About Nordic Ecolabelled

Boilers for solid biofuel



Version 3.0

Background to the ecolabelling
2014-01-31 - 2014-03-31
Consultation proposal

Nordic Ecolabelling

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Appendix 1 Overview of the authorities' requirements and other labelling schemes
Appendix 2 Requirements that have been discussed, but not included in the criteria

060 Boilers for solid biofuel, version 3.0, 31 January 2014

This is a translation of an original document in Danish. In the event of any queries, the original document will apply.

Addresses

In 1989, the Nordic Council of Ministers decided to introduce a voluntary official ecolabel, the Nordic Ecolabel. The following organisations/companies operate the Nordic Ecolabelling system on behalf of their own country's government.
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1 Summary

Nordic Ecolabelled boilers for solid biofuel are relatively simple combustion systems of up to 500 kW. The fuel may be added manually or automatically. Solid biofuel is firewood, wood pellets, briquettes, wood chips or straw. The boiler's function is to be the home's primary heating system to heat water to transport heat via the home's central heating system.

Greater use of bioenergy is an important parameter for achieving the UN's climate targets and thereby reducing emissions of carbon dioxide and other greenhouse gases. Biofuels are considered to be partly carbon-dioxide neutral on complete combustion. They also contribute to emissions of, among other things, particles, volatile hydrocarbons (OGC), carbon monoxide (CO) and nitrogen oxides (NOx) on combustion. It is therefore important that increased combustion of biofuel does not increase emissions to the air and derived health effects.

Life cycle analyses show that the largest element of the environmental impact occurs during operation of the boiler, i.e. as emissions to air.

In this revision it is proposed, first and foremost, to significantly tighten the requirements of emissions to air and efficiency. Emissions have a negative effect on health, and the emission volumes vary considerably between the various types of boiler. New requirements have been added concerning the use of chemicals in final production and for surface treatment, as well as a five-year guarantee requirement for the bearing structure. A new requirement is furthermore proposed that the boiler must be equipped with a sensor system, to ensure optimum combustion. In addition, new requirements of the boiler's electricity consumption have been added. A new requirement has also been proposed for the manufacturer of the boiler to inform the distributor/installation technician about how the boiler must be installed by certified installation technicians, the offer of annual service agreements, and the requirement of access to spare parts for ten years after the boiler is no longer manufactured.

Emission and efficiency data from producers shows that it is possible to tighten the Nordic Ecolabel's current requirements of particles, CO, OGC, NOx and efficiency. The Nordic Ecolabel has differentiated the requirement level for boilers below and above 20 kW, respectively, as the small boilers may present challenges with low-load emissions. For manually fired boilers, the Nordic Ecolabel now proposes tighter requirements for emissions of CO, OGC and particles compared to class 5 in EN303-5:2012 and at the level of the requirements in the Austrian ecolabel. The efficiency requirement is tightened from 85% to 90% and 91% for large and small manually fired boilers, respectively, which is tighter than the EU Ecolabel and the Austrian ecolabel.

For automatically fired boilers, the Nordic Ecolabel proposes requirements for emissions of CO, OGC and particles at the requirement level of Der Blaue Engel, the Austrian ecolabel and the EU Ecolabel. The efficiency requirement is tightened from 86% to 91% for large and small automatically fired boilers, respectively, which is tighter than the aforementioned labelling schemes.

The revision has examined the problems concerning emissions of Black Carbon (BC). Both areas must be studied more closely in the future assessment of the criteria.

Requirements of testing and test methods are updated in relation to current standards.

Requirements of installation and user manuals are clarified.

2 Introduction to the criteria

Original languages of this document are both Danish and Swedish.

2.1 Products that can achieve the Nordic Ecolabel

Boilers for solid biofuel with a nominal heat output of up to 500kW can achieve the Nordic Ecolabel. The fuel may be added manually or automatically. Solid biofuel is:

- Firewood
- Briquettes
- Wood pellets
- Straw
- Woodchips

Solar collectors may be included in the heating system.

Background to the requirement:
The requirement is changed from criteria version 2. The requirement adheres to the definition in EN 303-5:2012, which concerns boilers with a nominal heat output of up to 500 kW, compared to the previous 300 kW (EN303-5 and in the Nordic Ecolabel's criteria, version 2). It is now specified in EN 303-5:2012, that boiler and burner must be tested together. So that another seperate, replaceable burner cannot be used on a new bioboiler. In the Nordic Ecolabel's criteria, version 2, it was possible to Nordic Ecolabel a separate burner if the burner and defined boiler were tested together. This is no longer possible in the new criteria version 3.

2.2 Versions and validity of the criteria

The criteria for boilers were approved for the first time on 14 December 2000 with validity until 14 December 2003, version 1.0.

The criteria were evaluated in autumn 2005 and some changes were added to the criteria document. The text was placed in a new template and certain requirements were adjusted in accordance with other criteria for heat sources. The criteria's validity was extended to 31 December 2007.

On 14 March 2007, the revised criteria version 2.0 were approved, with validity until 30 June 2011. In this revision, new materials requirements were added, and the threshold values for emissions and efficiency were tightened.

The criteria's validity was then extended to 31 December 2015, as version 2.2.

The criteria, version 2.2, were evaluated in the spring/autumn of 2012 and adopted by NMN in March 2013.

2.3 The reason for Nordic Ecolabelling

Relevant environmental parameters and the potential for improvements in the product's life cycle have been assessed and are described in previous evaluations and revisions. The work has led to the criteria setting requirements in the following areas:

- Emissions to air are limited via threshold values laid down for health- or environmentally-hazardous emissions of carbon monoxide (CO), organic gaseous carbon/volatile hydrocarbons (OGC), nitrogen oxides (NOx) and particles.
- Utilisation of the energy content of the biofuel by making requirements of the boiler's efficiency.
- Materials must comply with the relevant requirements in standards. There are also requirements of surface varnish, marking of plastic elements and PVC-free packaging.
- Emissions to air are regulated indirectly via the information required in the installation and user manuals for volumes of combustion air, type of smoke flue, lighting instructions, etc. The purpose is to ensure optimum combustion that reduces emissions to air and makes efficient use of the wood's energy content.

