation, when a heat pump is recycled, reclaimed or destroyed, certified personnel must recover over all the fluorine-containing gases in order to limit the amount of fugitive emissions from disposal of the units and thereby mitigate their impact on the ozone layer (as well as reducing their global warming impact).

§ Experts from the Competent Bodies said that for example in the Blue Angel there are some soft criteria for recyclable construction, such as avoiding insolvable connections, composite materials, easy dismantling of groups of components, low quantity of materials

§ NGO stakeholders asked that warranty should be between 5 and 10 years. Industry stakeholders (heat pumps) suggested a full warranty of 2 years. Other stakeholders said that this is already the case in the market. However, there was disagreement on this point: some manufacturers stated that the full warranty is for 6 months; after that, it is necessary to prove that it was the producer's fault.

Feedback received on minimum recycled content and recyclability

Stakeholders have expressed that the specification of a **minimum recycled content** may be appropriate for some materials, but not for materials such as metals and alloys, glass and certain plastics, which are already extensively recycled via well-established recycling markets. In addition, a specification on recycled content is focused on the manufacturing stage, and may make sense for products with short life times, limited market growth and where the recycling industry is not profitable or mature. Metal products for example often have lifetimes of several decades, and recycling markets are steady or growing. Therefore, there does not seem a correlation between the recycled content of a product and its recycling performance when reaching its end-of-life. Instead of recycled content, stakeholders propose **recyclability** as the key criterion for metals, glass and other highly recycled materials.

Other experts agree that it is not necessary to specify a minimum recycled content on materials such as metals. Metals are expensive and the industry already has a high incentive to recycle. In addition, some parts of the heating generator may by design need a pure metal (with no recycled content). Also it might not be necessary to include criteria on design for disassembly/recycle (as this is difficult to enforce). Finally, the lifetime of heating generators is longer than other market products, and therefore a requirement on minimum recycled content is less meaningful for heating products compared to other type of products in the market. It is important that materials are marked correctly to ensure they are recycled or disposed of in the correct manner in the end of life phase. Stakeholders finally suggested a requirement to mark precious metals and/or rare earth metals in electronic parts as information to facilitate recycling Blauer Engel includes a criterion on recyclable design, criteria regarding ease for reuse/ recycle, marking of plastics, guarantee of repairs and maintenance of equipment, product take back requirement.

3.13 Criterion 13 – Installation and user information

3.13.1 Formulation as core and comprehensive criterion

The following issues shall appear on the packaging, a leaflet attached to the product, or on a companion website:

- correct installation instruction,
- correct operation instruction,
- information concerning appropriate disposal at end-of-life,
- information on appropriate dimensions of heating generators for different building characteristics/size.

3.13.2 Verification

A certificate signed by the manufacturer declaring compliance with these requirements shall be submitted to the awarding competent body, together with the relevant documentation.

3.13.3 Rationale

According to many sources of information including different Ecolabel criteria, GPP preparatory work for boilers, and stakeholder feedback, environmental impacts will to a significant extent be governed by the behaviour of end users.

It is therefore essential that end users maintain and operate the heating generators in the correct manner, as designed to achieve the maximum efficiencies and lowest emissions. To assist this it is important that clear instructions and guidance/training are provided, highlighting where necessary the need for trained engineers.

As explained above, the correct operation of the heating generator that will lead to the maximum benefits in terms of reduced energy consumption and reduced air emissions depends to a large extent on the user behaviour. Therefore the Ecolabel will provide installation and user information.
In the wider context of the heating system as a whole, it is also important that the system has adequate control mechanisms to ensure the heating is only on and at the required temperature when there is a demand for it. Other aspects of the system also have potential environmental impacts, for example insulation foams containing greenhouse gases and asbestos-containing fire-retarding materials. This is a particular issue for generators where insulation is replaced, as older materials that have been in-situ for a number of years may contain these gases, which will need to be recovered properly.

The installation and user information will include information regarding: installation, operation, and end-of-life management.

Feedback from a majority of stakeholders coincided in the installation and user information as probably the crucial part in the life cycle of all types of heating generators, and especially in technologies such as biomass generators, and heat pumps. Stakeholders pointed out that one of the key aspects of the ecolabel is related to the installation and the installer. Feedback from the Nordic Swan pointed out that the Ecolabel criteria should require a competent installer. The ecolabel should provide a system to teach the installer, and it should provide teaching programs. There should be also a certification program for installers, and the installer would need to be certified in order for the product to be ecolabelled.

Installation guidelines are a very important issue, because a correct installation can have a large impact on the overall environmental performance of the heating product.

Several stakeholders at the 2nd workshop proposed that Criterion 3 should be split in two parts:

- Criterion 13a – Information for users (purchasers/consumers)
- Criterion 13b – Information for installers
-

The reason for this split is that the type of information for users is very different than that provided to installers (which will be very complicated for the users to understand and confusing).
In addition, it was also said that producers should have the responsibility to ensure that installers will be properly trained, and therefore it was proposed that a separate criterion is developed, which will require the producer to guarantee trained installers.

<u>Comments on Criterion 13a – Information for users</u>

- The criterion should include the requirement that producers inform the consumers as to where to find installation information
- Regarding consumer information, the Ecolabel should explain to the consumer that the performance of the heat pumps is evaluated in reference to all heating generator products (including liquid and gas boilers).
- Heat pump manufacturers expressed that it is important what the Ecolabel communicates to the consumers. Two important things in products are: durability, but also sustained optimum performance along time, at least for the first 3-5 years.

<u>Comments on Criterion 13b – Information for installers</u>

- The Ecolabel should give some instructions for installers leading to efficient and environment friendly operation.

