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PART 1/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for solid fuel boilers, and

Commission Delegated Regulation supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of solid fuel boilers and packages of a solid fuel boiler, supplementary heaters, temperature controls and solar devices

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Contents

This report commits only the Commission's services involved in its preparation and does not prejudge the final form of any decision to be taken by the Commission.

1. INTRODUCTION

Directive 2009/125/EC of the European Parliament and of the Council establishes a framework for the Commission, assisted by a regulatory committee to set Ecodesign requirements for energy-related products. An energy-related product, or a group of energy-related products, shall be covered by Ecodesign implementing measures, or by self-regulation (cf. criteria in Article 17), if the energy-related product represents significant sales volumes, while having a significant environmental impact and significant improvement potential (Article 15). The structure and content of an Ecodesign implementing measure shall follow the provisions of the Ecodesign Directive (Annex VII).

This study assesses the impacts of different policy options in the context of the Ecodesign Directive 2009/125/EC for solid fuel[1] boilers and the Energy Labelling Directive 2010/30/EU. The preparatory study for solid fuel small combustion installations has concluded that solid fuel boilers comply with the criteria in Art. 15, sub 1, of the Ecodesign Directive and are therefore a candidate for measures.

The scope of the report concerns solid fuel boilers, i.e. solid fuel indirect heaters that heat usually multiple rooms through a water based central heating system in which the heater is not located in one of those rooms. Solid fuel heaters that are located in a room, i.e. direct heaters, also referred to as 'solid fuel local space heaters' are covered by a separate impact assessment, because their characteristics are different from solid fuel boilers and they are more similar to other (non-solid) local space heaters that are addressed in that impact assessment.

2. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

2.1. Organisation and timing

A number of Commission services[2] were consulted between 7 and 16 November 2012 and contributed to the impact assessment. The present impact assessment takes into account the recommendations formulated by the Impact Assessment Board on 18 January 2013 which amongst others stressed the need to describe the options and any reasons for discarding them more clearly and for coherence between objectives and the comparison of the options and impacts.

Article 19 of the Directive 2009/125/EC foresees a regulatory procedure with scrutiny for the adoption of implementing measures. Subject to qualified majority support in the regulatory committee and after scrutiny of the European Parliament, the adoption of the measure by the Commission could take place by late 2013.

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1 Biomass solid fuel (wood pellets, chips or logs), mineral solid fuel (e.g. coal)

2 The Commission Directorates General who were part of this group included Secretariat-General, DG Climate Action, DG Communication Networks, Content and Technology, DG Competition, DG Employment, DG Enterprise and Industry, DG Environment, DG Health and Consumers, DG Markt, DG Trade and the Joint Research Centre

2.2. Consultation and expertise

External expertise on solid fuel small combustion installations was gathered in particular in the framework of a study providing a technical, environmental and economic analysis (in the following called "preparatory study") carried out by external consultants[3] on behalf of the Commission's Directorate General for Energy (DG ENER). The preparatory study followed the structure of the "MEEuP" Ecodesign methodology[4] developed for the Commission's Directorate General for Enterprise and Industry (DG ENTR). MEEuP has been endorsed by stakeholders and is used by all Ecodesign preparatory studies so far.

The solid fuel small combustion installations preparatory study was developed in an open process, taking into account input from relevant stakeholders including manufacturers and their associations, environmental NGOs, consumer organisations and EU Member State experts. The preparatory study provided a dedicated website[5] where interim results and further relevant materials were published regularly for timely stakeholder consultation and input. The study website was promoted on the Ecodesign-specific websites of DG ENER and DG ENTR. Open consultation meetings for directly affected stakeholders were organised at the Commission's premises in Brussels on 3 March 2008, 18 December 2008 and 13 July 2009 for discussing and validating the preliminary results of the studies. A preliminary background impact assessment study was carried out from October 2008 till July 2010 in order to assist the Commission in analysing the likely impacts of the planned measures[6]. This work and the preparatory study were used as input for a further external study providing the basis and calculations of this impact assessment[7].

During the preparation of a working document for consultation on potential ecodesign and energy labelling measures in early 2012, it was decided to split up Lot 15 into solid fuel boilers (covered by this impact assessment) and solid fuel local room heaters (integrated into Lot 20 for local room heaters).[8] Further to Article 18 of the 2009/125/EC Directive, formal consultation of stakeholders was carried out throughout the Ecodesign Consultation Forum on 12 July 2012, consisting of a balanced participation of Member States' representatives and all interested parties concerned with the product group of solid fuel boilers. The minutes of the consultation meeting can be found in Annex I. The participants were provided working documents one month in advance of the meeting and were invited to comment in writing until two months after the meeting.

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3 Ecodesign preparatory study "Lot 15: Solid fuel small combustion installations by Bio Intelligence service, final report of December 2009, documentation available via the website of the Commission: http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm

4 "Methodology for the Ecodesign of Energy Using Products", Methodology Report, final of 28 November 2005, VHK, available via http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm

5 www.ecosolidfuel.org

6 By contractor Van Holsteijn en Kemna (VHK) B.V., with CSTB, France, and Wuppertal Institute, Germany, as subcontractors for impact assessment study for Lot 15, solid fuel small combustion installations (direct and indirect heaters).

7 By contractor Van Holsteijn en Kemna (VHK) B.V., with Wuppertal Institute, Germany, as subcontractor.

8 The boundary between the two product categories is defined as such that heaters which have less than 6% of the heat output in the 'room' where they are located are considered boilers; others are considered local space heaters.

3. PROBLEM DEFINITION

3.1. What is the issue or problem that may require action?

The solid fuel boilers in the current stock of the EU-27 are significant energy users and contributors to greenhouse gas emissions. They are also major emitters of particulate matter (PM), organic gaseous carbon (OGC) and carbon monoxide (CO), which are harmful for human health and the environment. Domestic solid fuel combustion has traditionally been the major source of particulate emissions in the EU-27[9].

The improvement of energy efficiency, and therefore a reduction (in growth) of solid fuel consumption, is able to increase the security of energy supply and allows a more efficient utilization of the limited biomass resources in Europe. Furthermore, negative impacts of emissions affecting air quality and human health can be significantly reduced.

3.2. What is the scale of the problem?

As requested by Article 15 of the Ecodesign Directive, the preparatory study identified the relevant environmental aspects of solid fuel boilers. With more than 436,000 units purchased in the EU-27 in 2010, this product group has a market volume clearly exceeding 200,000 sales, which is the threshold for the Ecodesign Directive. Since 2005, the market volume has increased significantly and the stock is expected to increase from 5.26 million units in 2010 to 6.92 million units in 2025. According to the data collected in the preparatory and in the further external study for this impact assessment, in 2010 the stock comprised

- 55.5 % Small domestic manual boilers (wood logs)
- 19.7 % Small domestic downdraft gasifying boilers (wood logs)
- 17.2 % Retort boilers (coal)
- 6.3 % Pellet boilers (wood pellets)
- 1.3 % Non-domestic chip boilers (wood chips)

In the context of this impact assessment solid fuel boilers are classified and analysed either as "biomass" or "non-biomass" appliances.[10] In general biomass fuels may include log wood, chipped wood, compressed wood, briquettes, sawdust and non-woody biomass such as straws, reeds, kernels and grains. Non-biomass fuels may include fossil bituminous coal, brown coal, coke, anthracite and peat. Due to the standardisation requirements of the relevant test standards and norms, the available data from solid fuel boiler product type testing refers only to the test fuels wood logs, wood chips, wood pellets and coal. Consequently, it is only possible to evaluate the efficiency and emission performance of boiler designs using one of these test fuels. Boilers using only non-woody biomass fuels have a low market share and there is a lack of data on them and therefore they are not considered in the scope of the impact assessment.

9 http://www.eea.europa.eu/data-and-maps/indicators/energy-related-emissions-of-particulate-matter-2/assessment-1#toc-1

10 The intermediate operation and performance of "multi-fuel" boilers, which are capable to use different fuel types either separately or for co-firing cannot be analysed in this impact assessment due to lack of data. This is also the case concerning fuels for which the boiler is not primarily designed.

The share of biomass boilers in the stock is rapidly growing. Solid fuel boilers currently[11] consume 608 PJ of primary energy per year. Annually, they release 13.9 Mt of CO_{2eq} as well as air quality relevant emissions like CO (1.5 Mt), OGC (128.1 kt) and especially PM (80.9 kt). Thereby, the sector "Commercial, institutional and households" is the largest source of PM emissions accounting for about one third of all EU-27 PM emissions[12]. In contrast to almost all other sectors, the PM emissions from this sector were increasing in recent years.

Regarding the total product lifecycle, it is clear that energy consumption and emissions are dominated by the use phase – accounting for up to 99 % of the product's total energy use over the lifetime and between 80 and 98 % of the product's total emissions of particulate matter depending on the product type[13]. Since PM, OGC and CO emissions are depending on the quality of the combustion and best available technologies on the market can reduce significantly most of the specific emissions (compared to the corresponding base case), a high improvement potential is available. Especially particulate matter is a very important emission with significant impact on air quality and human health. There is consensus among most stakeholders that these emissions require an ambitious and effective regulation.

Furthermore, solid fuel boilers also release emissions of NO_x (oxides of nitrogen). According to the current state of knowledge and to stakeholder comments, the emissions of NO_x are mostly fuel-derived, and thus could only be reduced with secondary measures. For recently produced boilers, such emissions are usually under 200 mg/Nm^3 (at 10% O_2) and thus not at present a significant problem. However, due to new boilers designs with higher combustion temperatures that may be promoted further as a result of energy efficiency and organic emission requirements, additional emissions NO_x on top of the fuel-derived emissions may be generated and thus NO_x emissions of solid fuel boilers may be increasing as a result of ecodesign requirements. However, due to lack of data regarding NO_x emissions from boilers in Europe,[14] it is not possible to quantify the impacts of NO_x regulation in the context of this impact assessment. NO_x emissions will therefore only be addressed in qualitative terms.

Solid fuel boilers also release emissions dioxins and furans. These emissions are mostly fuel specific (notably from non-woody biomass and certain types of coal that contain high chlorine levels[15]) and could be reduced by optimisation of the combustion technology to a certain extent. Measures taken to reduce PM, OGC and CO emissions may achieve this. Due to a general lack of data and experience for measuring as well as regulating furan and dioxin emissions in solid fuel boilers, no emission limit levels for dioxins and furans can be set and assessed in this impact assessment.

More information on PM and other pollutants derived from solid fuel combustion are given in **Error! Reference source not found.**.

11 2012

12 EEA (2012): In 2008 the sector "Commercial, institutional and households" was responsible for 29 % of EU-27 total PM10 emissions and for 36 % of total PM2.5 emissions, http://www.eea.europa.eu/data-and-maps/indicators/energy-related-emissions-of-particulate-matter- 2/assessment-1#toc-1,

13 Based on Lot15 Preparatory Study Task 5

14 For old boilers and for base cases: no figures on NOx emissions are available in Lot15 preparatory study.

15 Kubica K. *et al.* (2007): Small combustion installations: Techniques, emissions and measures for emission reduction

3.3. What are the underlying drivers of the problem?

Market and regulatory failures are the main barriers and obstacles that hinder the realisation of the existing and substantial economic saving and environmental improvement potential at the time of purchase of a boiler.

Regulatory failure

Currently, there is no EU legislation specifically dealing with the energy consumption and the emissions of solid fuel boilers. There is national legislation in a number of Member States, but this does not address the problem for the EU as a whole and maintains the situation of transboundary air pollution across national borders as not all Member States are legislating emissions of solid fuel boilers. Further, such national legislation could in fact hamper the functioning of the EU internal market with regards to solid fuel boilers. Further, due to a lack of commonly accepted or harmonized methodologies and norms regarding the measurement of emissions like PM, there is currently a considerable variability of used test methods and national regulations within the EU-27.

Negative externality[16]

There is also a lack of a common interest to reduce emissions like PM, OGC and CO, because emitting these substances to the ambient air is free of charge. This situation is even fostered by the fact that external costs (e.g. health cost) are not included in fuel prices or other operation costs. That is the reason why consumer and producer choices are commonly made on the basis of operation costs not reflecting environmental or health costs for the society. Further detail on negative externality in this context is provided in the impact assessment accompanying the Commission proposal for the Ecodesign Directive.[17]

Asymmetric information and myopia

A main reason for the persistent sales of low efficiency solid fuel boilers and the out-dated, inefficient stock, is that end-user purchase decisions are commonly not based on life cycle costs of products which include purchase, installation and maintenance. In contrast, most consumers base their choice rather on purchase price and other factors like availability, service or 'trusted' brand names. Few people realise that energy costs are commonly the major part of total life cycle cost.

The necessary information on available technology and their impact may be available somewhere (e.g. on a web site or in a technical documentation) but is hard to locate and/or to understand. Therefore, the complexity or lack of understandable information for consumers introduces asymmetrical information. This problem can be even intensified by a lack of qualification and lack of economic incentive of wholesalers, retailers and installers, who give advice to end-users. Consequently, even cost-effective improvement potentials for the end-user are often not realised. Further detail on asymmetric information and myopia in this

[16] Economics: Side effect or consequence of an industrial or commercial activity that affects other parties without this being reflected in the cost of the goods or services involved.

[17] SEC(2008)2115

context is provided in the impact assessment accompanying the Commission proposal for the Energy Labelling Directive.[18]

Other barriers

In addition, there are problems regarding the use of solid fuel combustion installations that can only partly be addressed by an Ecodesign implementing measure. In particular, these problems refer to the quality and selection of the used solid fuel, e.g. traditions like the tradition of using coal or the burning of materials not recommended by the manufacturer like too wet firewood. Other examples are over dimensioned heating installations, insufficient chimney systems as well as inadequate maintenance or settings of manual/automatic air controls. For some users, e.g. owners of forest estates, life cycle costs may also appear much less relevant due to the very low primary costs to obtain biomass solid fuels.

3.4. Who is affected, in what ways and to what extent?

Society at large is affected because a more efficient usage of the limited biomass resources in Europe is a key element to achieve renewable energy targets, greenhouse gas reduction targets and to improve the security of energy supply due to a reduced dependence on fossil fuel imports and the corresponding fuel costs. Further, PM air pollution is pointed out as being responsible of an average 8.6 months life loss for every person in the EU. Studies have highlighted the fact that PM pollution causes cardiovascular and respiratory diseases[19] and even short-term exposure to higher PM air concentrations increases the risk of emergency hospital admissions. As burning of solid fuels in households is a major contributor in terms of total PM airborne pollution, regulations for solid fuel boilers will contribute to a substantial PM emission reduction and to an improved air quality in Europe.

EU regulation would affect consumers, manufacturers, retailers and installers. Consumers are affected since an energy label would give them a more informed choice. Overall costs for consumers, i.e. the cost of a boiler plus the fuel costs, may decrease or increase depending on which of the two cost elements prevails. Manufacturers are affected as they may have to redesign their boilers and they would in the energy label have an additional aspect to compete with each other. Retailers/installers are affected as they would have to show a label and may have higher revenues if product prices increase.

3.5. How are existing policies and legislation affecting the issue?

Promotion of market take up of efficient solid fuel boilers complies with the Europe 2020 agenda and its 20% energy savings target by the year 2020, as it aims to support more efficient and sustainable use of resources, protect the environment, strengthen EU's leadership in developing new green technologies, improve the business environment and help consumers make more informed choices.

Directive 2006/32/EC[20] on energy end-use efficiency and energy services ("ESD") provides energy savings targets for Member States and creates the conditions for the development and promotion of the market for energy services, including measures improving the energy

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[18] SEC(2008)2862

[19] Polichetti G. *et al.* (2009): Effects of particulate matter (PM_{10}, $PM_{2.5}$ and PM_1) on the cardiovascular system.

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

efficiency of boilers and the "domestic" input to domestic hot water production. However, it is up to the Member States to select the concrete measures to achieve the energy savings targets, and no harmonised measures specifically targeted at improving the environmental performance of solid fuel boilers are provided. Directive 2006/32/EC is soon to be repealed by a new Energy Efficiency Directive, which retains this situation as regard solid fuel boilers.

Directive 2010/31/EU on the energy performance of buildings[21] ("EPBD") requires Member States, amongst others, to apply minimum requirements to the energy performance of new and certain existing buildings, and technical building systems (including hot water systems). According to Recital (12) of the EPBD Member States should use, where available and appropriate, harmonised instruments, in particular testing and calculation methods and energy efficiency classes developed under the Ecodesign and Energy Labelling Directives when setting energy performance requirements for hot water systems[22]. Furthermore, it lays down requirements as regards energy certification of buildings or building units, and regular inspection of boilers of an effective rated output for space heating purposes of more than 20 kW. The energy performance certificates required by the EPBD aim to provide information to buyers and sellers as regards the energy performance of the building and building units as well as to provide incentives for owners and sellers to invest in energy-efficient installations, including water heating systems. The requirements on technical building systems, including hot water systems, aim at optimising the energy use of such systems, in particular if installed in existing buildings. Thereby, the EPBD does not set harmonised energy efficiency requirements for heat generators like solid fuel boilers or entire hot water systems and it does not provide energy efficiency classes and testing and calculation methods. Further, emissions (PM, OGC, CO) are not in the scope of the EPBD.

The levels of fine particulate matter and precursor emissions are controlled in the European Union by three main types of regulation: air quality standards, emission standards for specific (mobile or stationary) sources and national emission ceilings and transboundary air pollution standards for emission precursors[23]. Consequently, on EU and on Member State level initiatives have been launched, which are also relevant for solid fuel boilers.

Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants ("NEC") limits emissions of pollutants from all sources combined arising as a result of human activities in the territory of the Member States. Directive 2008/50/EC on ambient air quality and cleaner air for Europe ("AAC") requires Member States to limit the level of a number of air pollutants at zone and agglomeration level. These Directives contribute indirectly to a limitation of emissions from solid fuel boilers as they have led to a number of Member States starting to introduce maximum levels of certain pollutant emissions from such boilers[24]. However, the approach and levels for limiting the relevant emissions from boilers varies to great extent amongst Member States. This lack of harmonized specific solid fuel boiler regulation in the EU induces the risk that individual emission limits set by Member States could hamper the functioning of the EU internal market.

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21 OJ L 1, 4.1.2003, p.65

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

23 EEA 2012

24 At least Austria, Belgium, Czech Republic, Denmark, Finland, Germany, Sweden and Cyprus have implemented for certain (different) categories of solid fuel boilers limit values for some or all of the emission types referred.

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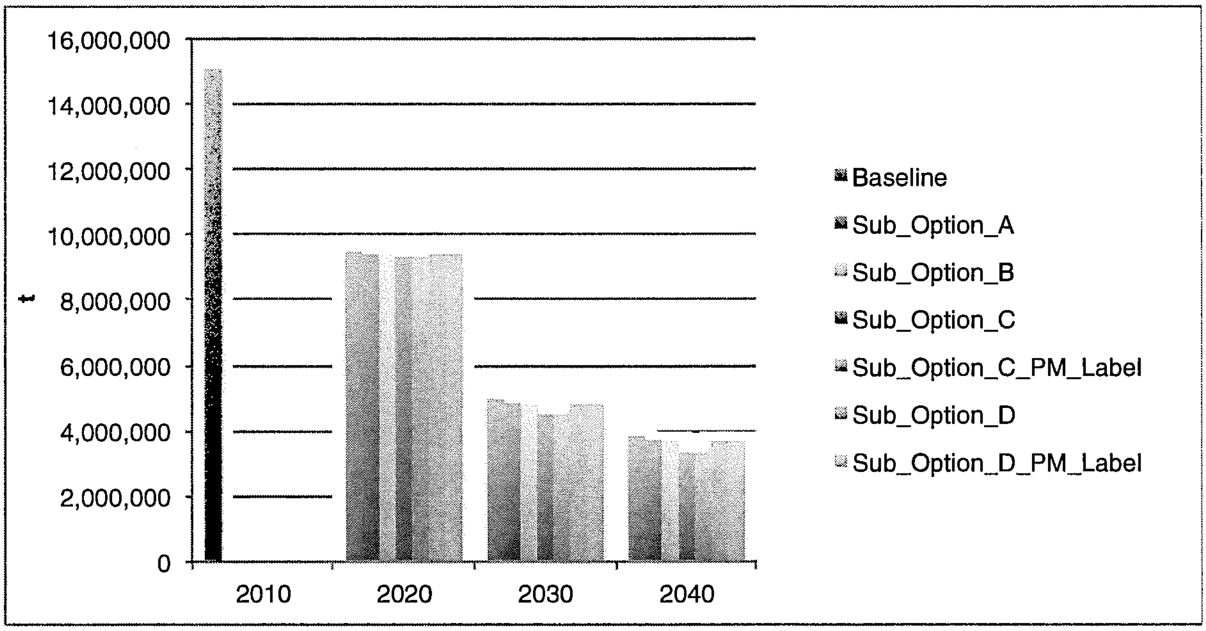
6.2. ENVIRONMENTAL IMPACT

Greenhouse gas emission reduction

Greenhouse gas (GHG) emissions are calculated based on the fuel consumption and the specific GHG emission of a fuel as well as on the electricity consumption and its specific GHG emission.