Chapter 3 presents a summary of the RPS analysis prepared in connection with evaluation for this product group. The RPS analysis with the concepts of relevance, potential and controllability is a research tool used in the development of criteria in Nordic Ecolabelling to maximizing environmental benefits for Swan labelled products on the Nordic market. Nordic Ecolabelling uses RPS as a tool to analyse whether environmental problems are relevant, whether there is potential for improvement, and whether a licence holder has the control measures in place to achieve these environmental improvements.

The main issues made during the analysis are:

Relevance: Is there an environmental problem and how big is it?

Potential: Can you do anything about the environmental problem?

Controllability: Can the Nordic Ecolabel do anything about the environmental problem?

3 RPS summary

Raw materials extraction and production

These life-cycle phases are naturally relevant, but are probably not as important as the operational phase[1]. (R)

These criteria make very exacting requirements of manufacture and materials, so that they have good potential to develop and contribute to reducing environmental impacts, The requirements should primarily focus on materials such as steel and its external treatment, chemicals, insulation and ceramics, as well as access to spare parts, in order to easily increase the boiler's lifetime. It is unclear how much potential is represented by the substitution of material, components and chemical products used in manufacture. Revision of the closed fireplaces product group showed that there is relevance, potential

[1] Bowyer Jim: Life Cycle Impacts of Heating with Wood in Scenarios Ranging from Home and Institutional Heating to Community Scale District Heating Systems. Dovetail Partners inc., 2012.

and controllability in setting environmental requirements that make a difference. For example, concerning glue, varnish and external treatment. (R,P,S). The same has proved to apply to boilers for solid biofuel.

The controllability is probably relatively good. Several suppliers have their own production/own factories and it should be possible to also make requirements for the first stage of their suppliers of parts/components and similar. (S)

Operations

The product group has high environmental relevance. A biofuel boiler is fundamentally an environmental product, as it provides heat that to a great extent (disregarding electricity for operation) is 100% renewable and does not contribute to the greenhouse effect. (R)

Nordic Ecolabelling contributes by setting requirements to ensure that only boilers with low health- and environmentally hazardous emissions and high efficiency can be labelled. Emissions to air are measured under optimum laboratory/test conditions. The actual emission picture and the actual efficiency are often more severe due to such factors as age, and the quality and moisture content of the firewood, and other fuel than wood is used. Nordic Ecolabelling cannot control such factors and can only seek to exert influence by requiring good, correct information in operating instructions and user manuals. (S)

Nordic Ecolabelling should be able to show differences between the best boilers in the market and the more inferior boilers (such as low-price imported boilers). Manufacturers interviewed state that low-price products have a significantly shorter lifetime than quality boilers. There are probably also differences concerning operating emissions and efficiency. For this to have an impact, however, greater awareness among distributors and customers is required, so that the price is not the only deciding factor. (P)

Relevance (R) and controllability (S) are good for information in installation and operating instructions, competence/certification of installation technicians, and other information to customers that may affect their firing behaviour (firing videos, etc.). Correct installation, including project design/calculation affects the boiler's efficiency and emissions. Distributors'/installation technicians' communication on, for example, the value of solar heating solutions may have a major impact on the final customer's purchasing decision. In summary, the criteria should be developed with more requirements that increase the competence of installation technicians/distributors and the information they provide as guidance for an environmentally-sound decision on purchase and installation.

Equipping the boiler with a lambda probe or equivalent technique is a means to reduce the actual emissions when the normal home-owner fires the boiler. On any revision, the project group should assess the possibility of setting requirements without focusing excessively on technology. (P)

End-of–life

The recycling rate for actual boilers is already very high, which means the ecolabelling contribution is very limited. (P)

Less health- and environmentally hazardous material used to manufacture boilers contributes to reduced environmental impacts from the waste stage. (R) The same applies to labelling that facilitates the dismantling and separation of materials. (P)

Information and labelling can facilitate the end-customers' sorting of packaging at source, but is actually to a great extent subject to legislation and manufacturer liability (S).

4 Market description

4.1 The Nordic market

Small-scale combustion of solid biofuel, primarily wood and wood pellets in a wood-burning stove or boilers is an option commonly used to heat single-family homes. In Sweden, in 2008 the total combustion of biofuel in single-family homes was equivalent to 11.4 TWh, which accounts for approximately 36% of the total heating requirement.

According to the report from the Swedish Energy Agency entitled ”Småskalig förbränning av fasta biobränslen, 2010” (Small-scale combustion of solid biofuel, 2010) in Sweden alone there are approximately 1.85 million small-scale combustion facilities, of which more than 80% are local fireplaces (wood-burning hobs, tiled stoves, open fires, wood-burning stoves and inset fireplaces). These are not used as the primary heating source, but as a heating supplement and for comfort heating. The remaining approximately 330,000 are boilers fired with solid biofuel that are used as the primary heating source.

An analysis from the Danish Environmental Protection Agency in Denmark from 2010 assesses the number of wood-burning stoves/inset fireplaces installed in Danish households to be approximately 700,000, the number of wood-fired boilers to be approximately 50,000, and the number of wood-pellet-fired boilers to be approximately 50,000[2]. The number of wood-burning stoves has been at the same level for several years. In terms of wood-fired boilers, the development has been to replace old boilers with new boilers, and of these, approximately 80% have accumulator tanks. The total consumption of firewood (not including pellets) in 2011 amounts to 23.8 *1015J. This corresponds to a reduction by 5.2% compared to 2009[3]. The total consumption of pellets in 2010 amounts to 1,718,976 tonnes, of which 577,453 tonnes (34%) used in households[4].

In Norway, wood firing is the most commonly used type of bioenergy. Statistics Norway calculates that firewood use corresponds to 7.2 TWh[5], which is equivalent to more than half of the country's bioenergy consumption. An estimated 80% of Norwegian households[6] use, or have the opportunity to use, firewood for heating, and there are over 1.2 million fireplaces in Norway[7]. Most of these are wood-burning stoves.