- o Stakeholders expressed the importance of information on the need for correct hydraulic balancing of the heat distribution in the heating system.
- o Stakeholders from the Competent Bodies said that, for biomass boilers, information on combination with storages should be given, and advice on the minimum size of storage to ensure continuous operation. In Germany for example it is mandatory to operate a biomass boiler with a storage unit (size: 55 litres / kW). This reduces operation with many starts which cause very high emissions.
- o For cogeneration units, information on catalysts and their exchange/maintenance intervals should be given.

Proposal for a separate Criterion – The manufacturer guarantees trained installers

- o Stakeholders from the Competent Bodies expressed that there will be some difficulties to establish this type of requirement. For example, in Germany there is a 3-step marketing process (manufacturer à wholesale company à installer), so the manufacturer has no influence on how its products are actually installed (beyond some training programmes for installers).

Other comments: Information and instructions have also been divided for: (1) installation, (2) service personnel, (3) end users. Finally other stakeholders commented that it would be necessary that the Ecolabel ensures qualification and training of installers.

Stakeholders have offered specific text proposals for installation and user information, as follows:

Services of the producer

- § Offer of the initial start-up of the heat generator by the user and/or the installation company.
- § Explanation of all parameters for an efficient, low-emission combustion and management (customer training)
- § Offer of a maintenance service available at the usual customer service hours
- § Offer of conducting the annual testing of the heater
- § Offer of equipping the system with additional metering accessories (e.g. waste gas thermometer, operating-hours meter etc.)
- § Availability of equivalent spare parts for at least **10 years**
- § Information with respect to all relevant regulations and standards concerning fuel quality, storage and transportation logistics
- § Information that in the planning and design of a fuel storage for pellets the requirements of standard ÖNORM M 7137 are to be taken into account
- § Technical training for installation companies and vendors

Installation details

To avoid faulty installations the written and graphical documents for the fitter shall be designed in such a way that the entire information required is comprehensible and given in correct order.m Furthermore, the documents shall contain at least the following information, if they are of relevance for the requested heat generator:

- o Technical information on the heat generator:
  - § Boiler class, diameter of flue gas connection, flue gas temperatures during operation as well as required feed pressure, dimensions of filling space, water content, water-side resistance, required cold water pressure, minimum return temperature
  - § Electric supply, fuse protection and circuits, additional sets
- o On the fuel:

    - § Type and piece size of fuel, maximum water content and heat output, filling ratios and corresponding combustion period
    - §
- o Mounting instructions for step-by-step fitting and the necessary on-the-spot tests, assembly and alternatives; information concerning sources of mistakes and their avoidance, fitting position of all sensing devices for control and reading equipment, setting ranges of the sensing devices, correct settings for the start-up
- o Control of the heat distribution:
    - § Zone-wise control, timers, thermostatic valves, etc.

Maintenance

The operator shall receive information and instructions on how to check the perfect functioning of the system. Such information shall be divided into owner maintenance and third-party maintenance and shall comprise at least the following points:

- § Periodic maintenance during heating operation (interval, scope, ...)
- § Weekly controls (e.g. visual control)
- § Maintenance and controls of the conveying system
- § Keeping maintenance records
- § Maintenance by the installation company or by a suitable maintenance service (interval, scope of work,...)

Declaration (information for the customer):

(1) Pre-selling information

Before purchasing, customers shall be informed about the below-listed items:

- § Tailoring the dimensions of the system to the required energy service
- § To ensure proper dimensioning of the system, an expert (producer, installation company,...) shall be consulted.
- § Efficient arrangement of boiler room and fuel storage as well as the optimum processing and storage of the fuels
- § Provision of the sources of relevant technical standards or laws for the dimensioning of the system
- § Most important technical data and all emission values
- § Information that in the guidelines for subsidisation of the Federal Provinces different requirements are made on buffer storages

(2) Operating instructions

The written information material for the user shall be designed in such a way that the parameters that are essential and required for the efficiency of the overall system are described in a comprehensible manner which takes into account also aspects of environmental protection.

To ensure that the high environmental standard of the biomass-fired system that was certified at the test stand can be maintained also in everyday operation, extensive operating instructions containing the below-mentioned points and indications shall be handed over to the user.

Environmental protection**:**

- § Clear note that the user can make a vital contribution to the environmentally benign operation of the heat generator only if all requirements listed in the operating instructions are complied with.
- § Use only admissible fuel
- § No burning of waste
- § Information about efficient and environmentally benign heating
- § Information on ash disposal

- Information regarding the disposal of the individual components of the system

Information on the fuel:
- Admissible type of fuel (maximum humidity content, size,...)
- Maximum filling height
- Combustion period at nominal heat output for each admissible type of fuel
- Energy content of one filling of the fuel
- Declaration of the test fuel

Start-up and operation:
- Proper firing, putting on, opening, and charging
- Functioning and operation of the control system for full- and part-load operation
- Information concerning the assessment of the quality of combustion and the operating status by means of visual observations (flame, deposits, ash, flue gas temperature,...)

Servicing and maintenance:
- Cleaning: Information on intervals and required equipment
- Fault: Correct behaviour, fault tracing and trouble-shooting
- Maintenance: Scope of owner and third-party maintenance, intervals
- Service phone numbers: Producer, maintenance service etc.

Additional information for boilers:

- Information on the design of the required boiler return and/or boiler temperature control. Recommendation concerning the installation of a control device (e.g. thermometer)
- Suitability of the boiler control for part-load operation
- Information on system adjustment to changing fuels (above all in the case of wood-chip furnaces)

Type label:

The type label fixed on the heater shall contain the following indications:
- Name and company headquarters of the manufacturer and manufacturer’s mark, if any
- Company name and address
- Trade name or type designation under which the heater is marketed
- Manufacturer number, type number and year of manufacture
- Indications on the admissible type and size of fuel
- Nominal heat output and capacity range in kW for the admissible type of fuel
- Electric supply (V, Hz, A) and electrical power input in watt (if available)

For heating boilers, the below-mentioned information shall be provided in addition:
- On the type label:
- Boiler class
- Maximum admissible operating temperature in °C
- Maximum admissible operating pressure in bar
- Water content in litres

System documentation

To ensure that, in practice, efficiency, environmental compatibility and operativeness of the overall system can approximately be achieved with the optimised conditions of a test stand measurement, it is of great importance that the system documentation is properly designed.