Already in the baseline, total GHG emissions will decrease from 15.1 Mt CO_2eq in 2010 to 4.0 Mt CO_2eq in 2035 and then remain almost constant. This development is mainly due to the declining share of solid fossil fuel boilers in the stock in the next two decades. All investigated policy options will lead to further but limited GHG emission reductions compared to baseline (Figure 1).

Figure 1: Total greenhouse gas emissions in t/year



The sub-options A, B, D and D+ will have a similar impact on GHG emissions, since they have almost the same MEPS in their respective last Tier. Compared to the baseline, these sub-options achieve from 3.5 % to 4.1 % GHG emission reductions in 2040.

Option C and C+ score the best with 13.4 % GHG reduction in 2040 compared to the baseline. This is mostly due to the fact, that no coal boiler is expected to achieve the PM requirements after 2018, therefore biomass boilers will be purchased instead of coal boilers.

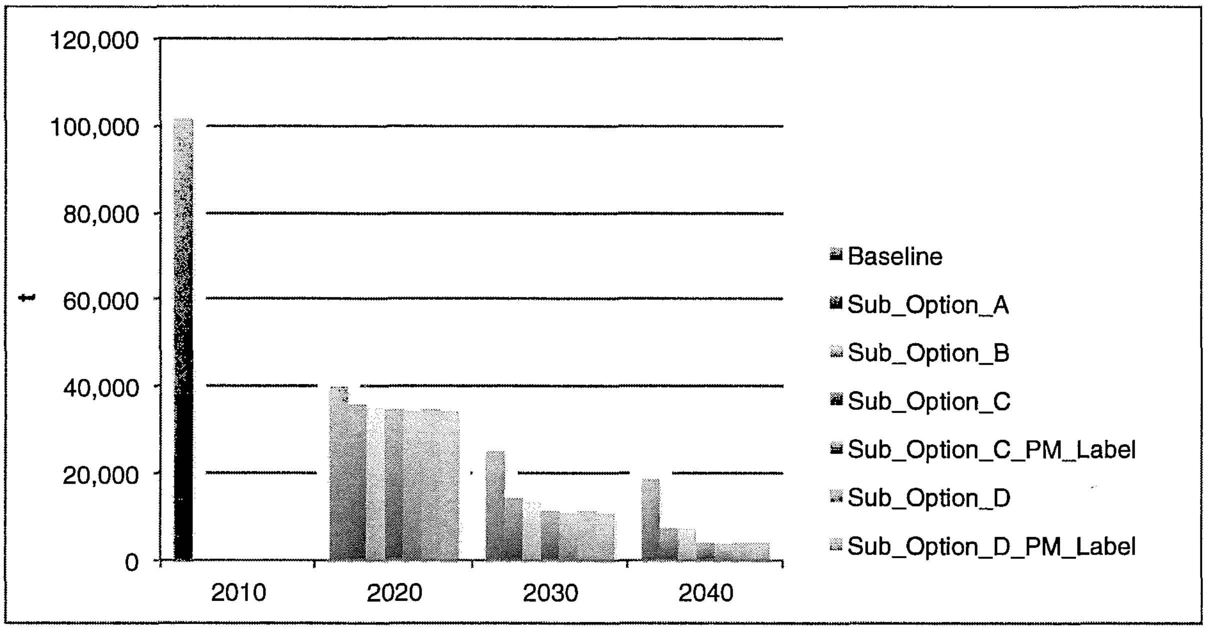
Reduction of other pollutants, particularly PM, OGC and CO

As mentioned in section 3.1, reducing PM emissions should be the most important objective of policies and measures aiming at reducing emissions of solid fuel boilers. In the baseline, the PM emissions of the stock will decrease by 81.7 % between 2010 and 2040 since the stock of old boilers with high emissions will be replaced (see also Chapter 3.7). Moreover, all policy options analysed in this IA will contribute to a further and significant reduction of the

PM emissions. While by 2040 the PM emissions in sub-options A and B are 60% below the baseline, sub-options C and D achieve around 77.5% PM reduction.

The indication of PM on the label contributes to an additional 1% reduction of the absolute PM emissions. This improvement is limited, since ELVs in sub-options C+ and D+ are already close to BAT level. Before the ELV for PM enters in force, the indication of PM on the label initiates a market transformation towards low PM technologies. In 2016, the PM emission factor of a typical boiler in sub-option C+ is assumed to be 22% below the typical boiler in sub-option C.[1] Sub-option C+ achieves the lowest total PM emissions in 2040: 4,034 t compared to 18,648 t in the baseline.

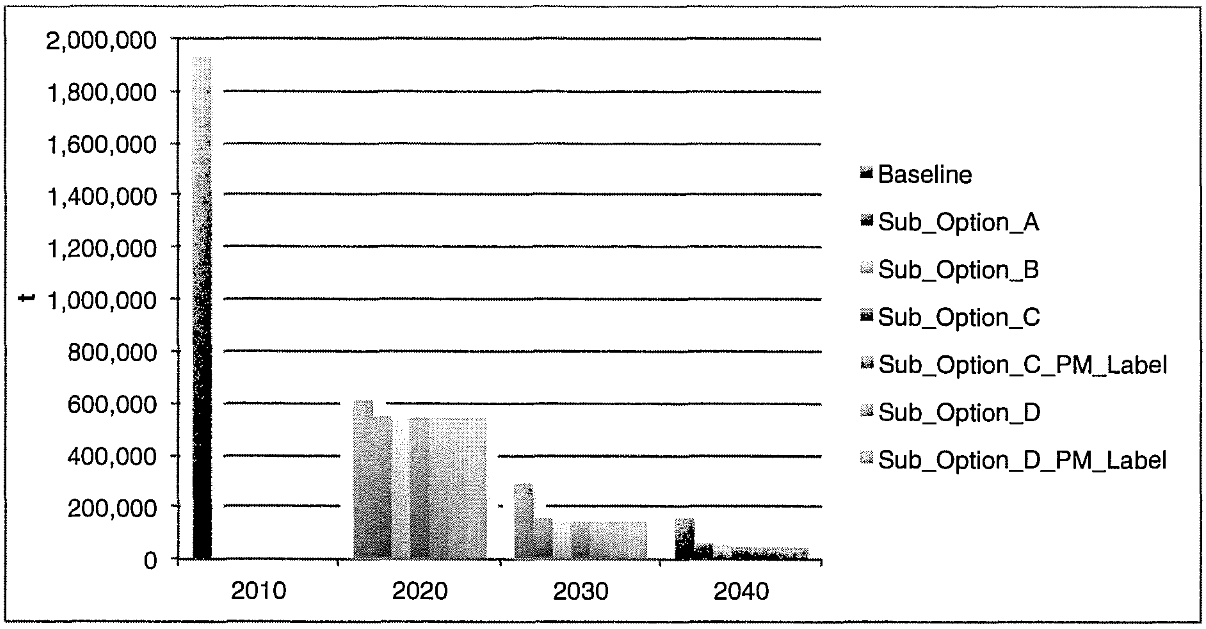
Figure 2: Development of total PM emissions of EU-27 stock according to the different policy options



CO emissions will also be reduced in the baseline (total emissions reduced to 1/12 within three decades) and the assessed sub-options will even improve the baseline in a range of 63% to 70%. The largest CO emission reduction can be achieved by the implementation of sub-option C, C+, D and D+ (Figure 3).

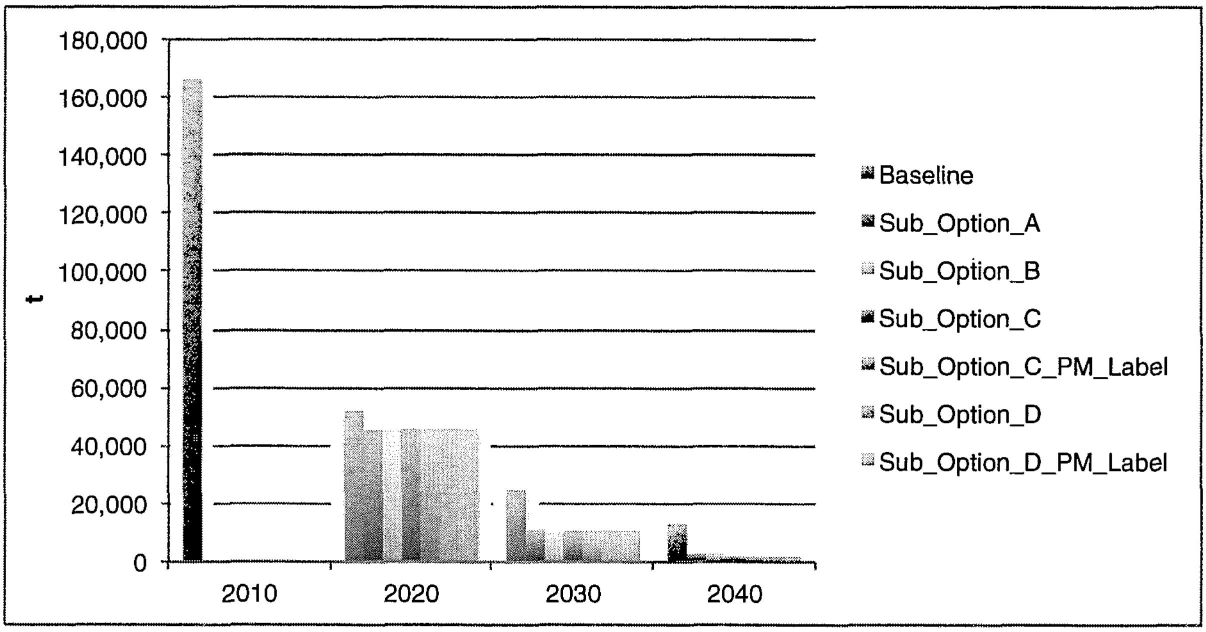
Figure 3: Development of CO emissions of EU-27 stock according to the different policy options

[1] Same when comparing D and D+. 2017: the difference is 17.3 %



OGC emissions follow a similar trend as CO emissions. In 2040, OGC total emissions account for 13,124 t/year in the baseline (vs. 166,221 t/year in 2010) and less than 2,850 t/year in the other policy options. Sub-options C, C+, D and D+ achieve the largest OGC-emission reduction with 86 % below the baseline and emit 1.9 kt OGC / year in 2040.

Figure 4: Development of OGC emissions of EU-27 stock according to the different policy options



6.3. Social impact

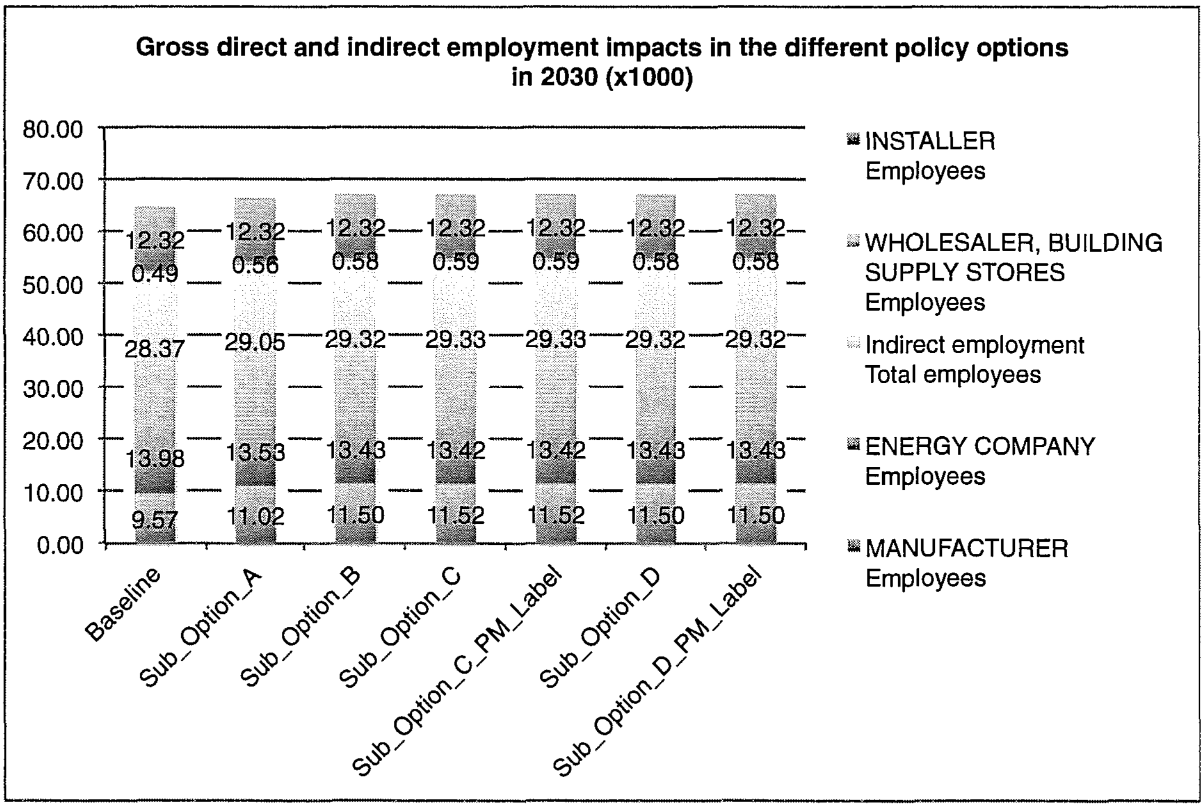
Employment, training and certification of market actors

Employment impacts have been roughly estimated by applying specific factors, which are based on a comprehensive data research based on annual reports of 25 market actors in the EU-27 (c.f. **Error! Reference source not found., Error! Reference source not found.**).

The comparison of gross direct and indirect employment effects in the following Figure 5 visualises the importance of installers of solid fuel boilers. The installation into the dwelling can be as influential on the system efficiency as the product itself. Therefore, improvements of existing or new systems must be accurately suited to their application with respect to sizing, frequency of use, fuel availability, condensation in the chimney and the potential for back draught. Another important aspect is the limited ability of solid fuel boilers to modulate their power output. Modulating fuel supply is not always easy in these appliances and modulating air supply is not recommended for modulating power output. The most suitable boiler should be chosen for each purpose and it should be also combined with a matching buffer tank to ensure constant high efficiencies and low emission values. Therefore, (properly trained and certified) technicians should be charged with sizing and installing a heating system for safety reasons as well as for optimising the system performance.

Employment impacts outside the EU are primarily indirect ones. The analysis does not calculate net employment impacts, which would require applying complex economic modelling. This would have to take into account (among other aspects) direct and indirect impacts of substituting other heating systems and conventional energy supply by the increase in stock of solid fuel boilers.

Figure 5: Gross direct and indirect employment impacts in the different policy options (values are given in thousands) – 2030



Source: Impact Assessment study based on Bio Intelligence service 2009

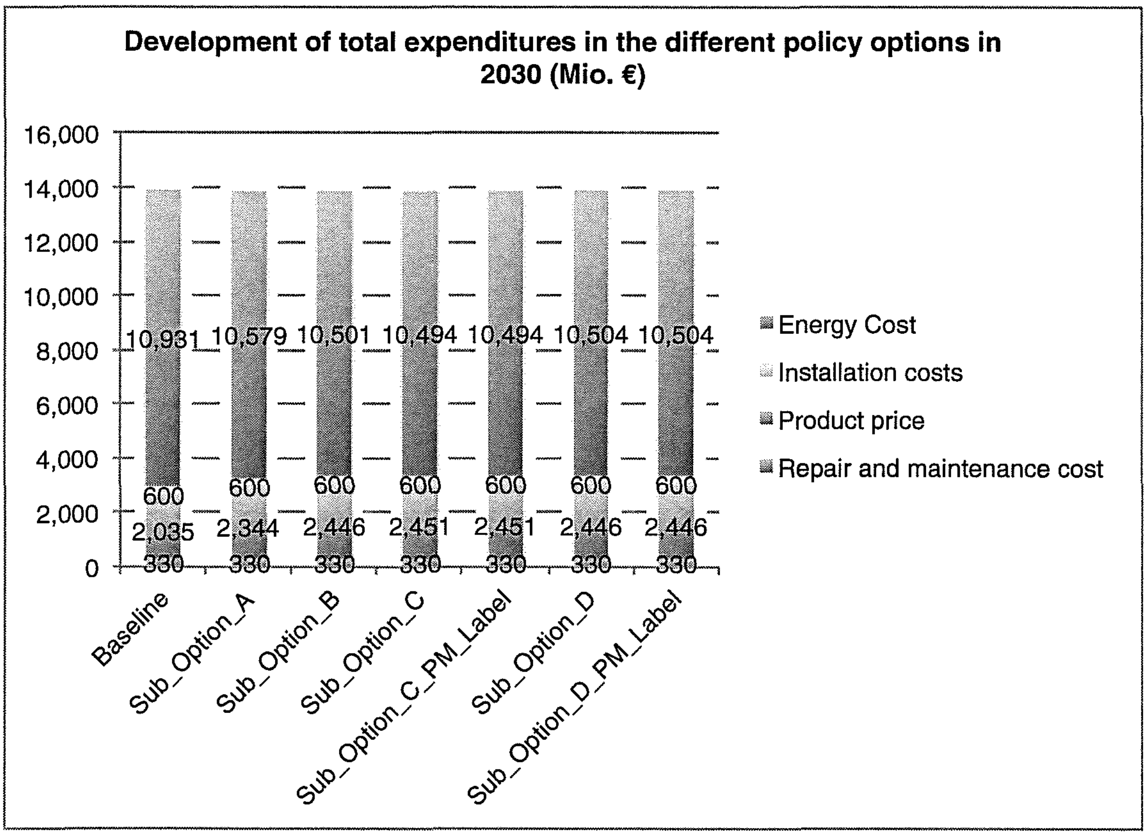
As presented in Figure 5, in all investigated sub-options employments in 2030 exceeds the baseline (64,720). In sub-option B, C, C+, D and D+, more than 67,100 employment places (gross direct and indirect) are created.

Consumer economics and affordability

In 2030, the weighted average payback time varies between 17.1 and 19.2 years according to the sub-options considered, which is within the range of the weighted average boiler lifetime of 18.5 years. On average, the sub-options will not induce additional costs for the consumer: the overall costs for consumers, i.e. the cost of a boiler plus the fuel costs, remain the same.[2] In general, total expenditures do differ only slightly from each other in the different policy options, and lay on the same level as the baseline (13.9 billion euro per year in 2030).

The options discussed will lead to a higher market share of innovative technology while not affecting the functionality of the products.