[2] http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2010/978-87-92617-85-9/html/kap03.htm$3.3.
[3] http://www.ens.dk/da-DK/Info/TalOgKort/Statistik_og_noegletal/Energistatistik_metoder/Documents/Brændeforbrug%202011.pdf
[4] http://energi7.dk/upload_dir/pics/Det-danske-traepillemarked-2010.pdf
[5] Norsk Ved 2010: http://www.norskved.no/default.aspx?pageId=37&articleId=232&news=1
[6] http://varmeprodusentene.wordpress.com/gode-tips/
[7] (Statistics Norway 31.01.2011): http://www.ssb.no/magasinet/miljo/tab-2010-11-09-01.html

In Finland, district heating plants are estimated to account for the largest share of heating of blocks of flats[8]. Electrical heating is also generally used. In newly-built blocks of flats heat pumps, wood or wood-pellet fired boilers are often installed as the central heating source. In single-family homes, often a supplementary heat source is installed, such as a wood-burning stove or heat-accumulating stove. Solar collectors and local wind turbines are still relatively rare. In Finland, the total use of wood-based fuel to heat buildings amounts to 16.9 TWh, which is equivalent to approximately 23% of the country's energy consumption in buildings[9]. In Finland there are approximately 220,000 oil-fired boilers and 100-200,000 water-based electrical heating systems. These represent potential for conversion to renewable energy sources.[10]

In its long-term forecast, the Swedish Energy Agency assesses that the total use of biofuel for heating in Sweden is assumed to increase by 0.7 TWh during the coming 20-year period[11].

Boilers generally have a long lifetime and the rate of replacement of "poor"[12] wood burners is very slow. In combination with the increase in the installation of wood-burning stoves that generally show poorer environmental performance than conventional wood boilers, the emission problems will continue to exist long into the future. The total use of various biofuels to heat single family homes and agricultural properties that only use biofuel has increased by around 3 TWh during 2003-2008 in Sweden, where the largest increase is in firewood. See Figure 1.

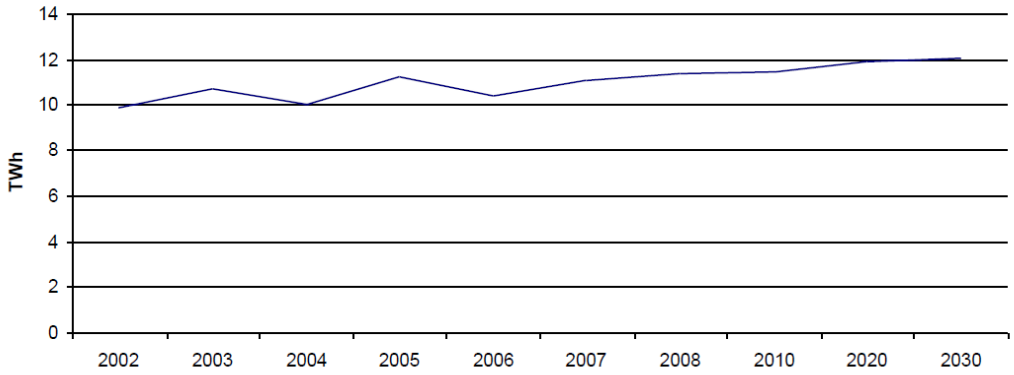


Figure 1: Long-term forecast for the use of firewood, woodchips and sawdust to heat single family homes in Sweden[13]

According to the Swedish Energy Agency's long-term forecast, the increase in firewood for heating is assessed to be stagnating, and is expected to be somewhat lower than in 2010, at approximately 5 TWh. The expected use of pellets is also expected to stabilise at around 3 TWh.

So far, the Ministry of Petroleum and Energy in Norway has set targets for expanded use of bioenergy by 14 TWh by 2020. This represents a doubling of today's level. The target

[8] Helio, Laine 2005. Rakennusten lämmitys. http://ilmasto-opas.fi
[9] Statistics Finland. http://tilastokeskus.fi
[10] Finland Heating pump association (SULPU). Lehdistötiedote 9.2.2012.
[11] Small-scale combustion of solid biofuel, Swedish Energy Agency, ER 2010:44.
[12] Must in the first instance be defined as non-BBR-approved facilities.
[13] Small-scale combustion of solid biofuel, Swedish Energy Agency, ER 2010:44.

will be achieved via close cooperation with the market players and via measures to increase both supply and demand[14].

In Norway there is clear development towards replacement of oil-firing with renewable technology. In central areas, connection to district heating is a competitive alternative. Biofuel is replacing oil in large facilities such as district heating plant and large properties (schools, industrial buildings, etc.), while heat pumps continue to be the first choice for single family homes. See also section 7.1.5 Climate plans. In 2001, almost 21% of all Norwegian households depending on oil for heating. In 2009 the equivalent figure was 14%.

It is clear that home boilers for solid biofuel compete with heat pumps, and usually the heat pump wins. The reasons stated by boiler suppliers depend to some extent on aggressive marketing as well as positive data on SPF (seasonal performance factor) for heat pumps. Heat pumps are also sold a lot due to how they are, in principle, maintenance-free once they have been installed. Similar conversion from oil boilers to district heating, heat pumps and in some case biofuel boilers already took place in the residential sector in Swede from the end of the 1980s.

Economic support

In some periods households were subsidised by the State when they installed small-scale combustion plant for solid biofuel. In Sweden, the latest subsidies have been for conversion from direct electrical heating[15] in residential buildings in order to stimulate the transition to district heating or individual heating with biofuel, heat pumps or solar heating. Subsidies were given for measures undertaken between 1 January 2006 and 31 December 2010.

Subsidies have also previously been given for single family home owners that switch from oil to heat pumps or biofuel boilers. Tax deductions have also been granted for the installation of biofuel systems in new single family homes. In 2006 subsidies were given in Sweden for the installation of pellet boilers and pellet stoves. This boosted sales in 2006 to 32,000 stoves. A year later, the number of stoves sold was down to 3,000. The result is that many pellet stove manufacturers went bankrupt or were restructured.

Under the current ROT (renovation, conversion and extension) deduction scheme[16] in Sweden, tax deductions are allowed for the labour costs of installing solar collectors, wood boilers and pellet boilers. For solar collectors, 30% of the total costs are counted as labour costs. For wood boilers, the equivalent figure is 28%, and for pellet boilers, 24% of the total costs are counted as labour costs.