The system documentation and the completion certificate, respectively, shall therefore comprise at least the following content and test certificates:

- Test report (acc. to the relevant standard) with the following attachments:
  - Drawing of the system with picture
  - Description and explanation of all indications provided on the type label

- Installation certificate with the following statement: "The installation company certifies that the system has been installed professionally and in compliance with the applicable provisions regarding fire protection. It further confirms the conformity of the built-in technical safety devices by the attachment of the test certificates."
- The operator of the system has been familiarised with the operation of the system and has been instructed about the mode of action and the self-control of all safety devices. In the course of the instruction the operating instructions have been handed over to the operator of the system.
- Handover of the operating instructions
- Handover of all technical documents
- Handover of all certificates of conformity
- Handover of the commissioning certificate
- Listing of all service numbers (manufacturer, fitter, maintenance,...)
- In the case of industrial plants with a nominal heat output $\geq$ 50 kW mention shall be made of the recurrent test according to the Ordinance on Firing Systems

<u>Information related to external controls</u>

During the 1st workshop it was suggested that, as part of the consumer information, information is provided with the appliance regarding installation and operation that would include details of external controls.

Feedback from stakeholders (EU.BAC) has suggested that, while the correct application and use of controls is important, it is not appropriate however to include it as an Ecolabel requirement. This is because the Ecolabel will only apply to the most environmentally friendly appliances, while external controls should be a requirement of all heating appliances. Including such requirement as part of the Ecolabel criteria could inadvertently provide a message that the application of controls and their correct operation can be ignored will less environmentally friendly appliances. This is seen as a negative consequence to be avoided.

Additional feedback was as follows. User manual is very useful and important. Regarding the extended producer responsibility to ensure the performance, 5 years is too short, it should be 10 years. Installation manuals are very important. We should include the requirement for existence of on-line support. Web based documentation to avoid paper wasting. Web information is also important for purchasing. There should also be info available on the Ecolabel website.

<u>Training and certification for installers</u>

Training and certification for installers is especially important in certain technologies such as heat pumps. A well known training and certification programme for heat pump installers is the EHPA EUCERT[41]. This program was developed as a common European training programme for heat pump installers.

[41] EHPA EUCERT training and certification program for heat pump installers, http://www.ehpa.org/eucert/

Questions to stakeholders:

We would like to ask the experts for feedback regarding the installation and user information.

The stakeholders are encouraged to propose other issues, which should, in their opinion, be covered by consumer information/user instructions.

4. SUMMARY OF PROPOSED GPP CRITERIA AND FURTHER DISCUSSION POINTS

The life-cycle analysis in this study does not indicate an overall favourable technology. Each heating generator type has its specific advantages and drawbacks, depending on which impact category is considered. Because each heating technology entails different magnitudes of environmental impacts in different impact areas, this study concludes that it is important to compare the different technologies horizontally. The discussion at the 2nd workshop will serve to discuss and comment the criteria proposals including the specific limit values. The overall goal is to set the Ecolabel criteria that will lead to the award of the label to about 15-20% of hydronic central heating generators in the market, taken together as a product group.

From the literature review and information available from product policy schemes in the area of heating generators, it can be concluded that two of the most important criteria area are related to energy efficiency, and greenhouse gas (GHG) emission reductions. Therefore, these two parameters were used to set the common benchmark of minimum performance that all heating generators shall fulfil regardless of technology. The remaining criteria can be applicable to some or all technologies; the relevance of each of the criteria with respect to the heating generator technology is indicated and justified in each of the criterion.

5. UNITS AND CONVERSION FACTORS

Air emissions can be expressed in different units. For example, in the Austrian regulations they are typically given in mg/MJ. In other countries, they are given in mg/Nm^3 (13.2% O_2). MJ means Megajoules and it refers to the energy production. Nm^3 means Norm (standard) m^3 air with an oxygen content of 13.2% and it refers to the exhausted fumes. A straightforward (approximate) calculation conversion factor is 1:1.5. For example, 100 mg/MJ NOx in the Austrian Ecolabel is equivalent to 150 mg/Nm^3 NOx as expressed in the Blauer Engel criteria.

Often in ecolabels the air emissions limits are given in: mg/kWh, described as "mg of pollutant per kWh of heat generating material" (i.e. of energy input).

Blauer Engel emissions are measured at 0 ^oC, 1013 mbar, 13% O_2 (EN 303-5 for biomass boilers). 1 MJ = 0.278 kWh.
Conversion primary energy to electricity = 2.5. This factor reflects the average EU-27 efficiency of providing electricity from primary energy sources.

$\beta_{elec.}$	Carbon emissions of electricity	[g CO_2-equiv./$kWh_{elec.}$]	384
β_{gas}	Carbon emissions of gas	[g CO_2-equiv./kWh_{gas}]	202

6. APPENDIX

The current draft criteria was partly developed based on the results from a life-cycle analysis using 12 base cases, and described in the accompanying technical report[42]. Compared to earlier versions of the life-cycle analysis, more base cases have been added, i.e.: a gas hybrid composed of gas boiler plus electric heat pump, additional heat pump base cases (as to include electrically-driven, gas absorption and other gas-driven heat pumps), and a coal boiler.