Figure 6: Development of total expenditures in the different policy options in 2030 (in million € per year)



Health and safety aspects

Long-term exposure to PM is particularly damaging to human health, reduces life expectancy and consequently needs to be tackled as a priority. As burning of solid fuels in households is a

2 The analysis focused on weighted average boiler. For some product categories, the whole cost of a boiler may increase (compared to the baseline) and for other product categories, the sub-options will lead to cost savings.

major contributor in terms of total PM air pollution, regulations for solid fuel small heating appliances can contribute to a substantial PM emission reduction. The achievable emission reduction of the different policy options is presented above. More information regarding pollutants derived from solid fuel combustion can be found in **Error! Reference source not found.**. With regard to safety aspects, it should also be noted that natural draught heating appliances depend on the draught of the appliances and the chimney to ensure effective removal of combustion flue gases. As the efficiency of heating appliances increases, the lower flue temperatures reduce the strength of the flue draught and therefore introduce the possibility of backdraught in the chimney and flue system. This is a safety concern, because toxic flue gases like CO can be emitted into the boiler room or the entire dwelling at the worst. Appliances operating at such high efficiencies, where also condensation is a concern, may require significant upgrading of the chimney to prevent health risks or damages to the flue gas system. This upgrading should only be done by a certified and trained technician.

6.4. Conclusion on economic, social and environmental impacts

The table below gives a comparative overview of the main impacts in 2020 of the analysed policy options. A summary table for 2030 and 2040 can be found in **Error! Reference source not found.**.

Table 1: Overview of impacts in 2020 of the different policy sub-options

ENVIRONMENT		Unit	*2010*	Baseline	A	B	C	C + PM Label	D	D + PM Label
	Weighted average efficiency (Market), NCV based	%	81%	85%	90%	90%	90%	90%	90%	90%
	Solid Fuels	PJ/year	598	637	630	627	627	627	627	627
	Electricity	TWh/year	0.380	0.632	0.632	0.632	0.631	0.631	0.632	0.632
	GHG	Mt CO_2-eq./year	15.1	9.5	9.4	9.4	9.3	9.3	9.4	9.4
	CO	t/year	1,928,872	613,832	550,619	539,642	544,390	544,390	544,421	544,421
	OGC	t/year	166,721	52,193	45,530	45,015	45,732	45,732	45,734	45,734
	PM	t/year	101,681	40,137	35,907	35,148	34,733	34,386	34,746	34,400
CONSUMER										
EU totals	Expenditure	€ bln./year	8.1	11.3	11.5	11.6	11.6	11.6	11.6	11.6
	of that, purchase & installation costs	*€ bln./year*	2.7	2.5	2.9	3.0	3.0	3.0	3.0	3.0
	of that, running costs	*€ bln./year*	5.4	8.8	8.7	8.6	8.6	8.6	8.6	8.6
Per product sold	Sales (regulated)	000	430.0	360.1	360.1	360.1	360.1	360.1	360.1	360.1
	Product price	€	4700	5329	6329	6599	6616	6616	6599	6599
	Installation costs	€	1575	1632	1632	1632	1632	1632	1632	1632
	Energy costs	€/year	557	1110	1054	1046	1044	1044	1046	1046
	Payback (SPP)	years	-	reference	17.7	19.8	19.6	19.6	19.8	19.8
BUSINESS										
EU turnover	Manufacturers	€ bln./year	1.8	1.7	2.0	2.1	2.1	2.1	2.1	2.1
	Wholesalers	€ bln./year	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	Installers	€ bln./year	1.1	1.0	1.1	1.1	1.1	1.1	1.1	1.1
	Solid Fuel and Electricity Companies	€ bln./year	5.1	8.4	8.3	8.3	8.3	8.3	8.3	8.3
EMPLOYMENT										
Employment (jobs)	Manufacturers	000	10	9	11	11	11	11	11	11
	Wholesalers	000	0	0	1	1	1	1	1	1
	Installers	000	13	12	12	12	12	12	12	12
	Solid Fuel and Electricity Companies	000	7	11	11	11	11	11	11	11
	Indirect Employment	000	22	26	27	27	27	27	27	27

TOTAL	000	52	58	61	61	62	62	61	61
of which EU	000	40	45	47	48	48	48	48	48

7. COMPARISON OF POLICY OPTIONS

All policy sub-options analysed in this impact assessment contribute to an improvement of energy efficiency and therefore to a reduction of solid fuel consumption as well as to a significant reduction of emissions compared to baseline development. The analysis for solid fuel boilers shows that in comparison to the baseline the policy options save between 17.43 PJ and 21.98 PJ in 2040 and reduce PM emissions by 59.6 to 78.4 % while increasing employment. Differences between options are indicated in Table 2 compiled on the basis of Table 1, **Error! Reference source not found.**, **Error! Reference source not found.** and the analysis in section 6. While option C and C+ score best on emission reduction of GHG and PM, they would remove all coal boilers from the market as from 2018, which would have a negative effect on the competitiveness of manufacturers for which such boilers are an important part of their portfolio.

In terms of sensitivity analysis, the scenarios in sub-options A, B, C and D can be considered robust since the input parameters are considered to be representative and reliable. For sub-options C+ and D+, however, the element of labelling of PM emissions is sensitive to assumptions about its effect on consumers and industry, for which no specific evidence was available. Further, the conclusions are for the 500-1000 kW range sensitive to the assumption that the impacts for such boilers would be similar as for those below 500 kW.

Table 2: Evaluation policy options in terms of their impacts based on both quantified and non-quantified impacts

	Sub-option					
	A	B	C	C+	D	D+
***Effectiveness & efficiency** (compared to baseline)*						
Reduce the energy consumption of solid fuel boilers	+	++	++	++	++	++
Reduce related greenhouse gas emissions	+	+	++	++	+	+
Reduce PM, OGC and CO emissions	+	+	++	++	++	++
Coherence						
No significant negative impacts on the functionality of the product from the perspective of the user	+	+	+	+	+	+
Health, safety and the environment shall not be adversely affected	+*	+*	+*	+*	+*	+*
No significant negative impact on consumers in particular as regards affordability and life-cycle costs	+	+	+	+	+	+
No significant negative impacts on industry's competitiveness	+	+	-	-	+	+
Setting of an ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers	+	+	+	+	+	+
Impose no excessive administrative burden on manufacturers	+	+	+	+	+	+

Requirements no less stringent than existing ones in Member States	-	-	+	+	+	+
Consistency with ecodesign and energy labelling for non-solid fuel direct heaters	+	+	+	+	+	+
Consistency with the promotion of renewable energy	+	+	+	+	+	+

* If the sub-option is accompanied by an emission limit value for NO_x of 200 mg/Nm^3 (at 10% O_2), otherwise '-'; see further the paragraph below this table.

The preferred option would be sub-option D[3] and indication of particulate matter on the label (sub-option D+) could in principle be added to that. However, given the stringent ecodesign requirements and the relatively large uncertainty affecting the measurement of emissions, it is not possible to state emission levels on the label in the form of a single reliable number or an A-G scale.

Since this option is not technology/fuel-neutral, the review should consider at least a further tier for particulate emissions in other to further spur technological development of reducing PM emissions especially from coal boilers. It is recommend that the requirements for emissions apply up to a scale of 1000 kW, although a testing standard should be requested for the 500-1000 kW size range. As indicated in section 3.2 due to lack of data regarding NO_x emissions from solid fuel boilers in Europe, it was not possible to quantify the impacts of NO_x regulation. However, in order to prevent an increase of NO_x emissions due to new boiler technology it is recommended that an emission limit value for NO_x is set at 200 mg/Nm^3 (at 10% O_2), a level that is technically feasible based on analysis of recent boilers[4]. This would ensure that technological development of solid fuel boilers to comply the ecodesign requirements of option D does not result in increased NO_x emissions and adversely affect health and environment.

8. MONITORING AND EVALUATION

The main monitoring element will be the tests carried out to verify correct energy efficiency, emission level and labelling. This compliance verification will be done by market surveillance carried out by Member State authorities, ensuring that requirements are met.

Another element of monitoring is assessing how the efficiencies and emission levels of solid fuel boilers sold changes over time. This information is available from the label and the product fiche. A market shift towards better efficiencies and lower emission levels will be the main indicator of progress towards market take-up of better solid fuel boilers. This is a monitoring task for the Commission with a view to the review of this specific regulation.

Further, the appropriateness of scope, definitions, concept and possible trade-offs will be monitored through an on-going dialogue with stakeholders and Member States. The main issues for a possible revision of the proposed ME&EPS and labelling scheme are:

- Improved standards (CEN/CENELEC), in particular regarding a harmonized European measurement standard for PM.

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3 The Ecodesign Regulatory Committee voted on 13 October 2014 on ecodesign requirements for solid fuel boilers for the year 2020 that closely resemble tier 3 of option A. Based on the analysis of the options in this impact assessment, this is estimated to result in 2030 in energy savings of approximately 18 PJ, together with related carbon dioxide emission reductions of approximately 0.2 Mt, and a reduction of 10 kt in particulate matter, 14 kt in organic gaseous compounds, and 130 kt in carbon monoxide,

4 See BAT analysis in Lot15 Preparatory Study Task 6 and test reports of boilers published by BLT Wieselburg (see: http://blt.josephinum.at/index.php?id=653)

- Necessity to revise the ME&EPS and labelling classification scheme according to technological improvements.

Revision and adaptation to technical progress (e.g. availability of suitable measurement or testing standards, upgrading of classes following market evolution, etc.) can again be implemented through comitology.

EUROPEAN
COMMISSION

Brussels, 28.4.2015
SWD(2015) 92 final

PART 3/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for solid fuel boilers, and

Commission Delegated Regulation supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of solid fuel boilers and packages of a solid fuel boiler, supplementary heaters, temperature controls and solar devices

{C(2015) 2644 final}
{SWD(2015) 93 final}

9. ANNEX 1: CONSULTATION

9.1. Minutes of Consultation Forum Meeting of 12/7/2012

MINUTES

Meeting of the Consultation Forum under
Article 18 of Directive 2009/125/EC on energy-related products

Brussels, 12th July 2012 (10.00 – 15.15)

EC Participants: Paul Hodson (Chair), Ewout Deurwaarder, Marcos Gonzalez Alvarez, Nicola Pusceddu (ENER), Davide Minotti, Manuela Musella (ENV)

1. Welcome and adoption of the agenda

The **Chair** welcomed the participants and asked for comments on the agenda. The agenda was adopted without change.

The **Commission services** presented the Working Document (WD) on possible measures for solid fuel boilers sent out one month in advance of the meeting.

2. Scope

The **Commission services** presented the scope of the WD and explained the link between the Working Document and Lot 1 ("Space heaters and combination heaters") and Lot 20 ("Local room heating products"). Stakeholders were invited to comment in particular on a possible extension of the scope of Lot 15 measures up to 1 MW_{th} nominal heat output.

NL preferred the scope in terms of nominal heat output to be kept in line with Lot 1, but could consider an extension if the proposed emission limit values (ELVs) would be more ambitious.

INFORSE preferred a coherent approach across Lots. They are not principally against extending the scope up to 1-2 MW, but mentioned that the existing test standards and market surveillance are different for these products. They pointed out that in their view stronger national requirements should still be possible.

FI welcomed the proposed regulations, but also stated that more clarification is needed, especially concerning dual fuel boilers and the consideration of boilers connected to (heated water) storage tanks.

DE commented on four different elements of the scope: 1) they welcomed the exclusion of boilers using non-woody biomass, but asked how to deal with appliances that can burn non-woody biomass in combination with woody biomass; 2) they were of the view that cogeneration products should be part of the scope as in the future some products may provide this function; 3) they stated that clear indication is needed on how the local space heaters combined with water heating would be separated from indirect heating appliances within Lot 15; 4) they asked how "non-space heating" solid fuel combustion installations e.g. providing process heat will be regulated.

SE agreed with FI that boilers connected to storage tanks need to be considered. Further, also boilers with integrated water heaters need consideration. They asked for more explanation on dual fuel boilers especially those that are combined with an auxiliary electric heating function.

IT asked for explanation whether fireplaces connected to a hydronic heat distribution system containing a tank, which are common in IT, are included or excluded in the scope and preferred to include these in Lot 15 measures, because the scope of the Lot 20 preparatory study explicitly excludes biomass.

The **Commission services** answered on the points raised:

– Concerning Lot 15 local heaters including those with water heating functionality, it is the intention to cover these in the forthcoming measures related to Lot 20 due to the similar functionality of the products covered. The exact boundaries between Lot 15 and Lot 20 measures are for discussion during the Lot 20 Consultation Forum in September 2012.
– Concerning non-woody biomass, only boilers using solely non-woody biomass are excluded from the scope. Boilers using multiple fuels, which include woody biomass and/or non-biomass solid fuels would be included.
– "Process heat installations" were excluded from the scope of the Lot 15 preparatory study early on. Arguments on whether and why to include them are welcome in the written comments.
– Concerning cogeneration, if stakeholders agree that the Lot 1 methodology on this point can be applied also to Lot 15 cogeneration boilers, including them in the scope would be relatively easy.
– Regarding the buffer tank, these questions are linked to how "boiler" and "tank" are placed on the market. Buffer tanks for boilers are currently covered through the Lot 1-based package approach, but the proposed calculation method currently only takes the tank into account if a secondary boiler or a solar system is included in the package. More information on application of buffer tanks insofar as not already covered by the methodology of Lot 1 is welcome.
– Regarding the nominal heat output, testing standards for installations above 500 kW are indeed different. The current version of the relevant norm EN303-5 covers boilers up to 300 kW nominal heat output and the forthcoming new version of the EN303-5 will cover boilers up to 500 kW. Larger installations were not part of the Lot 15 preparatory study and there is limited data concerning these installations.
– IT indicated that they preferred to include in the measures on Lot 15 all solid fuel appliances that have largely a boiler function.

CEN explained that cogeneration factors included in Lot 1 can be considered, but Lot 15 also requires the consideration of the Biomass Conversion Coefficient (BCC) factor in cogeneration electricity production.

DE inquired how other solid fuels than wood are considered and how boilers need to be tested for different fuels. This question may be especially important for mixed fuels, e.g. pellets containing 90% wood and 10% other ingredients, and in the case the boiler can also be used for straw, which generally generates higher emissions.

The **Commission services** replied that there is a general decision to be made on this issue. For example, the scope could be limited to boilers using woody biomass only, to those also using mixed fuels or to those that allow only strictly defined solid fuel types. Hence, several solutions are conceivable.

CEN remarked that the forthcoming version of the EN303-5 covers non-woody solid fuels and that it is principally prepared to deal with different fuel types. Nevertheless, CEN stated that there might be a problem for setting unique ELVs.

NL stated that only the product can be regulated, not the fuel that the user ultimately puts into the product. Nevertheless, the measure should avoid possible loopholes and thus not exclude too many types of boilers.

The **Chair** summarized the results of the discussion related to the scope:

– The boundary issues with local space heaters, i.e. the boundary between Lot 15 and Lot 20 measures, have to be clarified;
– Stakeholders are invited to comment on the introduction of cogeneration factors as in Lot 1, with consideration of the BCC factor where biomass is used for cogeneration;
– Regarding extending the nominal heat output to 1 MW more comments are welcome;
– Regarding "multi-fuel boilers", further information about respective products (e.g. burning wood and straw) is needed. It has to be further evaluated how to regulate these and if fuel specifications might be an option;
– Comments are welcome on the consideration of non-space heating combustion installations.

Ecodesign efficiency requirements

The **Commission services** continued the presentation on "Ecodesign efficiency requirements", and highlighted that three tiers are proposed with a review date further in time, following the discussion on this in the consultation forum on horizontal issues.

AT indicated that the timing should be more stringent and Tier 1 should be skipped in favour of earlier implementation of Tier 2.

DK supported the position of AT; the requirements included in Tier 2 should apply already two years after adoption.

INFORSE indicated that Tier 1 was not ambitious and that the measure should start with the requirements of Tier 2 or 3.

CEN mentioned that the forthcoming new standard EN303-5 has only the classes 3, 4 and 5, whereby class 3 (or better) can be considered as the minimum available on the market today and stated that Tier 1 is less ambitious than that. CEN asked how standby heat losses are determined in the proposal.

NL supported the positions of AT and DK.

SE supported the position of AT and indicated that in this case there should only be two tiers. They pointed out that according to their preliminary calculations, a significant number of the evaluated boilers would pass the Tier 3 requirements.

FR supported the previous comments related to more stringent requirements.

PL generally welcomed more ambitious requirements for solid fuel boilers, as long as there would not be any unjustified discrimination of non-biomass boilers.

The **Chair** concluded that the stakeholders would like to see requirements that are more ambitious.

Emission requirements

The **Commission services** continued with the part of the presentation concerning "Emission limit values" (ELVs) and explained the approach with three tiers as well as the proposed timing for the tiers.

UK pointed out that there are still difficulties for the introduction of Particulate Matter (PM) limits due to different and unharmonized measuring methods - the proposed method does not cover condensable particulates.

CY regarded the proposed limits, especially concerning Carbon Monoxide (CO) as not ambitious enough.

DE emphasised the importance of Lot 15 products for the overall EU emissions of especially PM and CO. These substances are already regulated because of health issues. They stated that the proposed PM and CO emission requirements are less stringent than the current ELVs already in force in Germany. In this context they requested clarification from the Commission on how Ecodesign interacts with more ambitious national regulations. DE has already given notice to the Commission of existing national measures for Lot 15 products. The Commission should further explain the relationship of ecodesign requirements and other EU air quality measures.

Regarding measurements, DE explained that there is a quite good correlation between PM and condensed organic particles, which are partly covered by the ELVs on Organic Gaseous Compounds (OGC). Buffer tanks are important to keep emission levels low, especially for manually stoked boilers but also for automatic ones, and therefore buffer tanks should be considered for the energy efficiency and ELV requirements.

DK appreciated to have 10% O_2 as measurement reference and that the proposal follows the norm EN303-5. DK already has EN303-5 Class 3 as national requirements and will have Class 5 in the near future. The same approach for Lot 15 with an earlier adoption of Class 5 is preferred. Hence at least the adoption of Tier 2 requirements would be welcomed directly from the start. The EU Air Quality Directive might justify even more stringent ELVs and national deviations to the Lot 15 regulation. DK asked for feedback from the Commission regarding the interaction with national and other EU regulations.

SE asked for more ambitious requirements if this would be possible. They remarked that in reality almost all biomass boilers are connected to a storage tank. However, many boilers are hand stoked with a low ability to modulate the power output, which means that emission values determined during testing are not representative, since they perform much better under real-use conditions because of the batch firing process combined with the buffer tank. They inquired further on how on/off control would be dealt with.

AT asked for faster timing for the ELVs and proposed third party testing, in particular because of the impact of the emissions on health.

INFORSE proposed to require Tier 3 immediately. They raised the question how part load emissions are covered in Lot 15. They mentioned that measurement methods using a dilution tunnel, which is e.g. used in Scandinavia, record much higher PM emission values than other methods.

NL requested more stringent ELVs and to avoid technology specific differentiation between manual and automatic boilers. Furthermore, they suggested that there should be SO_2 emission limit values for mineral fuels.

EEB mentioned that PM related limitations are generally not fully met by the Member States (MS). Regarding the air quality, they stated that in 2020 prospectively about 35% of the PM emissions in the EU will come from solid fuel small combustion installations. They remarked that the proposed PM limits are not strict enough and some MS have more stringent ELVs than the proposed Tier 3. They asked whether the condensed PM is included in the proposed ELVs, measured with the "Norwegian measuring method". They indicated that requirements are needed to avoid use of waste fuels in boilers for which they are not designed or tested, an issue that manually stoked boilers are more prone to than automatically stoked boilers.

FR was of the view that more stringent ELVs are justified and announced to deliver such values in its written contribution. They considered that third party testing would be an essential part of the regulation.