Norway's state energy authority, ENOVA, supports the purchase of new pellet boilers, for example, with up to NOK 10,000. Certain municipalities, such as Oslo, make a financial contribution to biomass boilers that replace oil-firing boilers of NOK 1.5/kWh up to maximum NOK 10,000.

[14] Ministry of Petroleum and Energy, Press Release no. 38/08 ad strategy to expansion of bioenergy.
[15] Electricity can heat buildings in an electrical boiler or immersion heater that heats the water that circulates in the elements (hydronic electrical heating), or via direct electrical heating where electricity is converted to heat in the element.
[16] ROT deductions are tax deductions allowed to private individuals for certain types of work in the home. ROT stands for renovation, conversion and extension.

In Finland, up to the beginning of 2013 there was a state energy contribution of maximum 20% of the investment cost to replace oil-fired or electrical heating with heating from renewable energy sources. In total, EUR 10 million was distributed. This contribution was discontinued as from 1 January 2013.

Manufacturers and markets

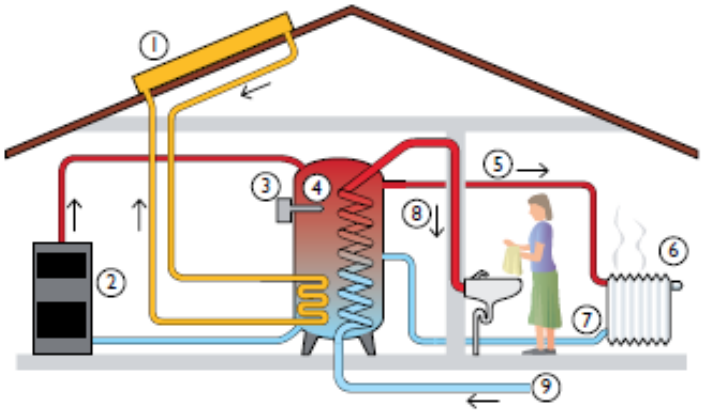
The sector can be summarised as follows:

- Most suppliers sell both wood-burning and pellet boilers, accumulator tanks and also separate pellet stoves (which can be installed in an existing oil boiler). Wood-burning boilers are a significantly larger product than pellet boilers, of which sales have fallen drastically in both Sweden and Norway. Some suppliers also sell fireplaces.
- The companies that are part of a European Group can also provide gas and oil boilers that are the usual heating method in many parts of Europe.
- Many of the suppliers (that manufacture themselves or import other brands) have the detached home market (boilers < 15-20 kW) as their largest market. It is not unusual for them to also deliver large boilers for large properties such as industrial facilities, schools and apartment buildings.
- There are suppliers that virtually specialise in large boilers for large properties (> 20 kW). SGP Värmeteknikk in Norway is one example. They can also deliver combined facilities for up to 1MW output. In some cases, these large boilers are installed in combination with other heating installations such as solar collectors, electrical heating or oil firing. Another Norwegian company, Bioenergy, can also see sound development (but from a low level) in bioenergy-based local energy centres/district heating centres that are established for industrial areas.
- Another example of a supplier that focuses on slightly larger boilers is Kaukora/ Jäspi. They manufacture their own wood-burning and pellet boilers in Finland, which lie in an output range of 15 – 40 kW. They also supply solar and wind energy facilities.
- Most suppliers of boilers for detached homes focus on firewood and pellets as the fuel source. There are manufacturers/suppliers that also work with other biofuels. The former licence holder CN Maskinfabrik sells straw boilers for agriculture. The Finnish supplier, Laatukattila, sells large boilers and district heating system for such fuels as woodchips, bark, wood shavings, briquettes, sawdust and peat.
- The boiler manufacturers usually also sell solar heating solutions. These are often manufactures outside the company and purchased complete. The same often applies to pellet stoves. As yet, the market for solar heating solutions is very limited. There are positive exceptions, however. One example is SGP Varmeteknikk, which has installed more than 20 solar collectors in the environmental profile area Bellona at Vulkan outside Oslo. Solar collectors produce surplus heat that can be delivered to surrounding buildings.
- Suppliers that specialise in large facilities often do not sell directly to tenants/ residents, but to property owners or managers. So they do not just sell boilers (products), but also other services such as heating. They take responsibility for project design, installation and also operations.
- Marketing is targeted at the final customer, while the distribution chain is as follows: Boiler manufacturer → wholesaler (sells many brands) → installation technician/heating and plumbing company (a few brands) → end-customer (house or property owner).

- All interviewees stated that the industry is susceptible to cyclical fluctuations. Buying a boiler is a major investment that can be postponed when economic conditions are less favourable. However, there is a continuous need for biofuel boilers. This latent demand means that many companies expect to sell more boilers than in an average year at a later time, when the European economy picks up.

4.2 Market development

Interviews with people in the industry show a partly reduced market in the Nordic region. Several Swedish companies state that they focus on export to countries in the rest of Europe (Germany, Italy, France, Spain) in order to grow. Wood-burning boilers is the produce that has shown the smallest decline in the Nordic region. Sales of pellet boilers have in principle stagnated completely in Sweden. Pellet burners for existing oil boiler are still sold, but to a limited extent. Sales of solar heating technology have also declined. Economic support has gone and the technology has not "broken through", to a great extent due to the cost. A solar collector entails an investment of at least SEK 40,000 and the repayment time is at least ten years. An exception is camping sites that have discovered that they can recover an investment in solar collectors within a few years. The reason is that they have a great need for domestic hot water in the summer when the sun shines. There are also detached home customers who have plenty of money and also a great interest in new technology and for that reason choose to invest in solar heating for their biofuel boilers. The contribution from the sun gives domestic hot water during the summer months when no space heating is required, and contributes particularly to heating in the autumn and spring.



Att kombinera ved- eller pelletseldning med en solfångare är bra eftersom du ofta slipper elda i din panna på sommaren. Bilden visar en biobränsleanläggning som är kompletterad med en solfångare.

1. Solfångare
2. Panna, pellets eller ved
3. Elpatron
4. Ackumulatortank
5. Varmvatten ut till radiator
6. Radiator
7. Returvatten (värmen är avgiven till rummet) in
8. Tappvarmvatten till tvätt och disk
9. Kallvatten in

Figure 2: Combining firewood or pellet firing with a solar collector is good as the boiler does not have to be fired in the summer The picture shows a biofuel facility that is combined with a solar collector. The picture is taken from "Heating the Home" published by the Swedish Energy Agency in September 2010.