The 12 base cases are as follows (their technical characteristics described in detail in the technical report available at the project's website):

1. Oil boiler
2. Gas boiler
3. Gas hybrid: The gas boiler represents 50% of the total thermal demand (i.e., of the total heat output of the hybrid unit); the remaining 50% is an electric heat pump
4. Electrically-driven heat pump
5. Gas absorption heat pump
6. Gas ICE (internal combustion engine) heat pump
7. Coal boiler
8. Small/wood manual biomass boiler
9. Small/wood automatic biomass boiler
10. Small pellet biomass boiler
11. Large wood chips biomass boiler
12. Cogeneration

The following figures summarize key findings of the accompanying technical report, representing main environmental impacts including greenhouse gases and other air emissions: NOx, organic carbon (OGC), carbon monoxide (CO) and particulate matter (PM), for the 12 base cases analyzed in the life-cycle analysis.

[42] "Development of European Ecolabel and Green Public Procurement Criteria for Hydronic Central Heating Generators. Draft Report. **Policy Analysis**", Nov. 2011, Van Holsteijn en Kemna BV (VHK), http://susproc.jrc.ec.europa.eu/heating/stakeholders.html

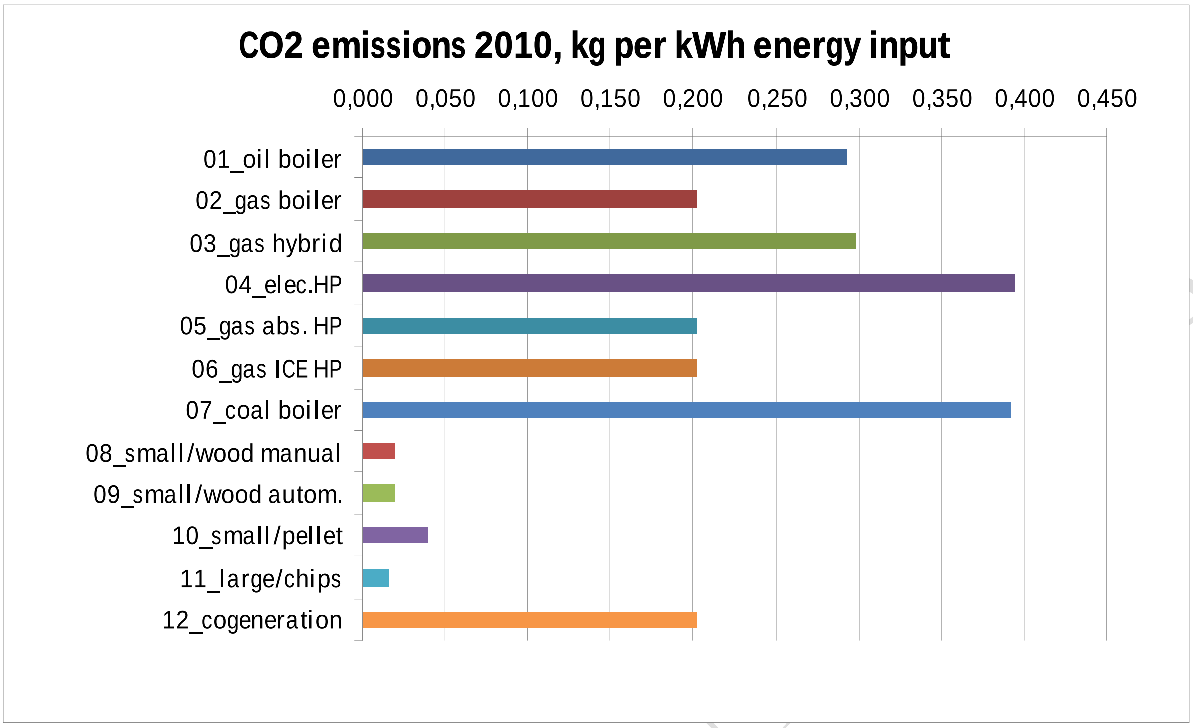

Figure 6. Greenhouse gas emissions in kg CO_2-equivalent per kWh energy input for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

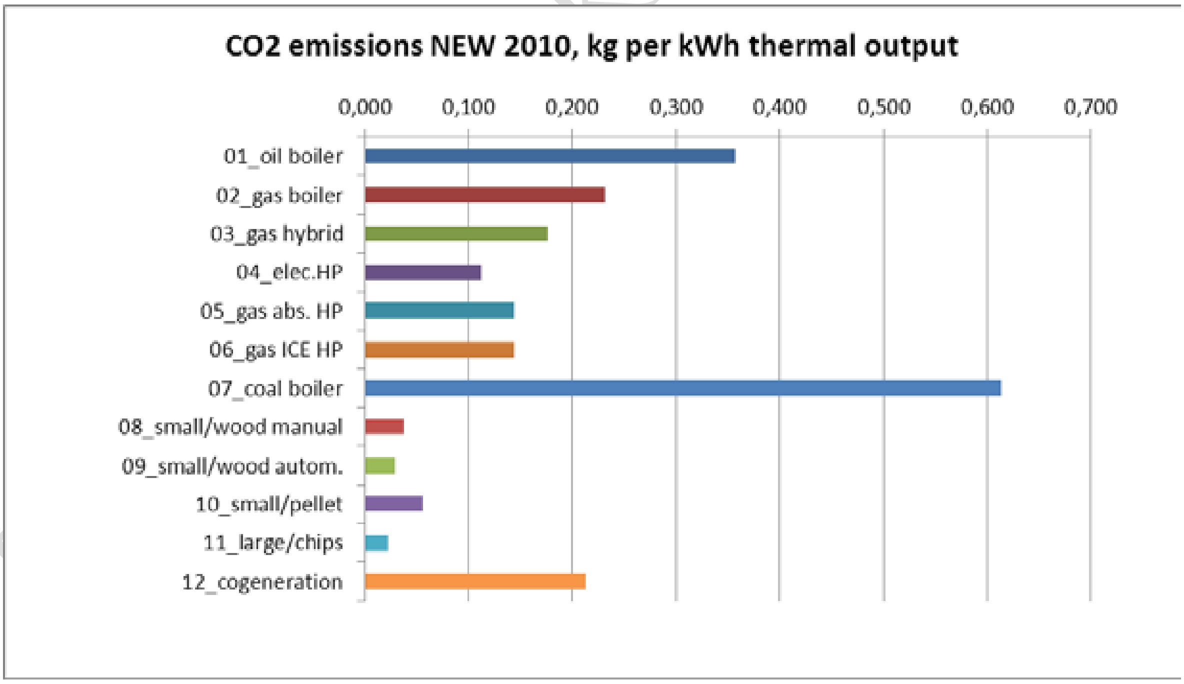

Figure 7. Greenhouse gas emissions in kg CO_2-equivalent per kWh thermal output for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