CEN indicated that in the forthcoming new EN303-5, Annex A, the gravimetric PM measuring method without dilution tunnel is referenced, as this method is reliable and gives reproducible results. CEN referred further to an on-going EU project on PM measurements whose method is not available yet.

HKI mentioned that ELVs for OGC already have a reduction effect on a significant part of the PM emissions derived from flue gas condensation.

BE stated that like FR it would suggest more stringent requirements in writing and asked the Commission to explain how to deal with the more stringent ELVs already in force in BE.

DE responded to the comments by HKI and SE. They welcomed the remarks concerning the correlation of OGC and flue gas condensation to PM as well as the positive effects of buffer tanks. Hence, the OGC requirements should be ambitious and the buffer tank should be included in the calculation method. Consequently, the differentiation between manual and automatic solid fuel boilers would not be needed anymore.

NL indicated that the health related issues of PM emissions should be considered when discussing the applicability of third party certification, especially regarding Lot 15 products.

IT stated that it did not support third party certification.

ANEC/BEUC supported the NL on the point of third party certification.

The **Commission services** answered on the legal issues raised by DE, DK and BE that the answer is threefold: Firstly, the preference would be setting ELVs at such levels that Member States would not feel the need to go further. Secondly, the internal market Article 114 of the Treaty of the Functioning of the European Union (TFEU) applies to Ecodesign measures, which includes a procedure of notification and approval by the Commission concerning national measures that set more stringent limits. Thirdly, the Commission will do further legal evaluation on the question regarding the interaction with national regulations, and the role of air quality legislation in this.

DK and **DE** asked for further written information from the Commission on this issue, especially with respect to the status of more stringent national regulations that are already in force.

The **Commission services** confirmed that they will look into this aspect with the Commission's legal service, but indicated that this would take time and that therefore when stakeholders are submitting written comments they should in doing so assume that Member States cannot set stringer requirements other than through the procedure referred to in Article 114 of the TFEU.

BE stated that third party testing was originally introduced in the CE marking modules because of the previous Boiler Directive and that inclusion of third party certification is fundamental issue.

The Chair summarized the discussion concerning the emission requirements:

– The view is that ELVs could be more stringent and stakeholders are invited to indicate what the levels in their view should be;

– The Commission services will consult with the Commission's legal service to explain the interaction of Lot 15 measures with Member State legislation on emissions also if based on other EU legislation;

– Third party testing is a challenging legal issue, which came up also in Lot 1 and has to be resolved for Lot 1 measures before it can be discussed for Lot 15;

– Concerning the ELVs' measurement, the current method for PM (gravimetric) combined with ELVs for OGC is reliable, although even more robust and harmonized methods should be developed.

– Concerning SO2, the initial response would be that this seems more applicable for larger installations and not for the smaller appliances falling in the scope of Lot 15, but more information and data on this point is welcome;

– The question on how to consider buffer tanks will be further investigated. This question is linked to Lot 1, but it is more relevant for Lot 15 boilers;

– The Commission services would welcome information and data from SE on on/off control products.

9.2. Labelling requirements

The **Commission services** continued with the presentation concerning the labelling requirements and explained the proposed consistency with the Lot 1 approach (labels G to A+++). It was highlighted that a Biomass Conversion Coefficient (BCC) would be necessary in order to promote biomass as a renewable fuel and allow a direct comparison with the renewable and fossil energy using heaters in Lot 1 measures.

UK supported in principle the BCC, but would want to explore further at which level it should be set.

INFORSE was critical towards the BCC, although they agreed with its aim to rate biomass boilers in the higher classes. This could however also be achieved via separate labelling, thus deviating from the Lot 1 classes distribution. They would prefer to use an "Energy Efficiency Index" where energy efficiency values rise above 100%.

NL remarked that the BCC is mainly a political value. An approach based on a physical parameter would be preferred to an "end-of-pipe solution", e.g. a correction related to the moisture content of the fuel.

ANEC/BEUC stated that energy efficiency classes that legally cannot be used should not be shown on the label.

SE welcomed the inherent idea of the BCC but indicated that also the efficiency number should be indicated on the label.

CEN indicated that they are not sure whether the product differentiation is as wide as shown and stated that most biomass boilers would be classified as A+, although with uncertainties regarding "standby". Secondly, they are not convinced by the correction of the efficiency by a value that has no physical relation to energy efficiency. Furthermore, it is not clear how standby heat losses were covered.

INFORSE pleaded to show also the actual energy efficiency on the label.

DK supported the principle of the BCC approach, but found the upper two efficiency classes too wide. As a result about 50% of today's biomass boilers would according to estimations based on a Danish database with 210 approved boilers be classified as A+.

The **Commission services** indicated that it is probably not possible to find a physical way to address the labelling issue for biomass boilers. An approach based on the suggestion of NL would lead to at best class A, which is lower than for the renewable energy technologies in Lot 1. With regard to providing information on the actual unmodified efficiency, this would not be a problem for the product fiche, but for the label this question would be more challenging since it is not obvious which value, the modified or unmodified, would provide better information to consumers. The unmodified value without BCC would give better information on how much energy can be obtain from the fuel input, but it can e.g. not be compared with a value on a label of a heat pump in the same energy class for which a different calculation approach is applied.

NL requested comparative data charts for a better understanding of the presented efficiency values and thresholds.[1]

The **UK** asked to indicate the type of fuel on the label in all cases.

ANEC/BEUC asked why there is no sound power information on the label.

DE remarked that some boilers may use several different types of biomass fuels and may perform differently with different fuels and for these boilers it needs to be clarified which tests need to be done and what needs to be indicated. If the manufacturer has the choice of with which fuel to test for the energy class on the label, this raises the question of whether the ecodesign requirements for emissions have to be met for any fuel that can be used in the boiler.

CEN mentioned that for automatic boilers it would not make much difference whether they are operated with e.g. pellets or wood chips, but that for boilers that have an automatic and a manual function for different types of biomass there are significant differences and this needs clarification.

INFORSE requested a clear indication of the fuel on the label. Further, air pollution relevant emission values should be shown on the label, at least for PM and maybe for OGC, possibly with an A-G scale.

ANEC/BEUC supported the comments by INFORSE.

The **Commission services** explained that in the proposal it is foreseen to deal with the different types of fuels in the product fiche. As regards labelling, indicators for “biomass” and “non-biomass” would only be shown for boilers that can use fuels falling into both of these groups in order to deal with the fact that the BCC factor result in a different energy class for these two groups. In line with Lot 1 the specific fuel the boiler uses is not generally indicated on the label. The “sound power level” on the Lot 1 label is mostly relevant for heat pumps, and appears less relevant for Lot 15 boilers, but additional information from the stakeholders is welcome.

NL asked why it is not possible to show emission values on the label, while “Sound Power level” is indicated on the Lot 1 label. Nevertheless, emission issues should rather be dealt with through stringent ELVs and not through information on the label.

INFORSE emphasized that information on emission values on the label would be helpful for consumers because preferences may depend on the area where one lives.

The **Chair** concluded that there is a need to think how to deal with different types of biomass. On labelling of emissions, the comments of NL are pertinent, although it is difficult to foresee at this stage what the eventual ELVs will be.

Lunch break 12.30 – 14.00 PM

Water heating efficiency

1 Graphic data of 35 boilers investigated in addition to those of the preparatory study were shown later during the meeting; see point 7 of the minutes.

The **Commission services** continued the presentation, explaining that the scope includes "combination heaters" as in Lot 1 and therefore water heating efficiency requirements and labelling were proposed following the Lot 1 methodology, with in addition minimum storage tank size requirements.

NL agreed with a consistent approach for water heating efficiency to be aligned with Lot 1 as far as possible.

CEN signalled that there might be an issue with the exact definition of a “solid fuel combination heater“: all Lot 15 appliances with the ability to provide domestic hot water will likely be defined as a “package”, with a separate hot water storage tank and controls for load management in order to provide domestic hot water. CEN mentioned the value of 55 l/kW for manual boilers was intended for water-based systems heating systems, which cannot modulate down to 30% of nominal heat output. The 20 l/kW value for automatic boilers was derived from the German 1.BImSchV regulation. However, neither is intended to be used for water heating performance assessment.

IT supported the comment by NL.

INFORSE indicated that the requirements seem to result in relatively large tanks. They further asked whether the Lot 1 efficiency scale for water heaters would be applied and suggested to be open to other possible labelling scales.

DE remarked that the integration of a buffer tank into the proposed methodology requires a thoughtful solution, e.g. consideration has to be given on how to deal with the remaining buffer tank in case of replacement of the boiler and vice versa.

The **Chair** summarised the discussion, stating that alignment with Lot 1 and 2 is preferred, and that the issue of a (sanitary) hot water tank needs to be properly considered.

Comments on other elements

The **Commission services** finalized the presentation and opened the floor for a discussion on other elements of the proposal.

NL proposed to align the timing for the review process of Lot 15 measures with Lot 1 and Lot 2 measures.

FI argued for changing the number of tests required for market surveillance into initially one test and if the product fails one more test instead of three as the costs for testing are steep.

DE indicated its support for the package label.

DK supported the point raised by FI.

SE suggested that the review should be aligned with the review of the Lot 1 measures and supported FI on the issue they raised .

IT explained that it did not agree with the comment made by FI.

CEN supported the point raised by FI and was in favour of third party testing.

The **Commission services** indicated on the topic raised by FI that market surveillance is an increasingly important topic and that they are conscious that it is expensive and that the Commission is supporting market surveillance through the Administrative Cooperation (ADCO) group and potentially through joint action. At this stage it is not appropriate to move away from the 1+3 testing approach in particular product measures.
DK indicated that third party testing is necessary anyway for boilers to obtain the CE marking in relation to other EU Directives.

BIOENERGY 2020+ asked for an explanation of the calculation method of Gross Calorific Value (GCV) out of Net Calorific Value (NCV), because it is not part of the current standards. Furthermore, they asked how standby heat losses and controllers (every boiler is sold with one) were considered in the calculation of η_s.

The **Commission services** responded that the NCV to GCV conversion is based on standard technical formulas, but would investigate whether it could be made clearer in the text. The standby heat losses and the effects of control systems are as described in the Lot 1 methodology, but further technical input from the stakeholders, especially CEN, regarding the standby heat losses would be welcome.

INFORSE asked if and how instructions for proper use and maintenance are considered in the proposal.

The **Commission services** indicated to INFORSE that such issues are *inter alia* dealt with by Article 14 of the Energy Performance of Buildings Directive.

The **Chair** summarized the discussion welcoming in particular further comments on the review.

<u>**Supporting data of the proposal**</u>

The **Commission services** gave a further explanation of the BCC by means of comparative data charts (as requested by stakeholders during the discussion of labelling requirements) for boilers tested by BLT Wieselburg. It was mentioned that the boilers tested and for which testing data was published by BLT Wieselburg are mainly the better performing biomass boilers on the market. With a BCC=1.4 these products qualify for the efficiency class A+. This approach would also give an incentive for manufacturers to develop even more efficient biomass boilers with condensing technology to reach the efficiency class A++.

DK stated that almost all efficient biomass boilers they recently tested would fall into class A+, which would reduce the possibilities for consumers to recognise and buy the most efficient out of this group.

SE supported the comment by DK and remarked that the wide label class ranges of the higher label classes in Lot 1 cause the problem and that it is therefore important to indicate the energy efficiency itself on the label.

EEB proposed to adjust the wide energy efficiency classes and thresholds from Lot 1 for a better differentiation for the purposes of Lot 15.

The **Commission services** remarked that the details of the Lot 15 BCC can be considered in this context, but the classes and thresholds established for Lot 1 should not be reopened.

IT remarked that if the data of the boilers shown represents the best segment of the market, then it is not surprising that they all fall into the same class. Concerning the issue of mentioning the energy efficiency value on the label, they stated that this raises issues of how one can distinguish between values of e.g. 106 and 107.

Summary

The **Chair** summarized the discussion and noted that further feedback and data input from the stakeholders is welcome, in particular on the following points:

- The boundaries between Lot 15 measures on solid fuel boilers and forthcoming Lot 20 local space heaters with water heating functionality have to be clarified;
- Cogeneration could be included in the scope of Lot 15, provided the same methodology as for Lot 1 can be applied, taking into account the BCC factor if appropriate;
- The scope could be extended to products with higher than 500 kW output power, although this would need supporting data for efficiency and other requirements such as possible SO2 requirements;
- More clarity is needed as regards the treatment of multi-fuel boilers and/or boilers that combust also non-woody biomass;
- Strong arguments with supporting data would be needed for extending the scope to include “process heat installations”, i.e. with other purpose than space heating;
- The general opinion is that the efficiency limits can be set stricter. The number of tiers is linked to the question of the review date;
- The introduction of the BCC in the seasonal efficiency has support, but further comments on the principle and the number are welcome. There is a question regarding which efficiency number should be in the product information and, if any, on the label;
- The general opinion is that the ELVs can be set stricter and comments and information on (expected) national ELVs is welcomed, preferably expressed as metric ELVs in mg/Nm3 at 10% O2, and not ppm or mg/kWh;
- Input on the consideration of 'on/off' regulated boilers is needed;
- Further consideration is needed on the question of buffer tanks;
- As regards third party testing the outcome of the discussion for Lot 1 in the Regulatory Committee needs to be awaited and comments regarding any legal arguments specific for Lot 15 on third party testing are welcomed;
- As regards stricter ELVs set by MS, it would be preferable to avoid misalignment but in case misalignment remains, a notification procedure is to be expected. The Commission will look into this further;
- Consideration needs to be given to whether and how in the light of the above the differentiation for technology, manual or automatic stoked, can be omitted;
- Indication of emissions on the label may not be needed in light of more stringent ELVs, but comments on this are welcome;
- Comments are welcome regarding the possible integration of the water heating efficiency.

Comments on the WD are to be received in written form by **12 September 2012** at the latest.

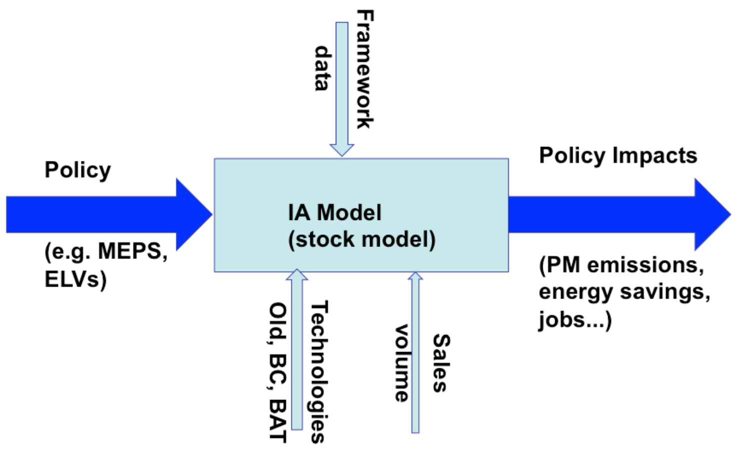
The Chair closed the meeting and gave an outlook regarding the further steps of the process. The adoption of the measures for Lot 15 appliances is expected for late 2013.

10. ANNEX 2: BASELINE ASSUMPTIONS

10.1. Stock model

For the impact assessment a so-called stock model is used, whose main input is the implemented policy and main outputs are the policy impacts (Figure 12).

Figure 12: Stock model used for the IA analysis



The basic logic of the stock model is the following:

$$Stock_{i,t} = Stock_{i,t-1} + sales_{i,t-1} - sales_{i,t-n}$$

i: specific product category of boiler

$Stock_t$: boilers in use in year *t*

$Sales_t$: boilers purchased in year *t*

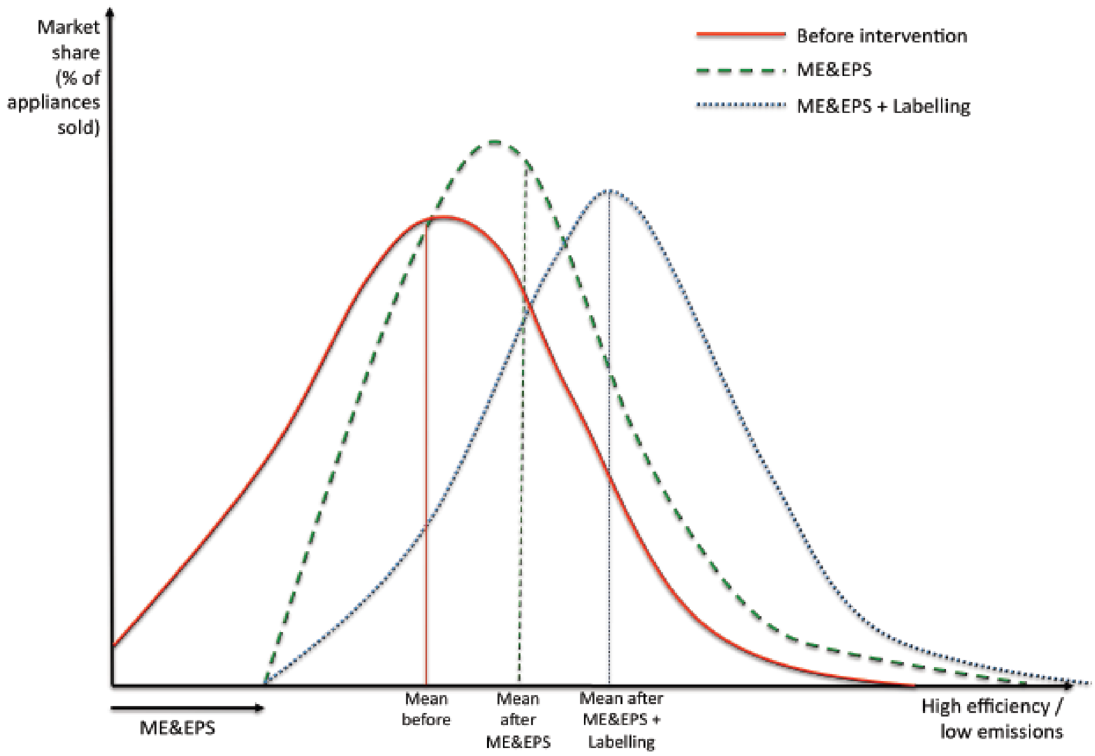
n: technical lifetime of a specific product category

For information relevant for the market (e.g. PM emissions of the market), the model sums up the corresponding characteristics of **all new purchased boilers**.

For information relevant for the stock (e.g. total solid fuel consumption), the model sums up the corresponding characteristics of **all boilers in use** and considers all the boilers purchased over the last *n* years.

The characteristics of new purchased boilers depend on the technologies available on the market and on the policy respectively implemented.