Several interviewees state that one of the biggest problems today is that sales of imported low-price products are increasing at the same time as the serious manufacturers are expected to produce better and better products. A licence holder says "the level is so low in the industry that some companies advertise that they have the CE mark". A CE mark is certainly a statutory requirement, but says nothing about the boiler's output and quality.

Product development is towards simpler, more time-saving products. Customers wish to save time, with simple, good functionality, rapid service and modern boiler design. The latest big step within technology development was the lambda probe. A lambda probe measures the oxygen content of the flue gases and adjusts the damper to optimise the inflow of air. This is now an established technique that is available as an option (or mandatory feature for wood-burning boilers. The difference does not seem so great in the test environment, but is stated to give 5-10% higher efficiency and at least 10% lower emissions in "customary/normal" firing conditions that differ from the optimum conditions in the test environment. Right now, the industry is in a phase that is characterised by small, but continuous improvements.

Another development that is already noted is that customers as for several (two or more) energy sources for heating. This is for several reasons: safety, easiness in old age, price, efficiency, etc.) This is often a case of different separate heating sources, but also of choosing to install a so-called combination boiler.

The players in the industry state the next development to be:

- wood-burning boilers in combination with solar collectors
- electro filters to reduce the quantity of particles
- higher energy efficiency (over 90%) and lower emissions
- control of combustion conditions to reduce emissions of nitrogen oxides
- a holistic approach to heating requirements by stating the seasonal space heating energy efficiency, taking account of the home's heating requirement and accumulator tank.

4.3 Nordic Ecolabelling licences

The table below presents an overview of licences for Nordic Ecolabelled boilers in the Nordic market, according to criteria version 2. As the table shows, this is only licences for boilers that are fired with firewood. Two manufacturers have Nordic Ecolabelled a total of five products, including accumulation tanks and solar collectors. There has been limited interest in Nordic Ecolabelling of boilers for wood pellets or straw.

Table 1 Overview of licences and registration of boilers, October 2013

Licence holder	Fuel (Firewood)	Fuel (wood pellets)	Fuel (woodchips)	Reg. in DK	Reg. in S	Reg. in N	Reg in Fin
Sweden							
BAXI	X						
Effecta AB	X						

4.4 Official requirements and instruments

4.4.1 The renewable energy directive

The EU's renewable energy directive (2009/28/EC)[17] on the promotion of the use of energy from renewable sources is intended to gradually increase the proportion of renewable energy sources in the EU's total energy consumption to 20% in 2020. The directive is an important element of the European Commission's overall climate and energy package to reduce the EU's greenhouse gas emissions. The directive also helps to improve the EU's supply reliability.

The renewable energy directive includes a distribution between the 27 member states in relation to the overall objective of 20% renewable energy. Denmark and Finland's ratios must be 30% and 38% in 2020, while for Sweden and Norway the ratios must be 49% and 67.5%, respectively (including ratios of renewable energy in the transport sector of 10%). The use of biofuel to heat buildings contributes to fulfilling the objective. The directive (article 13) states that the member states shall promote conversion technologies that achieve a conversion efficiency of at least 85% for residential and commercial applications.

The member state must also (cf. article 14 of the directive) ensure that certification schemes are available for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. In Sweden, the Swedish Energy Agency, together with the Swedish National Board of Housing, Building and Planning and Swedac (the Swedish Board for Accreditation and Conformity Assessment) has recently reported on its tasks under the renewable energy directive and proposed a system of voluntary certification of installation technicians, with the requirement of accreditation. The proposal entails that the Swedish National Board of Housing, Building and Planning states the requirement specifications via a regulation, and that installation technicians can then achieve certification in accordance with these specifications. The players that draw up certificates must be accredited by Swedac. The proposal was adopted in 2012[18].

4.4.2 Ecodesign and energy labelling

The work within Energy Related Products[19] is divided into different product categories, called LOTs, in which product studies investigate market data, production data and technical status, and function as a decision-making basis for the European Commission. The decision-making basis must result in environmental requirements ecodesign regulation and energy labelling regulation) that become mandatory for the product group in the European market.

The work in LOT 15 (Requirement for local space heaters) concerns all local space heating products that primarily function via direct heating and where the energy source is solid fuel (coal, biomass, wood pellets, etc.). The work in LOT 20 concerns the same product group, but in this case the energy source is electricity, gas, liquid fuel, etc. There

[17] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:DA:PDF

[18] http://omvarldsbevakning.byggtjanst.se/PageFiles/106765/SU1301054%20Certifiering%20av%20v%c3%a4rmeinstallat%c3%b6rer-rev.pdf

[19] http://www.eceee.org/Eco_design/products

is thus a certain functional similarity between certain product types in the two ongoing LOT areas, so that the work is run in parallel.

Ecodesign is a good tool to eliminate the poorest closed fireplaces/stoves from the market. Energy labelling is a good tool to drive the development towards more energy efficient closed fireplaces/stoves.

In July 2013, the European Commission presented a proposal for joint EU requirements for the energy efficiency and emission requirements of solid fuel boilers[20] and products for local space heating[21] (which include wood-burning stoves and open fireplaces). The proposal for the EU-ecodesign requirement for solid fuel boilers was voted on 24 September, but the European Commission did not manage to get a qualified majority for the required proposal. To avoid rejection of the proposal in the vote, the European Commission therefore withdrew the proposal and, probably after informal meetings with the leading countries, will submit it in an amended version in 2014.

Energy labelling of solid fuel boilers and products for local space heating was also discussed at the meeting. The energy labelling proposals follow a different set of regulations that are not subject to voting requirements. The Commission succeeded in achieving broad acceptance of the proposals. It will therefore continue with energy labelling, notwithstanding the lacking ecodesign requirements.

Ecodesign requirements

The European Commission tabled a proposal for a vote on 24 September 2013, which was not adopted, for solid fuel boilers. As a minimum, solid fuel boilers must achieve the seasonal space heating energy efficiency ηs stated in the table below. The fireplaces must furthermore comply with a number of emission requirements for CO, OGC, NOx and particles, as shown in the table below.