The comparison shows that the lowest CO2 emissions are achieved by biomass boilers, which is mainly due to political default of zero CO2 combustion emissions. The best non-biomass boiler emissions are by the electric heat pump due to its high energy efficiency and relatively low CO2 emissions per kWh output[43], followed closely by gas heat pumps and the gas hybrid solutions.
The oil boiler is relatively more polluting than the gas boiler due to lower average efficiency and a higher specific emission factors. The most polluting is the coal boiler, which has the worst efficiency and specific emission factor.

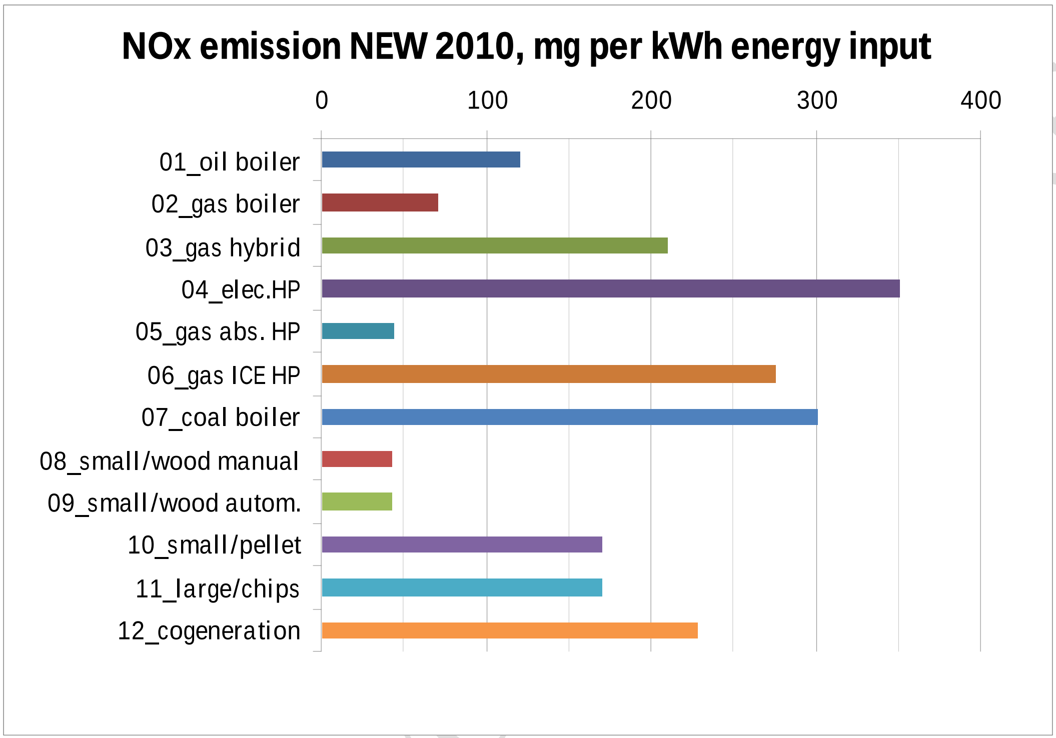

Figure 8. NOx emissions in mg per kWh energy input for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

[43] If the 0.394 kgCO2/kWh input for the electric heat pump (year 2010) is divided by 2.5, the specific emission per primary input is 0.158 kg CO2/kWh, which is lower than that for gas.

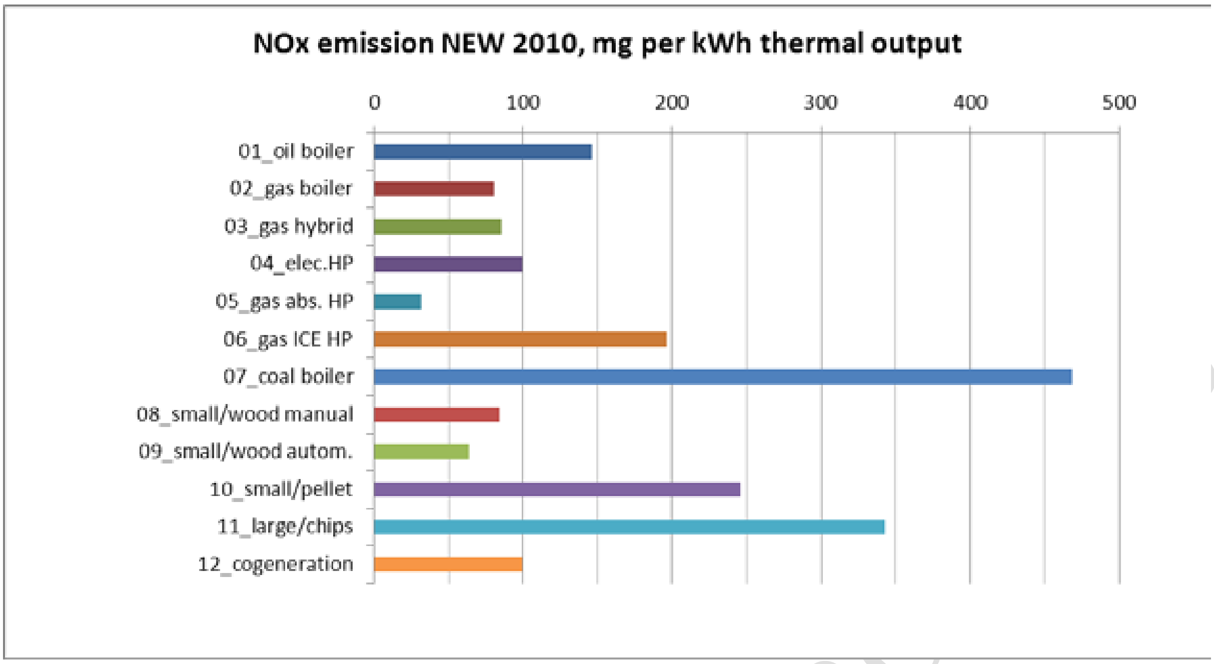

Figure 9. NOx emissions in mg per kWh thermal output for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