Figure 13: Market push and pull by ME&EPS and labelling



For each product category, the IA stock model calculates yearly the characteristics (performance, price…) of the typical product according to:

– Performance of typical product before policy implementation (**Base Case**)

– Performance of best product on the market (**BAT**)

– Ecodesign Requirements (MEPS and ELVs)

– Implementation of a **labelling scheme**

The main outputs are calculated over the period 2010 to 2040 (with a start-up period 1990 to 2010 in order to consider to the maximal technical lifetime of the analysed product categories):

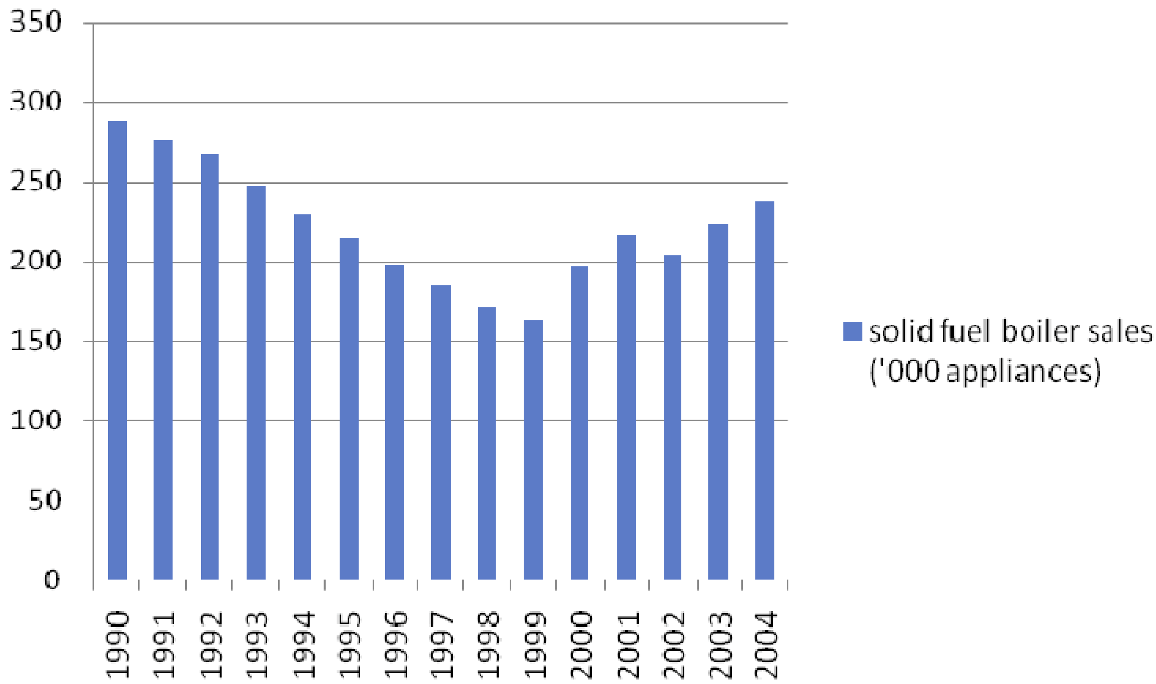
- Weighted boiler efficiency in %
- Solid fuel consumption in PJ/year
- Electricity consumption in TWh/year;
- Green House Gas emissions in MtCO2eq/year, related to solid fuel and electricity consumption

- CO, PM and OGC emissions in t/year
- Total EU-27 expenditure in billion €/year, with break down for purchase, installation costs and running costs
- Per product sold: regulated sales, product price in €, installation costs in €, energy costs in €/year and payback time in year
- EU-27 turnover in € billion/year, with break down for manufacturers, wholesalers, installers and energy companies (solid fuel and electricity)
- Employment (jobs), with break down for wholesalers, installers, energy companies and indirect employment
- The details of the framework data, the technology and the sales are provided in the following sections. An overview of the assessed policies is provided in ANNEX 3 and the overview of the output is presented in ANNEX 5 (seeTable 25, Table 26 and Table 27).

10.2. Sales volume

The Lot 15 Preparatory Study provides figures on the sales of solid fuel boilers.

Figure 14: Evolution of solid fuel boiler sales in Europe



Source: Bio Intelligence service 2009 Task 2 (based on BRG consult 2006)

Table 15: Evolution of solid fuel boiler sales in Europe until 2025

Product Category	2004	2005	2010	2015	2020	2025
Small domestic manual boiler	N/A	N/A	163,000	87,400	49,600	28,200
Small domestic DD gasifying boiler	N/A	N/A	222,000	226,000	220,000	205,000
Retort boiler	N/A	N/A	3,900	3,500	3,100	2,700
Pellet boiler	14,000	20,000	45,700	70,900	68,500	59,200
Non-domestic chip boiler	N/A	N/A	1,600	1,400	1,300	1,100

Source: Bio Intelligence service 2009, Task 8

For 2005 – 2025, the sales considered in this impact assessment are based on Table 15. For the timeframe 2025 to 2040, it is assumed that the growth of the sales will compensate the reduction of the thermal heat output of the new boilers (-2 % / years) due to the EPBD[2]. For retort coal boilers, a continuous decrease of the sales is assumed as well as for the small domestic manual boilers, which are replaced by more efficient small domestic DD gasifying boilers.

Table 16: Evolution of the sales after 2025

Product Category	Size	Evolution of the sales
Small domestic manual boiler	**-2%**	**-2%**
Small domestic DD gasifying boiler	**-2%**	**4%**
Retort boiler	**-2%**	**-2%**
Pellet boiler	**-2%**	**2%**
Non-domestic chip boiler	**-2%**	**2%**

In order to run the stock model calculations as of 2010, sales figures are also required for the 20 years prior the base year, since 20 years is the maximum lifetime of the considered product categories.

Table 17: Sales figures considered for the IA model (except for options C and C+PM label where after 2018 retort boilers are replaced by small domestic DD gasifying boilers)

2 See **Error! Reference source not found.**, section **Error! Reference source not found.**

Product Category	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Small domestic man. boiler	224,780	192,390	160,000	146,000	135,662	87,400	49,600	28,200	25,491	23,041	20,828
Small domestic DD gasifying boiler	5,000	15,000	25,000	35,000	222,000	226,000	230,520	205,000	249,414	303,450	369,193
Retort boiler	63,220	54,110	45,000	40,000	27,638	3,500	3,100	2,700	2,441	2,206	1,994
Pellet boiler	0	6,000	12,000	20,000	45,700	70,900	70,900	70,900	78,279	86,427	95,422
Non-domestic chip boiler	0	1,000	2,000	10,000	5,000	5,000	6,000	7,000	7,729	8,533	9,421

10.3. Technologies

Table 18: Overview of the Base Cases

	ENERGY USE		USE PATTERN			ECONOMIC INPUTS			ELECTRICITY CONSUMPTION				EMISSIONS			
Name	Nominal heat output (kW)	Test standard efficiency (NCV %)	Dominating Fuel	Hours of use per year (hours)	Product lifetime (years)	Product price (Euro/unit)	Installation costs (Euro/unit)	Repair and maintenance cost (Euro/unit over lifetime)	On-mode consumption (kW)	On-mode: hours per year (hours/year)	Standby consumption (kW)	Standby: hours/year (hours/year)	Test standard CO (mg/m3 @ 13% O2)	Test standard OGC (mg/m3 @ 13% O2)	Test standard PM (mg/m3 @ 13% O2)	Applicable standard
Small domestic man. Boiler	18	66%	Wood	1000	18.0	3,000	1,500	866	0.02	1,000	0.00	0	4000	350	180	EN 303-5
Small domestic DD gasifying boiler	20	88%	Wood	1000	18.0	5,000	1,500	866	0.02	1,000	0.02	3,500	200	10	50	EN 303-5
Retort boiler	25	82%	Coal	1000	20.0	4,000	1,500	850	0.10	1,000	0.01	3,500	200	10	50	EN 303-5
Pellet boiler	25	88%	Pellets	1000	20.0	6,000	2,000	850	0.13	1,000	0.01	3,500	350	50	50	EN 303-5
Non-domestic chip boiler	160	88%	Chips	1000	20.0	30,000	3,500	4,260	0.34	1,000	0.03	3,500	350	10	50	EN 303-5

Source: Based on Bio Intelligence service 2009

Note: PM does not include condensable organic compounds, which may form additional particulate matter when the flue gas is mixed with ambient air

Table 19: Overview of the Best Available Technologies

	ENERGY USE		USE PATTERN			ECONOMIC INPUTS			ELECTRICITY CONSUMPTION				EMISSIONS			
Name	Nominal heat output (kW)	Test standard efficiency (NCV %)	Dominating Fuel	Hours of use per year (hours)	Product lifetime (years)	Product price (Euro/unit)	Installation costs (Euro/unit)	Repair and maintenance cost (Euro/unit over lifetime)	On-mode consumption (kW)	On-mode: hours per year (hours/year)	Standby consumption (kW)	Standby: hours/year (hours/year)	Test standard CO (mg/m3 @ 13% O2)	Test standard OGC (mg/m3 @ 13% O2)	Test standard PM (mg/m3 @ 13% O2)	Applicable standard
Small domestic man. Boiler	18	91%	Wood	1000	18.0	6,305	1,500	866	0.02	1,000	0.00	0	100	5	12	EN 303-5
Small domestic DD gasifying boiler	20	91%	Wood	1000	18.0	6,305	1,500	866	0.02	1,000	0.02	3,500	100	5	12	EN 303-5
Retort boiler	25	88%	Coal	1000	20.0	4,000	1,500	850	0.10	1,000	0.01	3,500	90	7	30	EN 303-5
Pellet boiler	25	93%	Pellets	1000	20.0	6,990	2,000	850	0.13	1,000	0.01	3,500	30	1	10	EN 303-5
Non-domestic chip boiler	160	92%	Chips	1000	20.0	35,000	3,500	4,260	0.34	1,000	0.03	3,500	36	2	15	EN 303-5

Source: Based on Bio Intelligence service 2009, and test reports of boilers published by BLT Wieselburg[3] and the BAFA[4]

Note: PM does not include condensable organic compounds, which may form additional particulate matter when the flue gas is mixed with ambient air

10.4. Fuel and electricity

Greenhouse gas (GHG) emissions of power generation are assumed to develop from 0.41 kg CO_2/kWh_{el} in 2010 to 0.34 kg CO_2/kWh_{el} in 2030. The electricity price is 0.18 €/kWh_{el} in 2010.

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3 http://blt.josephinum.at/index.php?id=653

4 http://www.bafa.de/bafa/de/energie/erneuerbare_energien/biomasse/publikationen/energie_ee_biomasse_liste_automatischbeschickt.pdf and energie_ee_biomasse_liste_handbeschickt.pdf

Table 20: Fuel characteristics and prices

	GWP FUEL	NCV	Dry flue gas volume per kg fuel standardised to N%O_2		Fuel cost	
	KG CO_2EQ/GJ	MJ/kg	m^3/kg @ 13%	m^3/kg @ 10%	(Euro/GJ)	(Euro/kWh)
WOOD LOGS	6	16	11	8	8.4	0.0302
WOOD PELLETS	11	16	11	8	13	0.0468
WOOD CHIPS	4	16	11	8	6.5	0.0234
COAL	109	25	20	15	8	0.0288

The prices for all energy sources are assumed to increase by 4 % per year.[5]

10.5. Economic assumptions

For the purposes of this IA study, the presumed real discount rate is 4%.

Based on the preparatory study and further information gained from manufacturers, it is assumed that roughly about one third of appliances is sold via wholesalers and building supply stores, the others directly via installers. Based on this and information from the preparatory study as well as further data collected in the course of the impact assessment study, the following average composition of product price has been calculated (Table 21).

Table 21: Composition of product price (valid for all policy options)

Market actor	Fraction of product price
Manufacturer	86.7 % (20 % margin per product sold)
Wholesaler / Building supply store (retailer)	6.7 %
Installer	6.7 % (10 % margin per product sold)

Employment impacts of the different policy options have been roughly estimated by applying the following specific factors, which are based on a comprehensive data research based on annual reports of 25 market actors in the EU-27 (Table 22).

Table 22: Specific employment factors (valid for all policy options)[6]

Turnover per employee	Unit	Value
Manufacturer	[mln Euro/year]	0.184
Wholesaler / Building supply store (retailer)	[mln Euro/year]	0.279
Installer	[mln Euro/year]	0.075
Energy company (solid fuels, electricity)	[mln Euro/year]	0.782
Extra EU Imports		
Share of products imported into the EU-27 market	[%]	0 %
Indirect employment		
Indirect employees as fraction of total direct employment gains or losses due to investment in energy efficiency (multiplier effect)		0.667
Indirect employees as fraction of total direct employment gains or losses due to running cost expenditures (multiplier effect)		0.733
Additional indirect and direct employment per mln Euro net economic benefit (i.e. possibilities for additional consumption/investment) or loss of end-users compared to BAU (multiplier effect)	[mln Euro/year per employee]	0.0739
Fraction of indirect employees outside EU	[% of indirect employees]	0.500

5 As proposed by the MEErP methodology
6 Based on the companies listed in Annex 8

10.6. Particulate matter on the label

For policy options including indication of the level of particulate matter on the label either indicated as ABCDEFG[7] or expressed as a number[8], it is assumed that:

$E_{PM(Option+PM\_Label)} = E_{PM(Option)} - a \times (E_{PM(Option)} - E_{PM(BAT)})$

with:

$E_{PM(Option)}$: PM emission factor of a typical appliance purchased on the market according to a policy option, which does not include PM-label

$E_{PM(Option+PM\_Label)}$: PM emission factor of a typical appliance purchased on the market in the policy option including PM-label

$E_{PM(BAT)}$: PM emission factor of the BAT technology

a: improvement factor of PM–label. In the absence of specific evidence for such value[9], a value of 30% is assumed.

Since the relation between PM-performance and other characteristics of the boilers is unknown (e.g. end-user price), it is assumed in the IA model, that PM-label has only an impact on the PM emission factor of the boilers, which are in the scope of the PM labelling scheme.

7 As 'spin drying efficiency' for household washing machines and 'drying efficiency' for household dishwashers.

8 Indication as a number may be challenging as this would seem to require measurements to be of better precision than currently available. This also applies to the A-G scale indication though to a lesser extent.

9 No studies are available on consumer behavior related to aspects of the energy labels other than the energy efficiency class.

11. ANNEX 3: ECODESIGN REQUIREMENTS: MINIMUM ENERGY PERFORMANCE STANDARDS (MEPS) AND EMISSION LIMIT VALUES (ELVS)

11.1. Overview of the MEPS and ELVs

Table 23 presents the proposed Tiers of the assessed sub-options A to D.

Table 23: Overview of the MEPS and ELVs[10] for the boiler as defined in the Table 18

Sub Option	Tier	Boiler category	From	Energy Label	PM Label	MEPS (Etas, GCV based)	Indicative corresponding test standard efficiency (NCV based)	CO (mg/Nm3 @ 10% O2)	OGC (mg/Nm3 @ 10% O2)	PM (mg/Nm3 @ 10% O2)
A	1	Small domestic man.	2016	Yes	No	60.00%	71.30%	5,000	150	150
A	1	Small domestic DD gasifying	2016	Yes	No	60.00%	71.30%	3,000	100	150
A	1	Retort	2016	Yes	No	65.00%	74.40%	3,000	100	125
A	1	Pellet	2016	Yes	No	60.00%	71.00%	3,000	100	150
A	1	Non-domestic chip	2016	Yes	No	60.00%	78.80%	1,200	80	150
A	2	Small domestic man.	2018	Yes	No	67.00%	79.10%	1,200	50	75
A	2	Small domestic DD gasifying	2018	Yes	No	67.00%	79.10%	1,000	30	60
A	2	Retort	2018	Yes	No	71.00%	80.70%	1,000	30	60
A	2	Pellet	2018	Yes	No	67.00%	78.70%	1,000	30	60
A	2	Non-domestic chip	2018	Yes	No	67.00%	83.60%	1,000	30	60
A	3	Small domestic man.	2020	Yes	No	76.00%	88.45%	700	30	60
A	3	Small domestic DD gasifying	2020	Yes	No	76.00%	88.45%	500	21	40
A	3	Retort	2020	Yes	No	77.00%	87.00%	500	21	40
A	3	Pellet	2020	Yes	No	76.00%	88.00%	500	21	40
A	3	Non-domestic chip	2020	Yes	No	76.00%	90.80%	500	21	40
B	1	Small domestic man.	2016	Yes	No	67.00%	79.10%	1,200	50	75
B	1	Small domestic DD gasifying	2016	Yes	No	67.00%	79.10%	1,000	30	60
B	1	Retort	2016	Yes	No	71.00%	80.70%	1,000	30	60
B	1	Pellet	2016	Yes	No	67.00%	78.70%	1,000	30	60
B	1	Non-domestic chip	2016	Yes	No	67.00%	83.60%	1,000	30	60
B	2	Small domestic man.	2018	Yes	No	77.00%	90.00%	700	30	60
B	2	Small domestic DD gasifying	2018	Yes	No	77.00%	90.00%	500	21	40
B	2	Retort	2018	Yes	No	77.00%	87.00%	500	21	40
B	2	Pellet	2018	Yes	No	77.00%	89.60%	500	21	40
B	2	Non-domestic chip	2018	Yes	No	77.00%	92.40%	500	21	40
C	1	Small domestic man.	2016	Yes	No	-	-	-	-	-
C	1	Small domestic DD gasifying	2016	Yes	No	-	-	-	-	-
C	1	Retort	2016	Yes	No	-	-	-	-	-

[10] Note: PM does not include condensable organic compounds, which may form additional particulate matter when the flue gas is mixed with ambient air.

C	1	Pellet	2016	Yes	No	-	-	-	-	-
C	1	Non-domestic chip	2016	Yes	No	-	-	-	-	-
C	2	Small domestic man.	2018	Yes	No	77.00%	90.00%	300	10	20
C	2	Small domestic DD gasifying	2018	Yes	No	77.00%	90.00%	300	10	20
C	2	Retort	2018	Yes	No	77.00%	87.00%	300	10	20
C	2	Pellet	2018	Yes	No	77.00%	89.60%	300	10	20
C	2	Non-domestic chip	2018	Yes	No	77.00%	92.40%	300	10	20
C_PM_Label	1	Small domestic man.	2016	Yes	Yes	-	-	-	-	-
C_PM_Label	1	Small domestic DD gasifying	2016	Yes	Yes	-	-	-	-	-
C_PM_Label	1	Retort	2016	Yes	Yes	-	-	-	-	-
C_PM_Label	1	Pellet	2016	Yes	Yes	-	-	-	-	-
C_PM_Label	1	Non-domestic chip	2016	Yes	Yes	-	-	-	-	-
C_PM_Label	2	Small domestic man.	2018	Yes	Yes	77.00%	90.00%	300	10	20
C_PM_Label	2	Small domestic DD gasifying	2018	Yes	Yes	77.00%	90.00%	300	10	20
C_PM_Label	2	Retort	2018	Yes	Yes	77.00%	87.00%	300	10	20
C_PM_Label	2	Pellet	2018	Yes	Yes	77.00%	89.60%	300	10	20
C_PM_Label	2	Non-domestic chip	2018	Yes	Yes	77.00%	92.40%	300	10	20
D	1	Small domestic man.	2016	Yes	No	-	-	-	-	-
D	1	Small domestic DD gasifying	2016	Yes	No	-	-	-	-	-
D	1	Retort	2016	Yes	No	-	-	-	-	-
D	1	Pellet	2016	Yes	No	-	-	-	-	-
D	1	Non-domestic chip	2016	Yes	No	-	-	-	-	-
D	2	Small domestic man.	2018	Yes	No	77.00%	90.00%	300	10	20
D	2	Small domestic DD gasifying	2018	Yes	No	77.00%	90.00%	300	10	20
D	2	Retort	2018	Yes	No	77.00%	87.00%	300	10	40
D	2	Pellet	2018	Yes	No	77.00%	89.60%	300	10	20
D	2	Non-domestic chip	2018	Yes	No	77.00%	92.40%	300	10	20
D_PM_Label	1	Small domestic man.	2016	Yes	Yes	-	-	-	-	-
D_PM_Label	1	Small domestic DD gasifying	2016	Yes	Yes	-	-	-	-	-
D_PM_Label	1	Retort	2016	Yes	Yes	-	-	-	-	-
D_PM_Label	1	Pellet	2016	Yes	Yes	-	-	-	-	-
D_PM_Label	1	Non-domestic chip	2016	Yes	Yes	-	-	-	-	-
D_PM_Label	2	Small domestic man.	2018	Yes	Yes	77.00%	90.00%	300	10	20
D_PM_Label	2	Small domestic DD gasifying	2018	Yes	Yes	77.00%	90.00%	300	10	20
D_PM_Label	2	Retort	2018	Yes	Yes	77.00%	87.00%	300	10	40
D_PM_Label	2	Pellet	2018	Yes	Yes	77.00%	89.60%	300	10	20
D_PM_Label	2	Non-domestic chip	2018	Yes	Yes	77.00%	92.40%	300	10	20

12. ANNEX 4: CALCULATION AND MEASUREMENT METHOD

12.1. Approach and methodology

In order to be consistent with Lot 1, a similar package approach is considered for Lot 15 boilers. It establishes a labelling scheme and the provision of supplementary product information for packages including such boilers placed on the market with temperature controls, solar device and/or passive flue heat recovery devices. In this impact assessment, the policy analysis is limited to the solid fuel boilers and it does not take into account the effects linked to the package approach.