Table 2 Proposal (rejected) from 24 September 2013 for ecodesign requirements of solid fuel boilers

	Measurement unit	Biomass boilers
Calculated seasonal space heating energy efficiency, Ns, calculated on the basis of the gross calorific value (GCV): boilers <20kw	%	75
Calculated seasonal space heating energy efficiency, Ns, calculated on the basis of the gross calorific value (GCV): boilers <20kw	%	77
CO (weighted annual emission)	mg/m^3, 13% O_2	300
OGC (weighted annual emission)	mg/m^3, 13% O_2	10
Particles/dust (weighted annual emission)	mg/m^3, 13% O_2	20
NOx (weighted annual emission)	mg/m^3, 13% O_2	200

Energy labelling requirements

As the above shows, the member states agreed to continue with energy labelling, irrespective of the lacking ecodesign requirements. Proposals for energy classes from 24 September 2013 for energy labelling of solid fuel boilers are presented in the table below.

[20] http://www.eceee.org/ecodesign/products/solid_fuel_small_combustion_installations
[21] http://www.eceee.org/ecodesign/products/Lot_20_local__room_heating__products

For solid fuel boilers for biomass, this means that energy classes D – G are excluded from the European market.

Table 3 Proposal for energy classes from 24 September 2013 for energy labelling of solid fuel boilers

Energy classes	Seasonal space heating energy efficiency, ηs, in %
A+++	$\eta s \geq 150$
A++	$125 \leq \eta s < 150$
A+	$98 \leq \eta s < 125$
A	$90 \leq \eta s < 98$
B	$82 \leq \eta s < 90$
C	$75 \leq \eta s < 82$
D	$36 \leq \eta s < 75$
E	$34 \leq \eta s < 36$
F	$30 \leq \eta s < 34$
G	$\eta s < 30$

Seasonal space heating energy efficiency is a value that is calculated according to a formula/mathematical model. The basic idea is that seasonal space heating energy efficiency is a more accurate value of the boiler's function since it takes account of the output from the boiler in different seasons. The ecodesign and energy labelling regulation's energy efficiency requirements are proposed to be defined as an efficiency of the biomass fuel adjusted by a biomass conversion factor of 1.15 that takes account of renewable characteristics of the biomass fuel. Seasonal space heating efficiency is abbreviated to ηs and pronounced “eta-s”. Eta-s is defined as $\eta s = \eta e$ * conversion factor 1.15. The test basis for energy efficiency is EN303-5:2012. I.e. the same standards (revised) as are used by the industry and the Nordic Ecolabel today.

4.4.3 RoHS directive and REACH regulation

RoHS 2 (Restriction on Hazardous Substances)

RoHS is intended to protect consumers from hazardous substances. Brominated flame retardants can, for example, cause foetal deformation and cancer. In addition, the equipment is less environmentally hazardous if it later becomes waste, and it can be easier to recycle the waste.

As from 1 July 2006, new electrical and electronic equipment (relevant for electronically controlled pellet stoves) may not contain the following hazardous substances:

- Lead
- Mercury
- Cadmium
- Hexavalent chromium
- PBB and/or PBDE

In principle, the regulations concern all electrical and electronic equipment.

Threshold values: The threshold value for the hazardous substances listed is 0.1% by weight in homogeneous material besides cadmium, where the limit is 0.01% by weight in homogeneous material.

The directive is evaluated and revised on a continuous basis in order to adapt the requirements to the scientific and technical development, as well as in cooperation with manufacturers of electrical and electronic products, the material recovery industry, environmental organisations and consumer organisations. Exemptions concerning the use of the prohibited substances can be found in the annexes to the WEEE directive.

The REACH regulation

The REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) regulation (no. 1907/2006) with reference to the ECHA (European Chemical Agency) candidate list, annex 1 (http://echa.europa.eu/chem_data/candidate_list_en.asp) contains an overview of hazardous substances, cf. the definition: ”Substances of Very High Concern (SVHC)”. The candidate list is published by ECHA and the substances on the list are subject to the authorities' official requirements when the European Commission has confirmed the substances on the list. Before the substances are confirmed by the Commission, Nordic Ecolabelling pays particular attention to these substances and often makes requirements of them in relevant criteria.

How are REACH and RoHS 2 related to each other?
RoHS and REACH are two different acts with different scope and objectives. RoHS 2 is a sector-specific directive that lays down regulations to limit certain hazardous substances in EE products, while REACH is a general act that regulates the registration, evaluation, authorisation and restriction of chemical substances.

RoHS 2 and REACH apply in parallel. REACH also includes regulations to limit substances in various programmes, but in principle there should not be any overlaps, so that restrictions to the specific use of substances in EE should not be addressed by REACH[22].

[22] http://ec.europa.eu/environment/waste/rohs_eee/pdf/faq.pdf

4.4.4 CE marking

With the revised, harmonised standard EN 303-5:2012, automatically fed pellet stoves fall under machinery directive (2006/42/EC) and are subject to CE marking requirements for the boilers that are to be sold freely in the European market.

Manually fed wood-burning boilers do not fall under the machinery directive and are thus not subject to the CE marking requirement. In theory, a wood-burning boiler might be subject to CE marking on the basis of requirements in other directives. For example, that it is equipped with a fan and falls under the low-voltage directive, or due to the working pressure/temperature and that is falls under the pressure vessel directive.

4.4.5 Standards

In 2012 a new edition of the standard "Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500kW-Terminology, requirements, testing and marking" (EN 303-5:2012) entered into force. It contains specifications for how boilers are to be manufactured; minimum permitted efficiency, exhaust gas temperature, heat exchange and emissions, and describes conditions and methods for testing. It also includes safety requirements concerning, for example, electricity, adequate air intake, pressure, etc. and requirements of labelling and other information for the user. The standard includes boilers < 500 kW.

An innovation in the new version of the product standard is the introduction of a classification system. The boilers in class 1 and class 2 do not fulfil the requirements to be sold in the European markets. For this reason, they are not reported in table 4 either. The requirement for the approval level according to the standard (i.e. class 3) corresponds to the building regulations of the Swedish National Board of Housing, Building and Planning.