The emissions when harmonised per kWh thermal output show large differences over appliance types. Lowest emissions are achieved by the gas absorption heat pump, since this appliance combines a high efficiency with a very low pollution specific emission factor.

NOx emissions from wood biomass boilers are relatively low due to their low specific emission factor (42 mg/kWh fuel input)[44]. Emissions by pellet and chips boiler apparently emit more NOx, as do other fossil fuel fired boilers.

The gas internal combustion engine and the cogeneration unit have relatively high specific NOx emission factors (more difficult to reduce emissions in these appliances, unless catalyst is used).

[44] Boersma, A, et al, "Emissions of the use of biomass fuels in stationary applications", ECN/TNO, table 4-22, p.38, ECN-BKM-2008-81 (assumesNOx emissions of 150 mg/MJ input)

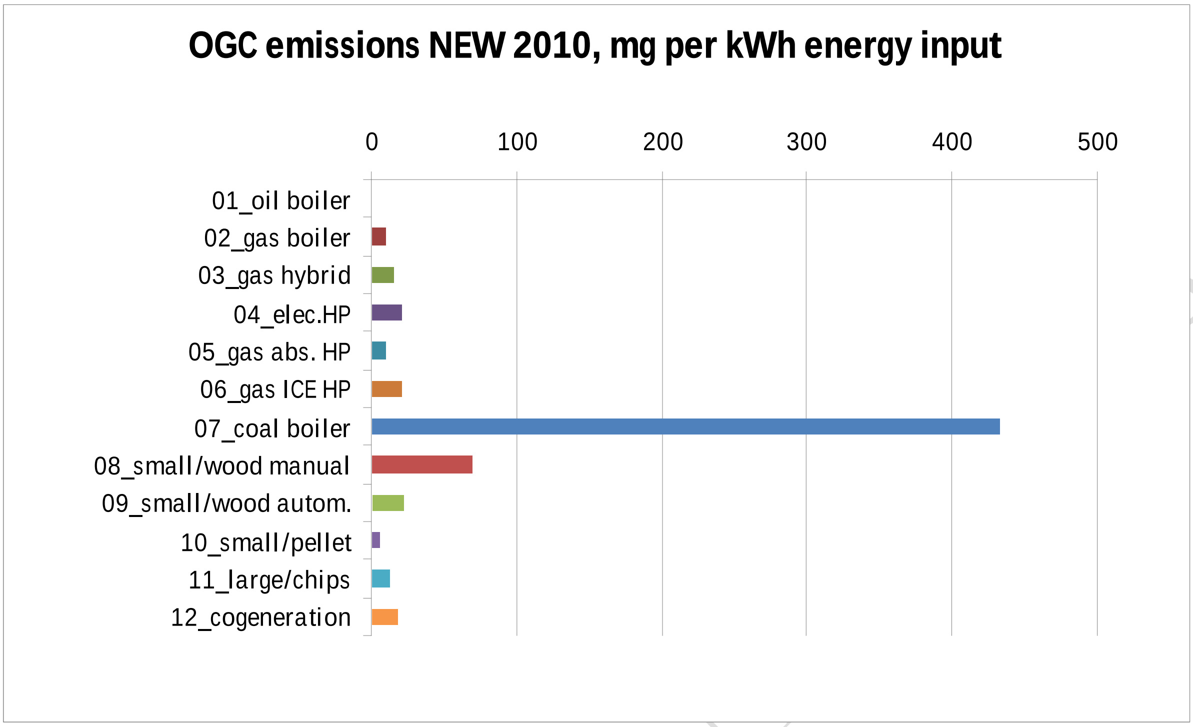

Figure 10. OGC emissions in mg per kWh energy input for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