The energy efficiency calculation is based on the current Lot 1 approach, which is based on the gross calorific value of the fuel 'as received' (GCV_{ar}). Due to the specificities of solid fuel boilers, a few changes of the Lot 1 methodology are required. The main differences are:

– The correction factors F(4), accounting for a negative contribution to the seasonal space heating energy efficiency by ignition burner power consumption and F(5), applied only for cogeneration space heaters, are not applicable[11].

– For the label, a multiplication factor for biomass boilers, the biomass label coefficient (BLC).

The biomass label coefficient is necessary, as indicated in section 5.5, because the approaches applied to other renewable energy technologies would not promote efficient use of biomass and using the approach applied to fossil energy technologies, would mean all biomass boilers would be ranked lower in a lower energy efficiency class than boilers using oil or natural gas as indicated in Table 24. The latter would compromise the objectives of the 'Renewable Energy Directive' (cf. section 3.5).

Table 24: Overview of the energy classes of Lot 1 and Lot 15 boilers (according to the Lot 1 methodology without any multiplication factor for biomass solid fuel)

Boiler type	**Energy class (according to Lot1 methodology)**
Solar thermal	A+++
Heat pump	A++
Cogeneration	A+
Gas (Condensing technology)	A

[11] For solid fuel installations, the correction F(4) accounting for a negative contribution to the seasonal space heating energy efficiency by ignition burner power consumption is not applicable. Measurement of electricity consumption performed for standard test procedure according to EN303-5 shows that F(4) is typically lower than 0,05 % and therefore not significant. This value is even lower when the test procedure takes more time, since the ignition process occurs only once per test. The correction F(5) accounting in the Lot 1 methodology for a correction applied only for cogeneration space heaters, which are not in the scope of this document, is not applicable for Lot 15 boilers.

Oil (Condensing technology)	A
Coal	C
Wood Chips	C
Wood Logs	C
Wood Pellet	C
Wood Pellet (Condensing technology)	B

Source: Based on Lot 1 Preparatory Study and Lot 15 Preparatory Study

The preparatory study already mentioned the introduction of a correction factor for biomass fuel combustion installations, if these products would be regulated comparable to Lot 1 appliances as it is proposed in this impact assessment. Such correction factor would multiply the energy efficiency of the biomass boiler for the purposes of determining the energy labelling class.

The question arises at what level to set the coefficient. When a consumer sees a product in a higher label class to an otherwise identical product, she/he is likely to assume that the better-labelled product has

(1) lower environmental impacts; and

(2) lower running costs

The BLC should, as far as possible, be set at a value, which ensures that these assumptions hold true for the consumer.

Concerning lower environmental impacts, this holds true as biomass is a renewable energy source. On labelling measures for 'Lot 1' heaters, new and renewable heating technologies are able to reach the top classes A+ to A+++. Population of classes lower than that for biomass BAT boilers would as indicated in Table 24 discourage the use of biomass in favour of fossil fuels.

Concerning lower running costs, the preparatory study analysed fuel costs.[12] It concluded that fuel costs vary widely over time for both solid fuels and gas and oil. Fuel costs also differ from country to country. While the preparatory indicated that biomass fuel costs are on average lower than fuel cost for gas, oil and coal, this is not necessarily the case for every individual situation. Therefore, the difference on the label between biomass boilers and fossil fuel boilers of comparable technology status cannot be too large.

12 The preparatory study also analysed purchase costs and indicated an average of 4000 euro for automatically stoked and 3000 euro for hand stoked solid fuel boilers. These costs similar to those of conventional stoked gas and oil boilers: on average 3500 euro according to the Impact assessment accompanying ecodesign and energy labelling measures 'Lot 1'.

Figure 15 shows the result for different levels of the coefficient and the accompanying label classes. Based on the two considerations set out above, the appropriate level of the biomass label factor would be 1.2[13], which means that:

– Biomass boilers can reach one of the classes (A+) that are available for other renewable energy technologies (A+ to A+++). Higher classes (A++, A+++) can only be reached by renewable energy technologies that have much lower running costs than other technologies.

– Biomass fuel BAT boilers will get a higher efficiency class on the label (A+) than those of gas or oil BAT boilers of Lot 1 (A). The difference between biomass and fossil fuel boilers with comparable status of technology is at maximum two classes (biomass versus coal) and usually one class (biomass versus gas or oil).

– Current biomass boilers populate a wide range of classes and at present very few populate the highest potential class for biomass boilers (A+).

Figure 15: Effects of different BLC factors regarding the achievable energy efficiency classes of solid fuel boilers.

Boiler	Fuel	Nominal heat output (kW)	EN303-5 Class	Energy efficiency (NCVar based, @ full load)	Seasonal space heating energy efficiency (GCVar based)			
					BLC=1.0	BLC=1.2	BLC=1.4	BLC=1.6
EN303-5 Class 3	pellets	5	3	65.6%	60.1% D	73.2% D	86.3% B	99.4% A+
EN303-5 Class 3	chips	15	3	66.1%	60.6% D	73.8% D	87.1% B	100.3% A+
EN303-5 Class 4	chips	15	4	73.5%	68.0% D	82.7% B	97.4% A	112.1% A+
DD Gasifying (BAT for small domestic manual boiler in PrepStudy)	logs	18	5	82.5%	77.0% C	93.5% A	110.0% A+	126.5% A++
Non-domestic boiler (BAT PrepStudy)	chips	160	5	82.9%	77.4% C	93.9% A	110.5% A+	127.1% A++
Lambda probe control with condensation heat (BAT Impact Assessment)	pellets	25	5	85.3%	79.8% C	96.8% A	113.9% A+	130.9% A++
Condensing @ low temperature	pellets	4	5	92.4%	86.9% B	105.4% A+	123.9% A+	142.4% A++

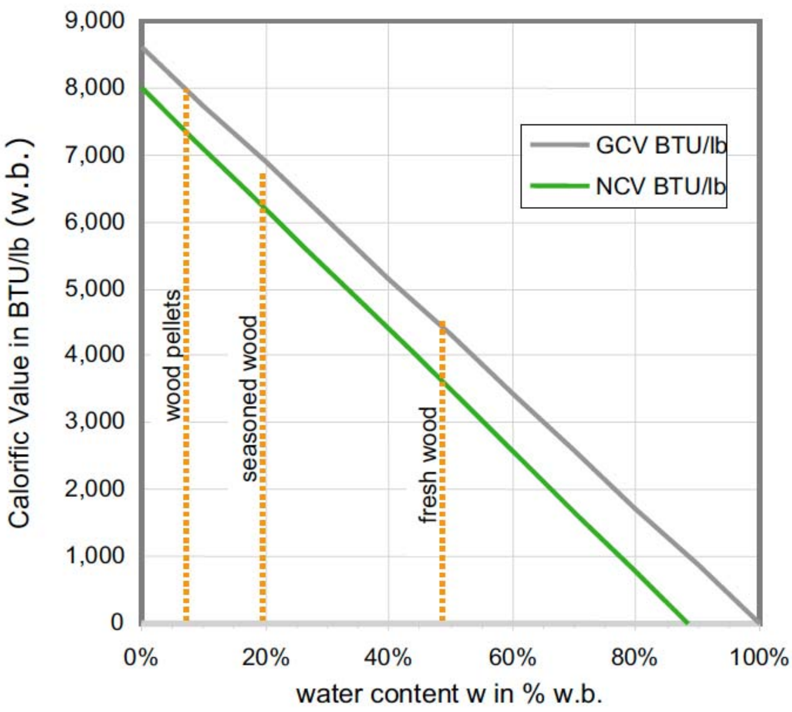
12.2. Relationship of GCV and NCV

'Gross calorific value moisture free' (GCV_{mf}): means the total amount of heat released by a unit quantity of fuel dried of all inherent moisture, when it is burned completely with oxygen, and when the products of combustion are returned to ambient temperature; this quantity includes the condensation heat of the water vapour formed by the combustion of any hydrogen contained in the fuel.

13 The Member States Expert Group on Energy Labelling requested on 23 September 2013 that a higher value be applied.

'Gross calorific value as received' (GCV_{ar}): means the total amount of heat released by a unit quantity of fuel measured with all moisture present, when it is burned completely with oxygen, and when the products of combustion are returned to ambient temperature; this quantity includes the condensation heat of the water vapour formed by the combustion of any hydrogen contained in the fuel.

Figure 16: Relationship of net and gross calorific value and water content



Source: NYSERDA 2010

The gross calorific value as received of the solid fuel (GCV_{ar}) is defined as:

$$GCV_{ar} = GCV_{mf} \bullet (100 - m) / 100$$

where m = moisture (as received), weight %

and GCV_{mf} = GCV moisture free

12.3. Calculation of the seasonal space heating energy efficiency

The seasonal space heating energy efficiency η_s is defined as:

$$\eta_s = \eta_{son} - \sum F(i)$$

Where:

η_{son} is the seasonal space heating energy efficiency in active mode, expressed in %;
F(i) are correction factors, which are expressed in % (see Lot 15 working document).

For the purposes of determining the energy labelling class only, a biomass label coefficient (BLC) applies which multiplies η_{son}. For biomass solid fuels: BLC = 1.2 and for non-biomass solid fuels: BLC = 1.0.

12.4. Calculation of the seasonal space heating energy efficiency in active mode

The seasonal space heating energy efficiency in active mode η_{son} is calculated as follows for solid fuel boiler space heaters:

$\eta_{son} = 0.85 \cdot \eta_1 + 0.15 \cdot \eta_4$

13. ANNEX 5: SUMMARY TABLES ON IMPACTS

13.1. Overview of impacts of the different policy options in 2020

Table 25: Overview of impacts of the different policy options in 2020

		Unit	*Baseline 2010*	Baseline	A	B	C	C + PM Label	D	D + PM Label
ENVIRONMENT										
	Weighted average efficiency (Market), NCV based	%	81%	85%	90%	90%	90%	90%	90%	90%
	Solid Fuels	PJ/year	598	637	630	627	627	627	627	627
	Electricity	TWh/year	0.386	0.632	0.632	0.632	0.631	0.631	0.632	0.632
	GHG	Mt CO_2-eq./year	15.1	9.5	9.4	9.4	9.3	9.3	9.4	9.4
	CO	t/year	1,928,872	613,832	550,619	539,642	544,390	544,390	544,421	544,421
	OGC	t/year	166,221	52,193	45,530	45,015	45,732	45,732	45,734	45,734
	PM	t/year	101,681	40,137	35,907	35,148	34,733	34,386	34,746	34,400
CONSUMER										
EU totals	Expenditure	€ bln./year	8.1	11.3	11.5	11.6	11.6	11.6	11.6	11.6
	of that, purchase & installation costs	*€ bln./year*	*2.7*	2.5	2.9	3.0	3.0	3.0	3.0	3.0
	of that, running costs	*€ bln./year*	*5.4*	8.8	8.7	8.6	8.6	8.6	8.6	8.6
Per product sold	Sales (regulated)	000	*436.0*	360.1	360.1	360.1	360.1	360.1	360.1	360.1
	Product price	€	4706	5329	6329	6599	6616	6616	6599	6599
	Installation costs	€	1575	1632	1632	1632	1632	1632	1632	1632
	Energy costs	€/year	867	1110	1054	1046	1044	1044	1046	1046
	Payback (SPP)	years	-	reference	17.7	19.8	19.6	19.6	19.8	19.8
BUSINESS										
EU turnover	Manufacturers	€ bln./year	1.8	1.7	2.0	2.1	2.1	2.1	2.1	2.1
	Wholesalers	€ bln./year	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	Installers	€ bln./year	1.1	1.0	1.1	1.1	1.1	1.1	1.1	1.1
	Solid Fuel and Electricity Companies	€ bln./year	5.1	8.4	8.3	8.3	8.3	8.3	8.3	8.3
EMPLOYMENT										
Employment (jobs)	Manufacturers	000	10	9	11	11	11	11	11	11
	Wholesalers	000	0	0	1	1	1	1	1	1
	Installers	000	13	12	12	12	12	12	12	12
	Solid Fuel and Electricity Companies	000	7	11	11	11	11	11	11	11
	Indirect Employment	000	22	26	27	27	27	27	27	27
	TOTAL	000	52	58	61	61	62	62	61	61
	of which EU	000	40	45	47	48	48	48	48	48

13.2. Overview of impacts of the different policy options in 2030

Table 26: Overview of impacts of the different policy options in 2030

ENVIRONMENT		Unit	Baseline	A	B	C	C + PM Label	D	D + PM Label
	Weighted average efficiency (Market), NCV based	%	86%	90%	90%	90%	90%	90%	90%
	Solid Fuels	PJ/year	530	512	508	507	507	508	508
	Electricity	TWh/year	0.737	0.737	0.737	0.736	0.736	0.737	0.737
	GHG	Mt CO_2-eq./year	5.0	4.8	4.8	4.5	4.5	4.8	4.8
	CO	t/year	291,746	157,304	146,073	144,790	144,790	144,898	144,898
	OGC	t/year	24,716	11,003	10,476	10,668	10,668	10,674	10,674
	PM	t/year	25,137	14,367	13,576	11,398	10,962	11,446	11,011
CONSUMER									
EU totals	Expenditure	€ bln./year	13.9	13.9	13.9	13.9	13.9	13.9	13.9
	of that, purchase & installation costs	*€ bln./year*	*2.6*	*2.9*	*3.0*	*3.1*	*3.1*	*3.0*	*3.0*
	of that, running costs	*€ bln./year*	*11.3*	*10.9*	*10.8*	*10.8*	*10.8*	*10.8*	*10.8*
Per product sold	Sales (regulated)	000	*363.4*	*363.4*	*363.4*	363.4	363.4	363.4	363.4
	Product price	€	5600	6450	6732	6745	6745	6732	6732
	Installation costs	€	1650	1650	1650	1650	1650	1650	1650
	Energy costs	€/year	1381	1332	1322	1321	1321	1322	1322
	Payback (SPP)	years	reference	17.1	19.2	18.9	18.9	19.2	19.2
BUSINESS									
EU turnover	Manufacturers	€ bln./year	1.8	2.0	2.1	2.1	2.1	2.1	2.1
	Wholesalers	€ bln./year	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	Installers	€ bln./year	1.1	1.1	1.1	1.1	1.1	1.1	1.1
	Solid Fuel and Electricity Companies	€ bln./year	10.9	10.6	10.5	10.5	10.5	10.5	10.5
EMPLOYMENT									
Employment (jobs)	Manufacturers	000	10	11	12	12	12	12	12
	Wholesalers	000	0	1	1	1	1	1	1
	Installers	000	12	12	12	12	12	12	12
	Solid Fuel and Electricity Companies	000	14	14	13	13	13	13	13
	Indirect Employment	000	28	29	29	29	29	29	29
	TOTAL	000	65	66	67	67	67	67	67
	of which EU	000	51	52	52	53	53	52	52

Table 27: Overview of impacts of the different policy options in 2040

		Unit	Baseline	A	B	C	C + PM Label	D	D + PM Label
ENVIRONMENT									
	Weighted average efficiency (Market), NCV based	%	87%	90%	90%	90%	90%	90%	90%
	Solid Fuels	PJ/year	465	447	444	443	443	444	444
	Electricity	TWh/year	0.856	0.856	0.856	0.854	0.854	0.856	0.856
	GHG	Mt CO_2-eq./year	3.9	3.7	3.7	3.3	3.3	3.7	3.7
	CO	t/year	159,777	59,270	58,813	48,542	48,542	48,711	48,711
	OGC	t/year	13,124	2,848	2,826	1,878	1,878	1,888	1,888
	PM	t/year	18,648	7,528	7,470	4,203	4,034	4,034	4,034
CONSUMER									
EU totals	Expenditure	€ bln./year	18.3	18.2	18.2	18.2	18.2	18.2	18.2
	of that, purchase & installation costs	*€ bln./year*	*3.6*	*4.0*	*4.1*	*4.1*	*4.1*	*4.1*	*4.1*
	of that, running costs	*€ bln./year*	*14.7*	*14.2*	*14.1*	*14.1*	*14.1*	*14.1*	*14.1*
Per product sold	Sales (regulated)	000	*496.9*	*496.9*	*496.9*	496.9	496.9	496.9	496.9
	Product price	€	5578	6358	6652	6660	6660	6660	6660
	Installation costs	€	1634	1634	1634	1634	1634	1634	1634
	Energy costs	€/year	1634	1586	1575	1574	1574	1574	1574
	Payback (SPP)	years	reference	16.1	18.1	17.9	17.9	17.9	17.9
BUSINESS									
EU turnover	Manufacturers	€ bln./year	2.4	2.7	2.9	2.9	2.9	2.9	2.9
	Wholesalers	€ bln./year	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Installers	€ bln./year	1.4	1.4	1.4	1.4	1.4	1.4	1.4
	Solid Fuel and Electricity Companies	€ bln./year	14.3	13.8	13.8	13.7	13.7	13.7	13.7
EMPLOYMENT									
Employment (jobs)	Manufacturers	000	13	15	16	16	16	16	16
	Wholesalers	000	1	1	1	1	1	1	1
	Installers	000	16	16	16	16	16	16	16
	Solid Fuel and Electricity Companies	000	18	18	18	18	18	18	18
	Indirect Employment	000	36	37	38	38	38	38	38
	TOTAL	000	84	86	87	87	87	87	87
	of which EU	000	66	67	68	68	68	68	68