A boiler in the best class (class 5) must show maximum 30 mg OGC/m3 on manual fuel addition. The highest permitted emissions from boilers in the best class are significantly tighter than the building regulations of the Swedish National Board of Housing, Building and Planning, equivalent to class 3.

Table 4 Threshold values for emissions on operation of boilers according to EN 303-5:2012 and equivalent requirements in the Nordic Ecolabelling criteria

	Nominal output	CO				OGC				Particles			
	(kW)	(mg/m^3 at 10% O_2)											
		Class			Nordic Ecolabel	Class			Nordic Ecolabel	Class			Nordic Ecolabel
		3	4	5		3	4	5		3	4	5	
Manual	≤ 50	5000	1200	700	2000a)	150	50	30	70a)	150	75	60	70c)
	>50 ≤ 150	2500				100							
	>150 ≤ 500	1200			1000b)	100			50b)				
Automatic	≤ 50	3000	1000	500	400c)	100	30	20	25c)	150	60	40	40c)
	>50 ≤ 150	2500				80							
	>150 ≤ 500	1200				80							

a) boilers ≤ 100 kW, b) boilers >100 but ≤ 300kW, c) boilers ≤ 300kW.

According to the EN 303-5:2012 product standard, testing must be performed by an independent third party that fulfils the requirements in EN/ISO 17025.

The current criteria for Nordic Ecolabelled boilers for solid biofuel are based on the previous edition of the same standard. The division by output is not the same, which impedes comparison. It can be noted that the present Nordic Ecolabelled requirements roughly correspond to a boiler somewhere between class 3 and 4 3 according to the new standard EN 303–5:2012 and the threshold values in table 4 above.

4.4.6 Official Austrian requirements

There are specific strict statutory requirements adopted in Salzburg via Heizungsanlagen-Verordnung 2010[23]. Threshold values are determined for CO, OGC, NOx and particles that must be fulfilled both on new installation and on control of installed boilers by so-called field measurement.

Table 5 Threshold values expressed in mg/MJ apply to nominal load as well as sub-loads Boiler output 4-400kW.

	CO	NOx	OGC	Particles
Manually fed	1,100	150	80/50*	60/35*
Automatically fed	500	150/100	30	50/25*

** Threshold values applying as from 1 January 2015.*

4.4.7 Special national official requirements in the Nordic region

Sweden:

Sweden's national environmental work is based on 16 environmental quality objectives in different areas. Small-scale combustion of biofuel primarily affects the environmental objective for Fresh Air, where small scale wood burning is stated as one of the reasons that the objective is assessed to be difficult to fulfil. Environmental quality objectives for "Environmentally sound construction", "Limited climate impact" and "Living forests" are also affected to varying degrees by the small-scale combustion of solid biofuel.

The Fresh Air objective has sub-objectives for six air regulations[24], where the combustion of wood is stated to be part of or the main reason that the sub-objective for particles and benzo(a)pyrene are difficult to meet[25].

The sub-objectives for nitrogen dioxide and tropospheric ozone are assessed to be very difficult to achieve, but other sources than wood burning are stated to be the primary reason.

Environmental quality norms are a legally binding control instrument that was introduced with the Environmental Act in 1999. They are based on various EU directives

[23] Verordnung der Salzburger Landesregierung vom 16. April 2010 über das Inverkehrbringen und den Betrieb von Heizungsanlagen.
[24] Sulphur dioxide, nitric oxide, tropospheric ozone, volatile organic compounds, particles and benzo(a)pyrene.
[25] Environmental Objectives Council, 2010. http://www.miljomal.se/sv/Publikationer-och-bilder/Rapporter/Miljomalsradet/Miljomalen--i-halvtid/
The Environmental Objectives Council was set up in 2002 and was responsible for assessing the work and reporting on the development of the national environmental quality objectives to the Swedish government. Since 2010 this responsibility has been held by the Swedish Environmental Protection Agency.

such as 2008/50/EC and 2004/107/EC. The norms are legally binding and the purpose is to guarantee citizens the lowest acceptable level of various types of air pollution. The norms affected by small-scale combustion of biofuel are shown in the table below.

Table 6 Threshold value for the air pollution where combustion of wood is stated to be a strong contributory factor The threshold values are laid down in Swedish legislation (Order on Air Quality SFS 2010:477)

Pollution	Threshold	Comment
Particles (PM10)	50 µg/m^3, daily average value (may be exceeded 25 times per year) 40 µg/m^3, annual average value	May not be exceeded
Particles (PM2,5)	25 µg/m^3, annual average value	Must be sought to fall below by 31 December 2014. May not be exceeded thereafter.
Benzo(a)pyrene	1 ng/m^3	Must be sought to fall below as from 1 January 2013

Within the framework of the Swedish BHM (Biobränslen-Hälsa-Miljö)[26] research programme, measurements have shown that even small detached home areas can find it difficult to comply with current environmental quality standards, especially with regard to particles. The reason is stated to be the combustion of wood in old boilers. It is probable that the standards are exceeded to a great extent by the inland areas of Norrland, where older wood boilers without or with accumulator tanks that are too small are used.

Today, around a dozen municipalities have action plans[27] because they exceed the norms for either NO_2 or particles. In these cases, traffic is stated to be the main reason for the high measurements. Besides emissions from road traffic, small-scale wood burning is a key contributing factor.

Environmental Code - environmentally hazardous activities: In the Swedish Environmental Code, heat production facilities are required to hold permits if their output exceeds 10 MW. Facilities below 05 MW are not subject to an inspection obligation and facilities of the intermediate size are subject to a notification obligation to the municipal environmental and health committee. The Swedish Energy Agency's report "Närvärme med biobränslen-vägledning från idé till färdig anläggning" (District heating with biofuel - guide from idea to final facility) from 2005 presents advice and guidelines summarised for large facilities, i.e. facilities in the 0.3-10 MW output range. The Nordic Ecolabel criteria solely apply to boilers with an output of maximum 0.3 MW.

The Swedish Energy Agency's report from 2010 states that Swedish municipalities do not appear to work proactively with the problems from small-scale combustion and do not intervene until there are complaints from neighbours. Some municipalities have drawn up so-called wood burning policies or wood burning advice. Such a policy is not mandatory, but can constitute a control document stating how issues are to be handled by the municipality.