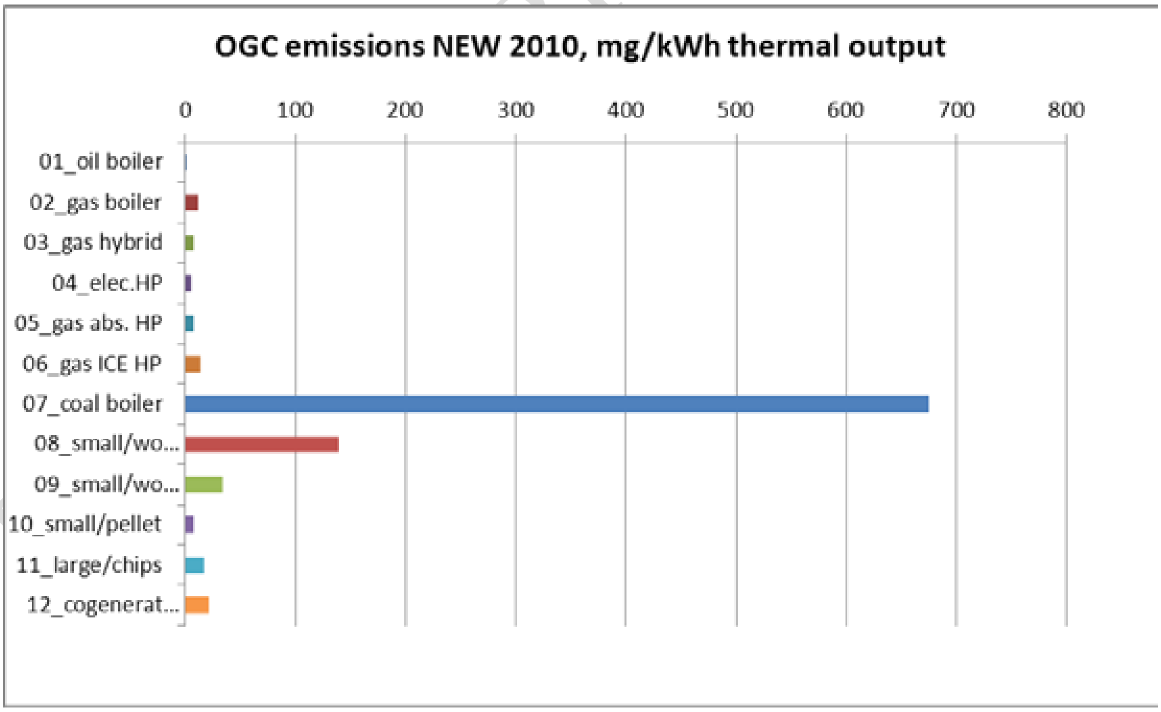

Figure 11. OGC emissions in mg per kWh thermal output for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

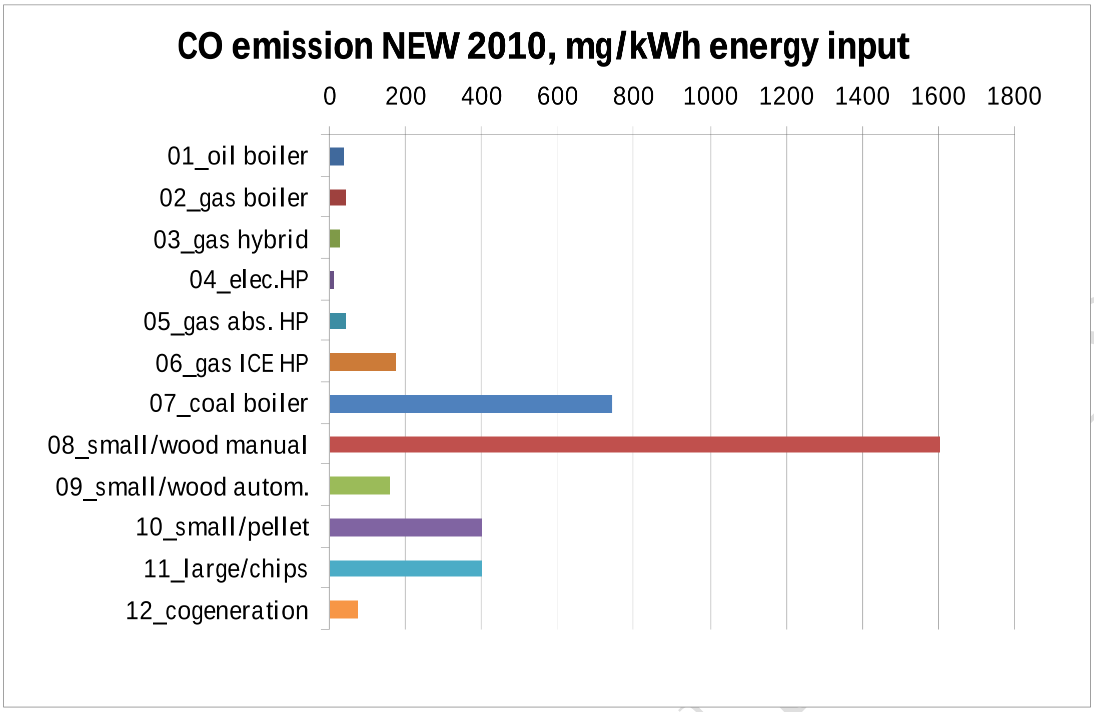

Figure 12. CO emissions in mg per kWh energy input for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

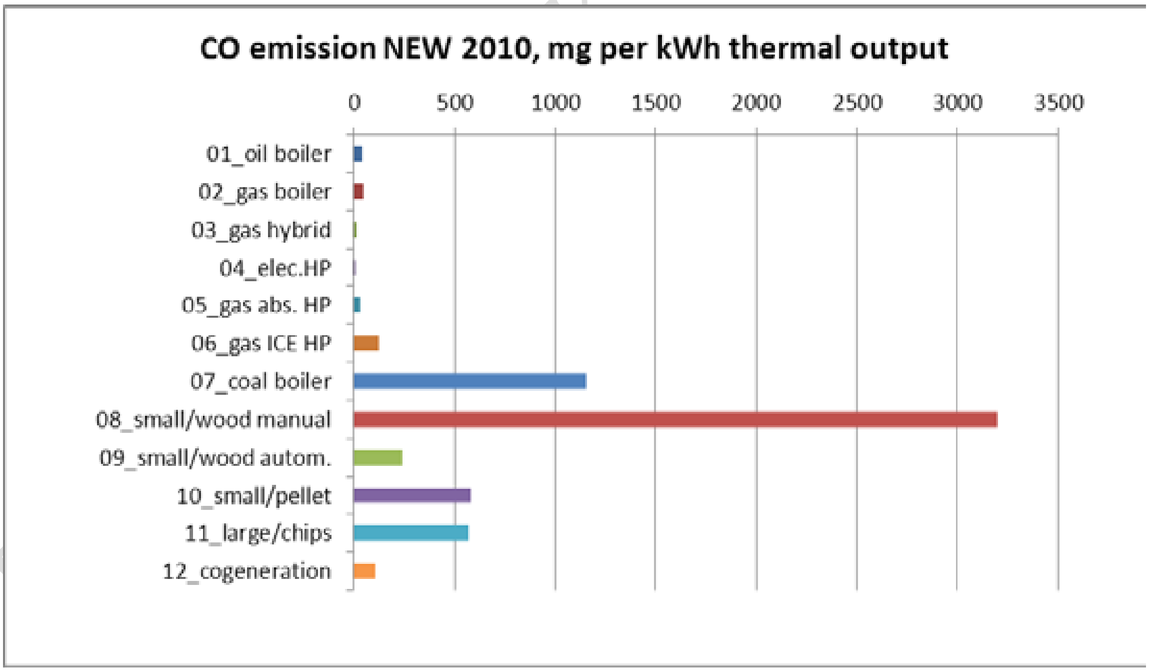

Figure 13. CO emissions in mg per kWh thermal output for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