Figure 17: Baseline development for solid fuel consumption and GHG emissions

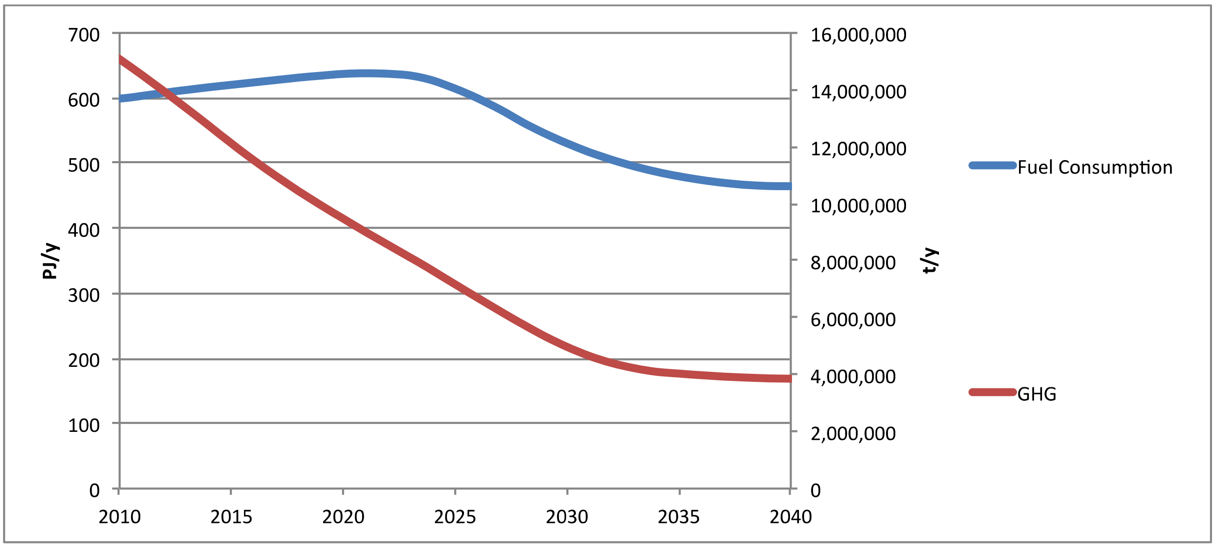


Figure 18: Baseline development for electricity consumption

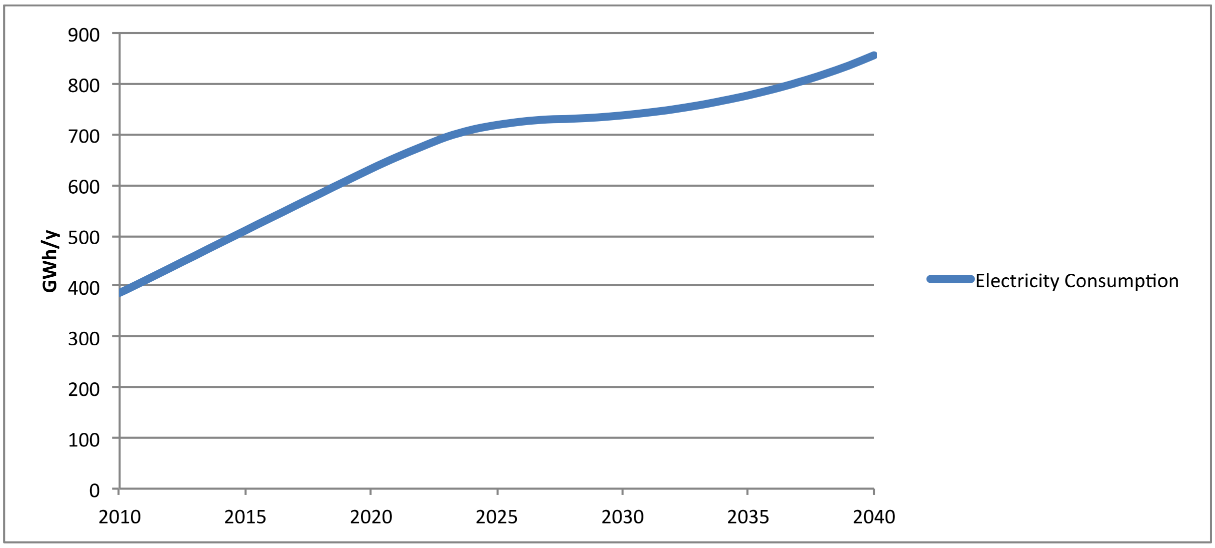


Figure 19: Baseline development for PM and OGC emissions

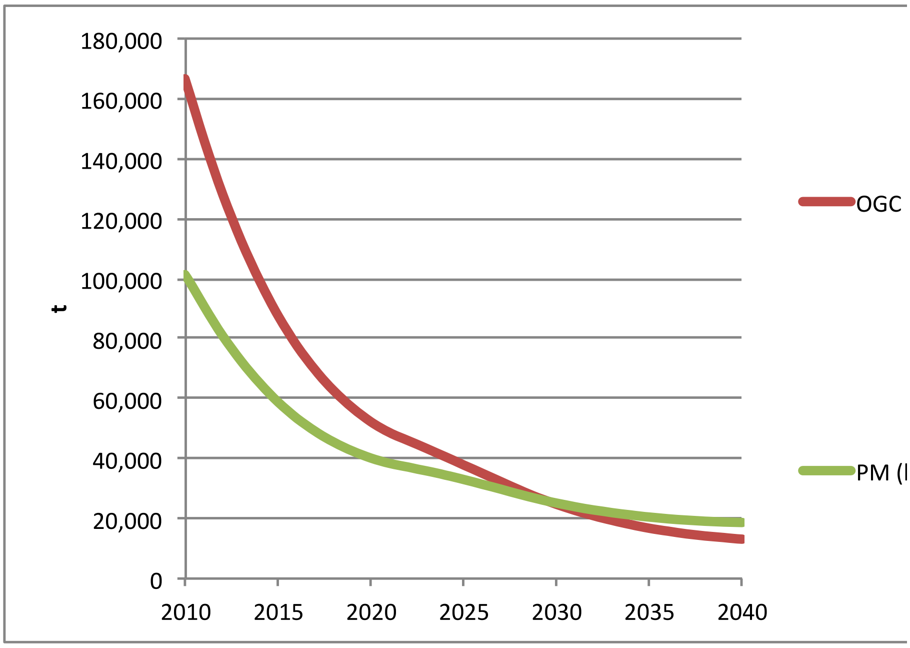
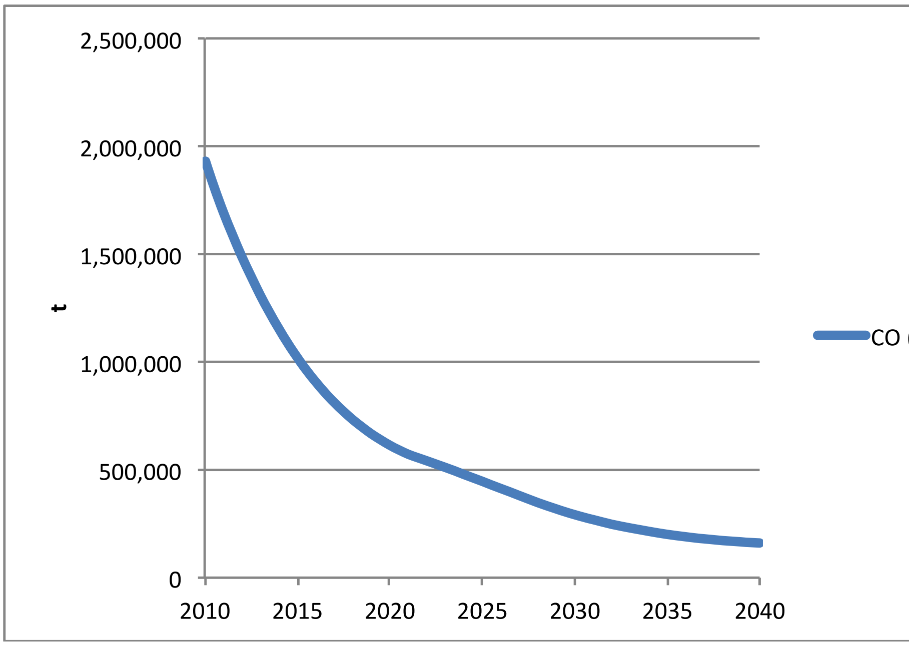


Figure 20: Baseline development for CO emissions



14. ANNEX 6: MOST RELEVANT POLLUTANTS LINKED TO SOLID FUEL COMBUSTION

In any type of combustion process airborne pollutants are formed, but their amount differs depending on fuel, appliance type and operational mode. In the following the characteristics of the most important pollutants specifically linked to solid fuel combustion are discussed.

14.1. Particulate Matter (PM)

Particulate Matter (PM) in flue gases from solid fuel combustion can be described as carbon, smoke, soot, stack solid or fly ash. Thereby, particulate matter can be differentiated in three major groups of fuel combustion products.

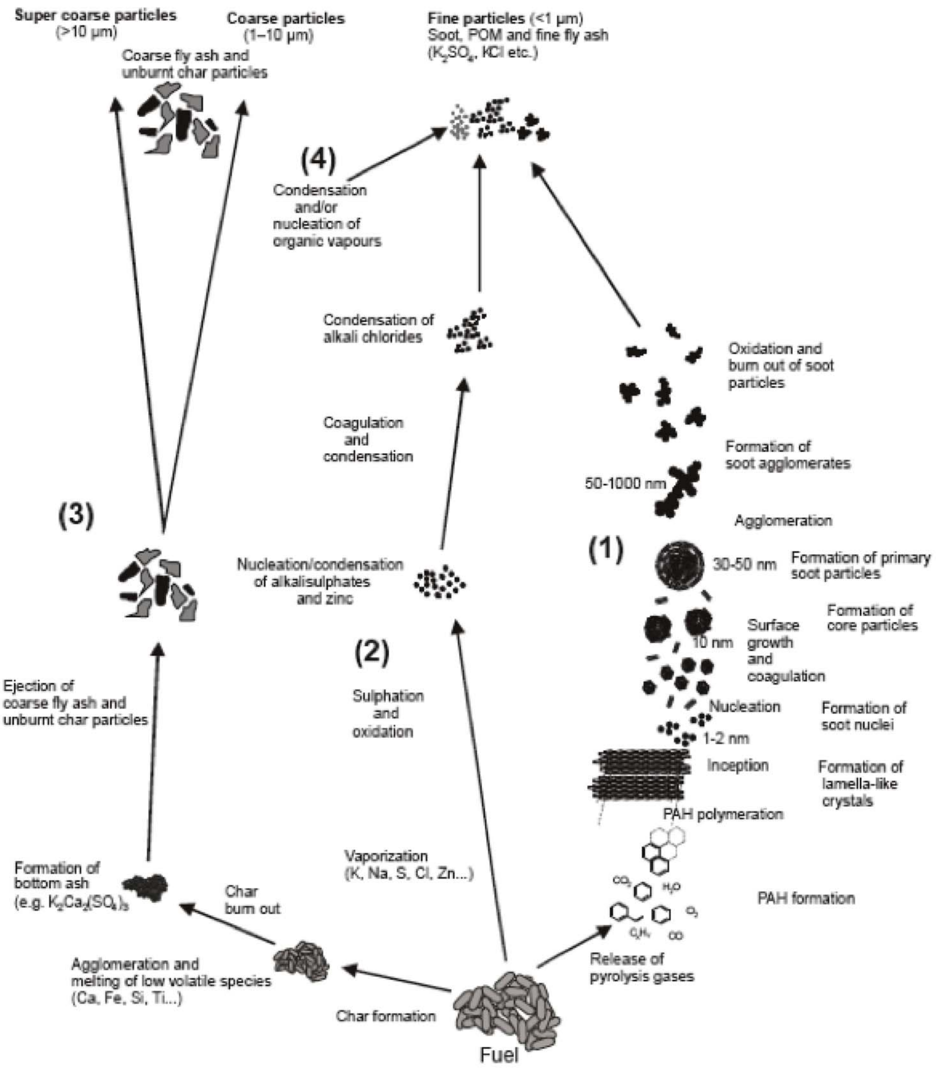
The first group of particulate matter is formed via gaseous phase combustion or pyrolysis because of the incomplete combustion of fuels (Products of Incomplete Combustion or PICs). Soot and organic carbon particles (OC) are formed during combustion as well as from gaseous precursors through nucleation and condensation processes (secondary organic carbon). These precursors occur as a product of chemical radicals' reactions in the presence of hydrogen and oxygenated species within a flame. Condensed heavy hydrocarbons (tar substances) are an important, and in some cases, the main contributor to the total level of particles emission, especially in small-scale manual solid fuels combustion appliances. The second and third groups of PM may contain ash particles that are largely produced from mineral matter in the fuel. They contain heavy metals, oxides and salts (S and Cl) of Ca, Mg, Si, Fe, K, Na, P as well as unburned carbon as a result of incomplete combustion of carbonaceous material (Also called "black carbon / elemental carbon" or "carbon-in-ash / loss on ignition"[14]).

Particulate matter emission from boilers is typically combined with PICs associated and/or adsorbed onto particulate surfaces. Size distribution depends on combustion conditions. Optimisation of the solid fuel combustion process (for example by introduction of continuously controlled conditions such as automatic fuel feeding and distribution of combustion air) leads to a decrease of emissions and to a change of PM distribution. Several studies have shown that the particulate emissions from modern and 'low-emitting' residential biomass combustion technologies are dominated by submicron particles (< 1µm) and the proportion[15] of the mass concentration of particles larger than 10 µm is normally < 10 % for boilers.

[14] Kupiainen, K., Klimont, Z., (2004); "Primary Emissions of Submicron and Carbonaceous Particles in Europe and the Potential for their Control"; IIASA IR 04-079, http://www.iiasa.ac.at/rains/reports.html

[15] Boman Ch., Nordin A., Boström D., and Öhman M. (2004); "Characterisation of Inorganic Particulate Matter from Residential Combustion of Pelletized Biomass Fuels"; Energy&Fuels 18, pp. 338-348, 2004

Figure 21: Illustration of the soot formation process (1), fine ash (2), coarse particles (3), particle organic matter (4), during residential wood combustion[16]



It must be stressed that PM values arising from solid fuel combustion differ significantly according to the measurement method used. Commonly used methods are:

- Gravimetric method, in stack (VDI)
- Gravimetric method with dilution tunnel (Norwegian method)

Currently, research is being carried out to compare the PM measurements obtained with different test methods. Intense work is also on-going to develop a new unified measurement method across the Europe[17].

16 Tissari J., 2008, Fine particle emissions from residential wood combustion, PhD Thesis University of Kuopio (FI)

17 HKI Position paper on new measurement method for dust emission

For the future, further studies are needed to analyse the differences of the three groups of particulate matter and their specific impacts on health. Based on this, there might be a need to revise and differentiate the PM emissions limits proposed in the different options presented in this impact assessment study as well as to further develop a harmonized European PM measurement methodology.

14.2. OGC

OGC is defined as "organic gaseous carbon" in EN303-5 and is essentially equivalent to a VOC ("Volatile organic compound") emission. VOC is a generic term for a large variety of chemically different compounds, like for example, benzene, ethanol, formaldehyde, cyclohexane, 1,1,1-trichloroethane or acetone. Furthermore, NMVOCs are identical to VOCs, but with methane excluded. They are intermediates in the thermal conversion of fuel to CO_2 and H_2O. As for CO, emission of NMVOC is a result of too low temperature, too short residence time in oxidation zone, and/or insufficient oxygen availability. The NMVOC/CH_4 emissions from combustion processes are often reported together as VOC. Emission of VOC has tendency to decrease as the capacity of the combustion installation increases, due to application of advanced or controlled combustion techniques.

14.3. NOx

'Oxides of nitrogen', expressed as NO_2 (general convention for reporting NO_x emissions), include the sum of nitric oxide (NO) emissions (>90% of the NO_x emission) and nitrogen dioxide (NO_2, typically <10% of the NO_x) emissions. Nitrogen emissions are the result of the partial oxidation of fuel nitrogen. The emissions of NO_x increase with increasing nitrogen contents in the fuel, as well as with increasing excess air ratio and higher combustion temperature. Nitrogen content in fuels varies both among and within fuel types: coals contain nitrogen mainly in N-organic form (0.5% to 2.9% daf, average about 1.4%). Biomass fuels contain N in N-organic form (0.05% to 0.8% daf) for coke the N-contents is between 0.6 to 1.55% (daf), for peat between 0.7 and 4.4 % (daf). NO_x emissions may be reduced by both primary and secondary measures aiming at emission reduction, but secondary measures are not applied in small installations due to economic factors.

Additional NO_x may be formed from nitrogen in the air under certain conditions, as "thermal NO_x" and as "prompt-NO_x". Thermal and prompt NO_x are generated by the flames surrounding individual particles, through free radical reactions. Nitrogen in the air starts to react with O-radicals and forms NO_x at temperatures above approximately 1300°C and its amount is depending on O_2 concentration and residence time. However, the combustion temperatures in boilers, in general, are lower than 1300°C and hence thermal NO_x formation is usually not important. However, most of the thermal NO_x is formed in the post-flame gases (after the main combustion process), and due to development of advanced boilers designs, the significance of such emissions may be increasing.

14.4. Dioxins / Furans (PCDD/F)

The emissions of dioxins and furans are highly dependent on the conditions under which cooling of the combustion and exhaust gases is carried out. Carbon, chlorine, a catalyst and oxygen excess are necessary for the formation of PCDD/F (Polychlorinated dibenzodioxins / -furans). Coal fired appliances in particular have been reported to release very high levels of PCDD/F when using certain kinds of coal. The emission of PCDD/F is also significantly increased when plastic waste is co-combusted in (typically manually stoked) residential appliances or when contaminated/treated wood is used. The emissions of PCDD/F can be reduced by introduction of advanced combustion techniques of solid fuels.

15. ANNEX 7: INFORMATION ON SOLID FUEL BOILERS OF 500-1000 KW

Compared to the subset of boilers (market share in 2020 about 22% of all solid fuel appliances, cf. Figure 22), medium sized boilers with a market share of about 4.5% of all solid fuel products constitute about 20% of the boiler market. Thus, this is a significant share certainly when their capacity and share of biomass heat output is considered: a smaller number of bigger boilers tend to have higher overall heating capacities and, because of more annual operating hours, a relatively high heat output.

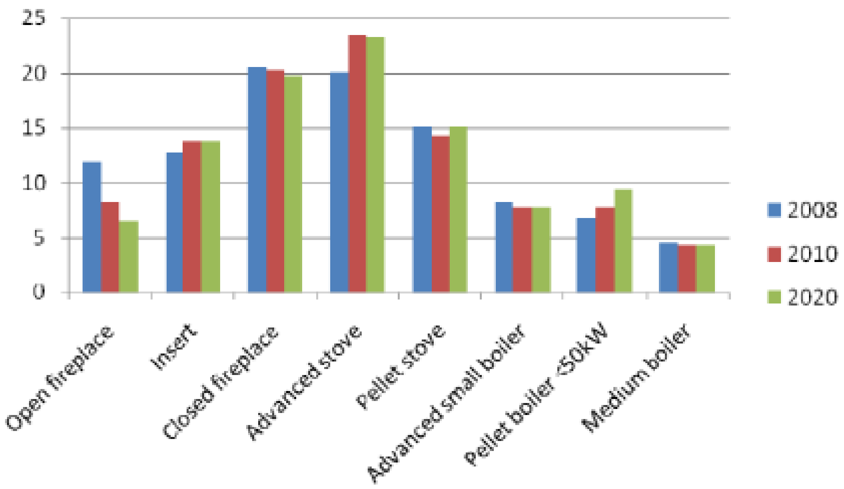


Figure 22: Market shares for different appliances, *From Lot 15 preparatory study*

This Annex provides information on medium-sized solid fuel boilers in Ireland, Austria, Germany and Latvia. Table 28 shows the comparative size of the EU solid fuel boilers stock in these countries.

	Solid Fuel Boilers				
	Fossil Fuel/ Universal	Logwood	Woodchips	Pellets	Others
EU 27	277.300	111.700	16.100	56.850	50.130
Austria	1.400	7.300	5.000	11.500	300
Belgium	100	800		400	
Bulgaria	10.000	1.500		300	
Cyprus					
Czech Republic	35.000	5.000		1.700	200
Denmark	1.400	700		3.000	
Estonia	2.200	600		200	
Finland	1.700	1.400	600	900	100
France	1.600	18.000	1.300	6.000	600
Germany	1.000	16.000	3.000	22.000	
Greece	100	500	100	50	50
Hungary	23.000	2.000		300	30
Ireland	3.500	600	300	1.000	50
Italy	200	5.800	600	1.700	1.200
Latvia	7.000	900		500	
Lithuania	14.000	2.400		200	
Luxembourg					
Malta					
Netherlands		200	100	100	
Poland	120.000	11.000	300	2.000	47.000
Portugal	100	400		100	
Romania	30.000	24.000		400	100
Slovak Republic	15.000	4.000	600	900	200
Slovenia	4.600	700	3.200	1.200	200
Spain	400	2.500	700	700	
Sweden		5.200	200	900	
United Kingdom	5.000	200	100	800	100

Table 28: Solid fuel boilers in Europe in 2008 (number if pieces) *From: 2011 AEBIOM Annual Statistical report, household biomass heating systems*

15.1. Data from Ireland

Table 29 shows that larger boilers (commercial/public services, such as hotels, leisure centers, schools, hospitals) are about one third of the space heating sector (residential plus commercial/public services). From many project descriptions and examples in Ireland it can be estimated that most likely a majority of these biomass boilers are in the range of 500kW-1MW. That would mean that in Ireland boilers of 500kW-1MW are responsible for about 1/6-1/5 of biomass space heating.

Table 29: From: "Renewable energy in Ireland 2011", SEAI

Table 10 *Trends in Renewable Thermal Energy (RES-H) by Sector 1990 - 2010*

	Growth %	Average annual growth rates %						Shares %	
Renewable Heat	**1990 - 2010**	**'90 - '10**	**'90 - '95**	**'95 - '00**	**'00 - '05**	**'05 - '10**	**2010**	**1990**	**2010**
Overall	82	3.2	-3.1	5.1	10.4	0.4	-1.2	4.7	4.0
Industry Total	106	3.9	-0.3	10.1	10.3	-5.6	-6.4	3.3	2.8
Wood & wood products	38	1.7	-0.5	10.1	2.6	-6.4	-4.2	2.1	1.8
Other industry	1921	17.1	4.6	8.6	65.9	-4.0	-10.3	1.2	1.0
Residential	10	0.5	-7.8	-10.4	7.9	18.1	11.2	1.0	0.9
Commercial/Public Services	-	-	-	-	-	41.9	9.1	0.4	0.3

Source: SEAI

In addition, the table shows significant ampount of industrial use of biomass heating, which covers both space heating and heating of industrial process installations. Alhtough a part of the industrial biomass boilers may be over 1MW, based on anecdotal evidence and examples it is a fair assumption that still a reasonable part is in the category of 500kW-1MW.

15.2. Data from Austria

Figure 23 illustrates that in Austria the heating capacity of the about 82 biomass installations of 500kW-1MW received some form of environmental subsidies when installed between 2002 and 2007 (nearly all of them boilers for buildings or "micro heating networks"). They represented a combined capacity of about 60MW. In reality more capacity may have been installed as there are no data for boilers between 500kW-1MW that did not get subsidies. Generally, larger installations have more operating hours so it can be assumed that the relative share in biomass space heating output is even larger. This means that for the output of space heating small combustion installations in 2008, Austria had an order of magnitude close to that of Ireland.

In addition, Austria has industrial biomass applications like in Ireland but no data were available. Taking into account that industrial applications tend to be larger and include a significant share of 500kW-1MW biomass combustion installations, it is reasonable to assume that industrial biomass small combustion installations in the range of 500kW-1MW in Austria constitute a substantial part of total biomass heat production, for space heating and for industrial process installations purposes.

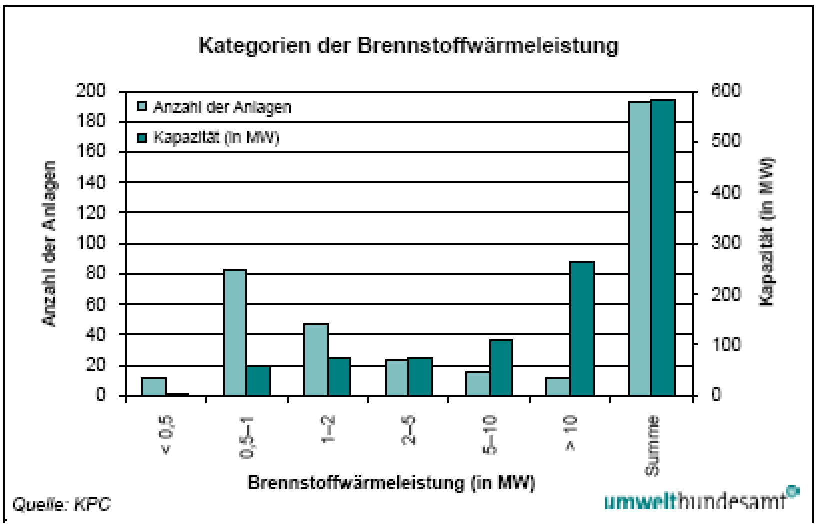
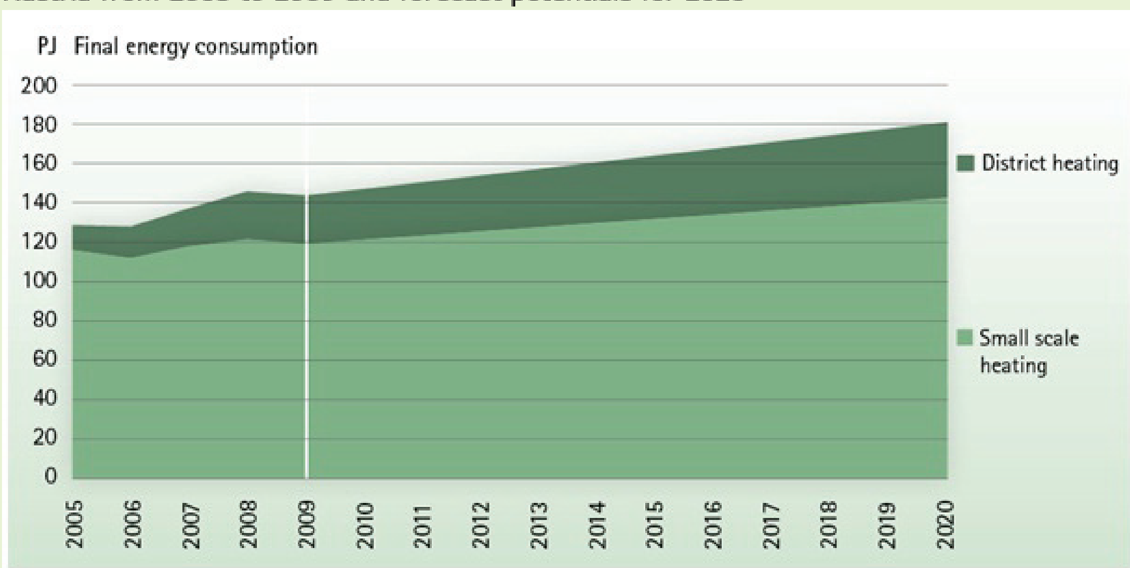


Abbildung 15: Brennstoffwärmeleistung und summierte Brennstoffwärmeleistung, 2002–2007.

Figure 23: From: Biomassefeuerungsanlagen – UBA (AT); subsidised biomass installations of 400kW–10MW

Recent data show that that the production of heat from biomass sources increased by about 12 % from 128.5 PJ in 2005 to 143.5 PJ in 2009, while in 2009 about 83 % of the produced heat contributed to small scale heating and 17 % arose from district heating (see Figure 24). In this period the heat from biomass sources nearly doubled from 12.7 PJ to 24.5 PJ. The heat production from small scale heating increased slightly from 115.8 PJ to 119.1 PJ. So biomass heat from district heating is increasing faster than biomass heat from household boilers.

Figure ‚Development Biomass Heat': Development of production of heat from biomass in Austria from 2005 to 2009 and forecast potentials for 2020



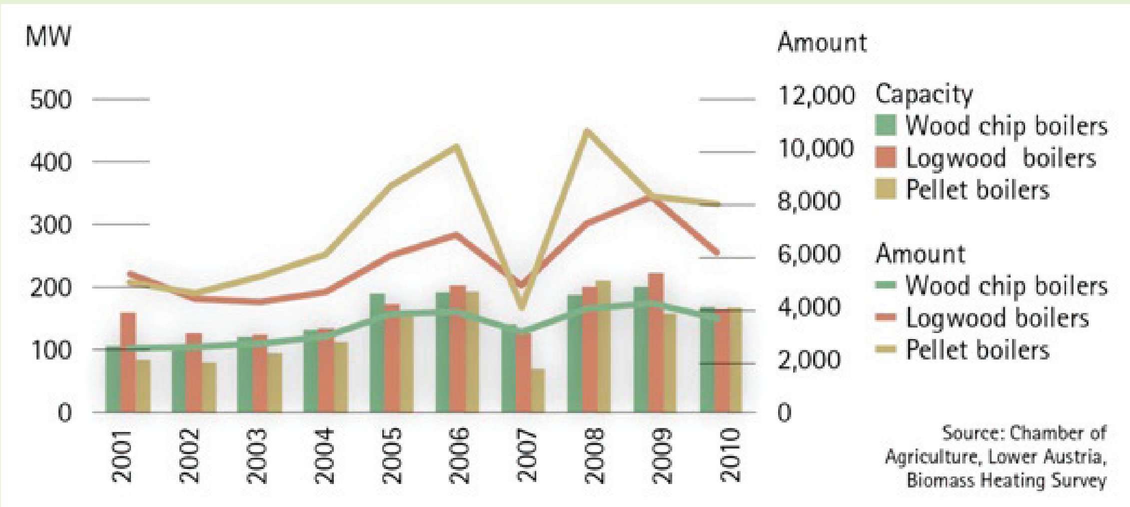
Source: „Heat, Electricity, Fuels – Bioenergy 2020"; Austrian Biomass Association, 2011; http://www.biomasseverband.at/servicedownload/publikationen

Figure 24: Basic Data Bioenergy 2012 *From: EU Handbook Small Scale Heating Markets*

Figure 25 shows the number and capacity of the annually newly installed biomass boilers below 100 kW in Austria. From this figure it is clear that the combined newly installed capacity in 2005 was about 510 MW, about the number found on the basis of earlier calculations. Figure 26 shows data for newly installed boilers over 100 kW up to 1 MW. The data from 2005 show that about 650 boilers were installed. From Figure 23 it could be deduced that from 2002-2007 82 biomass installations from 500kW-1MW received subsidies, which is about 14 a year, so at least about 2.5% of newly installed boilers from 100kW-1MW are in the larger subclass above 500kW (as also non-subsidised larger boilers may have been installed), representing at least 10MW. These 10MW may not seem much compared to the capacity shown in Figure 25. However, other more recent data and the market trends in Austria suggest higher amounts: the Austrian Biomass Association observes in the EU Handbook Small Scale Heating Markets: "In 2010, about 1880 biomass district heating plants with a total power output of 1600 MW were in operation, supplying 3200 GWh of heat. Currently a shift from big capacity units in the many MW-range towards smaller units in the range of several 100s kW can be observed."

This means that on average, an Austrian biomass district heating plant has a capacity of about 0.85 MW. Assuming a life span of about 30 years this means eventually about 60 of them will have to be replaced annually, representing about 51MW annually. There is no reason to assume that this trend will not be reflected in many other countries in Central and Eastern Europe where district heating is important, especially where retrofitting of the housing stock (reducing heat demand) is combined with updating district heating (to address reduced heat demand and reduce fuel costs) by installing relatively compact biomass district heating installations below 1MW.

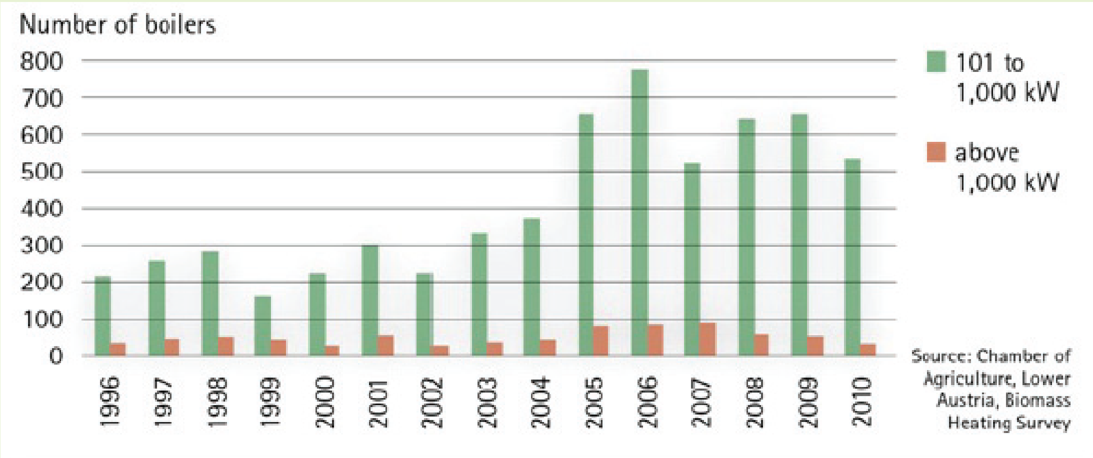
Figure ‚Installed Boilers': Number and Capacity of annually newly installed Biomass Boilers < 100 kW from 2001 to 2010 in Austria



Source: Chamber of Agriculture, Lower Austria, Biomass Heating Survey; publication: "Basic Data Bioenergy 2012"; published by Austrian Energy Agency and Austrian Biomass Association

Figure 25: From: EU Handbook Small Scale Heating Markets

Figure ‚Newly Installed Boilers': Number of annually newly installed Biomass Boilers > 100 kW Heat Output from 1996 to 2010 in Austria

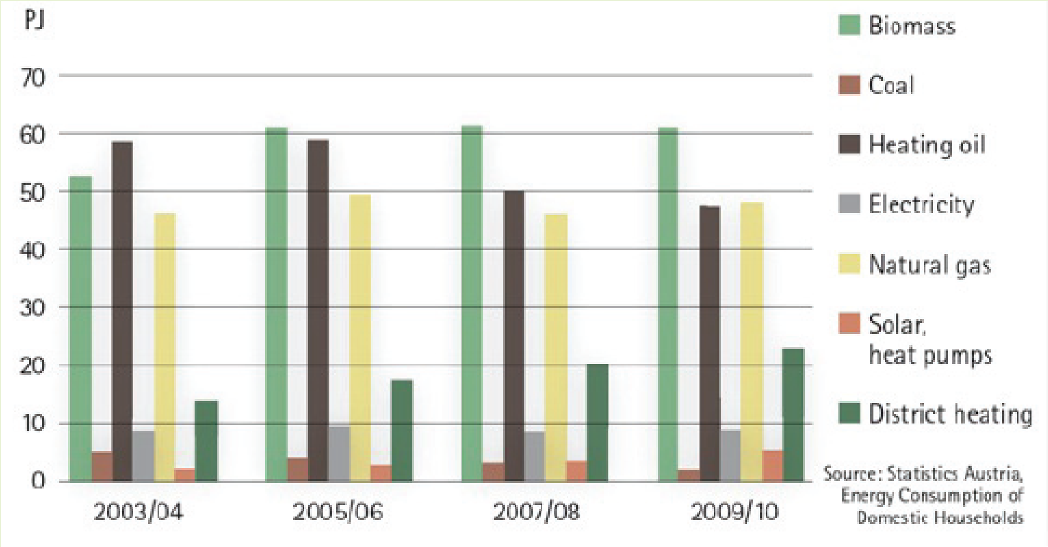


Source: Chamber of Agriculture, Lower Austria, Biomass Heating Survey; publication: "Basic Data Bioenergy 2012"; published by Austrian Energy Agency and Austrian Biomass Association

Figure 26: From: EU Handbook Small Scale Heating Market

Figure 27 illustrates clearly the growing trend in biomass heating in Austria. So biomass heat from district heating is growing faster than biomass heat from household boilers and there is a shift towards the upper range of smaller boilers below 1MW. Such boilers are also used for large buildings such as schools, for block heating and for local micro-grids. Combined the growing share of biomass heat output from district heating with a growing annual replacement and this annual capacity (estimate of about 60 MW) is certainly not negligible (not even taking into account any industrial applications).

Figure ‚Consumption Space Heating‘: Energy Consumption from Space Heating in Austrian Households 2003/04 to 2009/10



Source: Statistics Austria, Energy Consumption of Domestic Households; publication: "Basic Data Bioenergy 2012"; published by Austrian Energy Agency and Austrian Biomass Association

Figure 27: From: EU Handbook Small Scale Heating Market

15.3. Data from Germany

According to the Umweltbundesamt (UBA) in Berlin, in 2007 all combustion installations were subject to a check by chimneysweepers, and therefore there is an inventory of them. For the category of 500kW-1MW the numbers were as follows:

	solid fuel combustion installations > 500 kW - <1000KW	1534
Thereof:	Installations for woodchips	412
	Installations for coal	249
	Installations for pellets	78
	Installations for wooddust, bark, etc	515
	Installations for treated wood (without heavy metals or halogenes)	275
	Straw	5

It should be noted that since 2007 the number of installations for coal, wooddust and treated wood has decreased and the number of installations for pellets has increased, but no final figures are available yet for 2011.

Assuming that the size distribution is similar to the situation for biomass boilers of this size class in Austria indicated in Figure 23 (similar climate and economic structure), this would mean a heat generating capacity of about 1122 MW for solid fuel combustions installations in the size of 500kW-1MW in Germany alone in 2007. This is considerable in size. The capacity to be replaced annually would be around 50MW and involve about 30 installations. If market trends in other countries (e.g. Austria, Italy, Latvia, Slovenia) are an indication, there could be an uptake of biomass boilers if only because of the favourable fuel prices, which would add to the annual number and capacity sold in Germany in the category of 500kW-1MW.

15.4. Data from Latvia

In 2011, in Latvia there were 663 boiler houses used for local and district heating, of which a large number used solid fuel, mainly biomass:

– 130 firewood

– 85 wood chips

– 16 pellets

– 1 briquettes

– 1 wood cut-offs

– 1 straw

The size distribution of these boiler houses is shown in Figure 28 below. This shows that the range of 500kW-1MW is a substantial part of the boilers below 1MW, both in numbers (about 1/3) and in capacity (about 2/3), whereas in technology and in fuel they are basically not different.

Figure ‚Boiler Houses'

Thermal power	Quantity
<= 0.2 MW	105
0.2 <P<=0.5 MW	100
0.5 <P<=1 MW	113
1 <P<=5 MW	242
5 <P<=20 MW	77
20 <P<=50 MW	14
>50 MW	12

Figure 28 From: EU Handbook Small Scale Heating Market

16. ANNEX 8: NON-EXHAUSTIVE LIST OF RELEVANT COMPANIES

Manufacturers (company / holding company)	Base country
Viadrus	CZ
Guntamatic	AT
KWB	AT
Fröling	AT
ETA Heiztechnik	AT
Sommerauer & Lindner	AT
HDG Bavaria	DE
Ökofen	AT
Paradigma	DE
Paul Künzel GmbH & Co	DE
SBS Heizkessel Vertriebs GmbH & Co KG	DE
Concept and Forme S.A. - Stuv	BE
Bodart & Gonay	BE
Tulikivi Oyj	FI
Olsberg Hermann Everken GmbH	DE
Nibe AG	SE
Spartherm Feuerungstechnik GmbH	DE
Bosch Thermotechnik GmbH	DE
Wholesalers (company / holding company)	**Base country**
GC Group (Cordes + Graefe) / GC Sanitär- und Heizungs-Handelscontor GmbH	DE
Pfeiffer & May Group	DE
Installers (company / holding company)	**Base country**
Fritsch GmbH & Co. KG	DE
DASA Dach Sanitär Heizung Solar	DE
Dörau GmbH Bauausführungen	DE
Lengauer Heizung Sanitär	DE
Holz die Sonne ins Haus Energieconsulting GmbH	AT
Energy company (company / holding company)	**Base country**
E.ON	DE
EnBW	DE
Vattenfall	SE
Stadtwerke München	DE
RWE	DE
GDF Suez	F
EDF	F
Enel	I
CEZ	CZ
NUON	NL
Endesa	E
Iberdrola	E
British Energy (since September 2008 part of EDF energy)	UK
EVN AG (Energieversorgung Niederösterreich)	AT
Wienstrom	AT
Steweag - Energie Steiermark	AT
OMV	AT
Elia	BE
Czech Power Company CEZ	CZ
Prager PRE	CZ

EWE AG	DE
EESTI Energia	EE
gasNatural fenosa	ES
Fortum	FI
Eni Group	I
Viridian Group	IE
Polskie Sieci Elektroenergetyczne (PSE)	PL
PETROM	RO
Elektro-Slowenia ELES	SI
National Grid	UK
Essent	NL
Centrica	UK
Statkraft	NO
DEPA	GR
Verbund AG	AT
SPE	BE
Distrigas Belgien	BE
EnergiNet	DK
BG Group	GB
DEPA	GR
NEK (Natsionalna Elektricheska Kompania)	BG