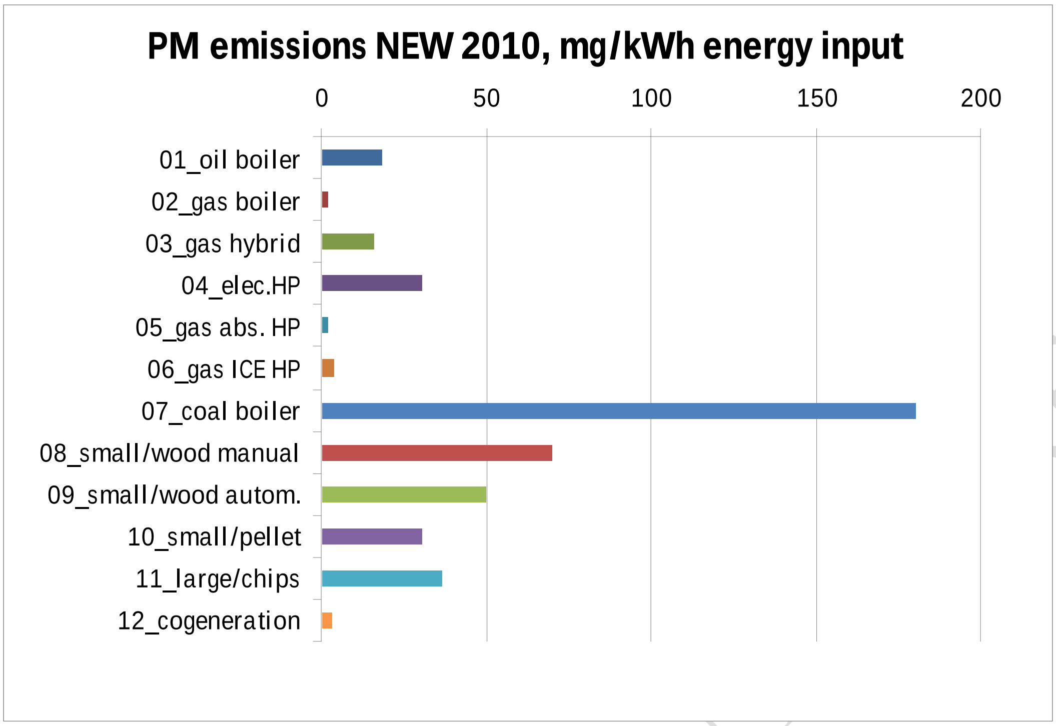

Figure 14. PM emissions in mg per kWh energy input for 12 base cases ("Policy Analysis", Nov. 2011, VHK).

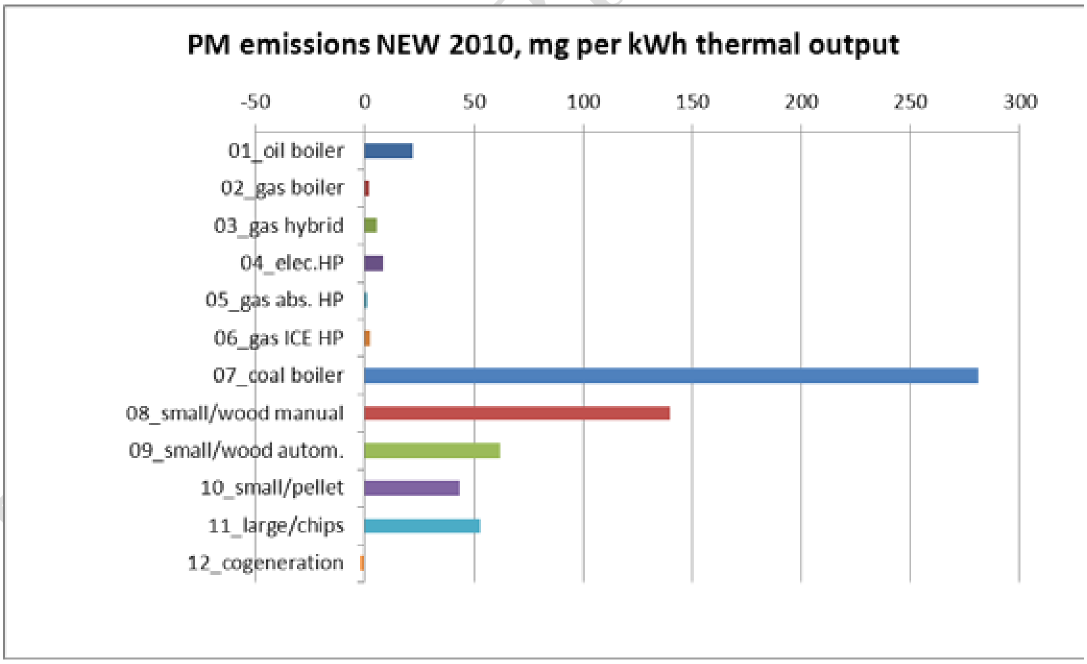

Figure 15. PM emissions in mg per kWh thermal output for 12 base cases ("Policy Analysis", Nov. 2011, VHK)