Building regulations: In the building regulations of the Swedish National Board of Housing, Building and Planning, BBR 2012 (chapter 6), the highest permitted values of

[26] Methods to assess the impact on air quality of local wood burning, Experience from BHM. ITM report 118, ITM Air Laboratory, University of Stockholm. http://www.itm.su.se/reflabmatningar/dokument/itm_rapp118_2003-12-10.pdf
[27] Small-scale combustion of solid biofuel, ER 2010:44. Swedish Energy Agency, 2010.

emissions of organic carbon (OGC) are regulated in accordance with the table below. Boilers that fulfil the Swedish National Board of Housing, Building and Planning's regulations are called less rigorously environmentally approved boilers.

Table 7 Highest permitted values for emissions of OGC for new boilers, according to the Swedish National Board of Housing, Building and Planning's building regulations 6:741. The threshold values according to the table have been in force since July 2006. Test methods should be performed in accordance with SS-EN 303-5.

Nominal output, kW	OGC, mg/m³ dry gas at 10% O_2
Manual fuel addition	
≤ 50	150
>50 ≤300	100
Automatic fuel addition	
≤ 50	100
>50 ≤ 300	80

In addition, the Swedish National Board of Housing, Building and Planning's building regulations state that testing should be performed in accordance with SS-EN 303-5 and that solid fuel boilers with manual fuel addition should be designed with accumulators or similar for good energy management. A recently introduced improvement is that the Swedish National Board of Housing, Building and Planning's building regulations (BBR) must also be applied to changes - and not just new installations. This means that if an old boiler is replaced by a modern boiler, the threshold values must be complied with.

Denmark:

Executive Order no. 1432 of 11/12/2007[28] on the regulation of air pollution from wood-burning stoves and solid fuel boilers and certain other fixed installations for energy production. The Executive Order lays down regulations for the testing prior to sale, transfer or connection of combustion plant with a total thermal input below 300 kW. The municipalities are able to make requirements of combustion plant if the air pollution from wood-burning stoves, etc. is assessed to be significant, cf. Section 42 of the Danish Environmental Protection Act (Consolidated Act no. 879 of 26 June 2010).

Table 8 Solid fuel boilers must comply with the following emission requirements of CO, OGC and particles

Combustion principle	Nominal heat output (kW)	Emission requirement (mg/Nm³, 10% O_2			Measurement methods
		CO	OGC	Particles	
Manual	<50	5000	150	150	EN 303-5
	>50 to 150	2500	100	150	
	>150 to 300	1200	100	150	
Automatic	<50	3000	100	150	
	>50 to 150	2500	80	150	
	>150 to 300	1200	80	150	

Solid fuel boilers must comply with emission requirements equivalent to EN 303-5, class 3. The requirements concern nominal and low load. However, there are no particle

[28] https://www.retsinformation.dk/Forms/R0710.aspx?id=105319

requirements at low load. If the boiler is fired manually and the installation may only be used with accumulation tank, there are emission requirements at low load.

Draft new revised Executive Order no. 1432 of 11/12/2007[29] was sent for consultation in December 2012 with the following emission limits:

Table 9 Revised consultation proposal for emissions of CO, OGC and particles from solid fuel boilers for solid biofuel from 0 to 1 MW

Combustion principle	Emission requirement (mg/Nm^3, 10% O_2)			Documentation of threshold values according to standard or method sheet no.**
	CO	OGC	Particles	
Manual	700	30	60	EN 303-5 Pellet stoves EN15270
Automatic*	500	20	40***	

** Automatically fired boilers that can be scaled down must be tested at nominal load.*

Solid fuel boilers must comply with emission requirements equivalent to EN 303-5, class 5. In the draft new revised Executive Order no. 1432 of 11/12/2007 there are proposals for specific requirements of chimney heights on the establishment of new chimneys and combustion plant. These minimum heights for new chimneys and combustion plant are stated in the Executive Order and exemplified in Appendix 3 of the Executive Order. The municipalities inspect compliance with these requirements. The background to the requirement is that the smoke can spread in the garden or to neighbours if the chimney is not high enough.

Tax on firewood and wood pellets.

Based on the energy policy proposal "Our Energy", in 2013 the Danish government will commence the planning of a tax on biomass for space heating, including firewood and wood pellets[30]. The tax will be a "supply reliability tax" to compensate for the loss of income to the State on a decline in the use of tax-liable fossil fuels to heat homes. The details of the tax are not yet known, but according to the political proposal the tax on the firewood will be DKK 27.40 per GJ heat from firewood for wood-burning stoves. According to DAPO, the Association of Danish Suppliers of Open Fires and Wood-Burning Stoves, this will correspond to a cubic metre of deciduous wood, depending on the nature of the wood, being subject to tax of DKK 160-170. According to the Danish Energy Agency, the bill for the supply reliability tax will be tabled in the spring of 2013, and the tax will be planned to enter into force in 2014 and phased in up to 2020.

The environmental organisation "Det Økologisk RÅD" (the Organic COUNCIL) (DØR) wishes to change the tax on firewood to a tax on wood burning that is an incentive for cleaner heating[31]. In urban zones, DØR proposes an environmental tax of DKK 8,000/year for old, polluting wood-burning stoves, open fires, etc. For Nordic Ecolabelled wood-burning stoves or equivalent, a tax of DKK 4,000/year is proposed. In rural zones, an environmental tax of only DKK 4.000/year is proposed for old, polluting wood-burning stoves, open fires, etc. The tax will be an incentive for residents to replace old wood-burning stoves and open fireplaces with more environmentally sound alternatives, such as Nordic Ecolabelled wood-burning stoves or mass stoves. The tax of DKK 4,000/year must also include wood furnaces and wood boilers that account for a large

[29] http://www.mst.dk/Virksomhed_og_myndighed/Luft/Luft+nyheder/Nye_krav_til_braendeovne.htm
[30] http://www.trae.dk/index.asp?page=/Dokumenter/Dokument.asp%3FDokumentID%3D1580
[31] http://www.ecocouncil.dk/index.php?option=com_content&view=article&id=1537:pressemeddelelse-afgift-pa-braendefyring-skal-sikre-ren-luft-i-villaomrader&catid=33:trafik-og-luft&Itemid=93

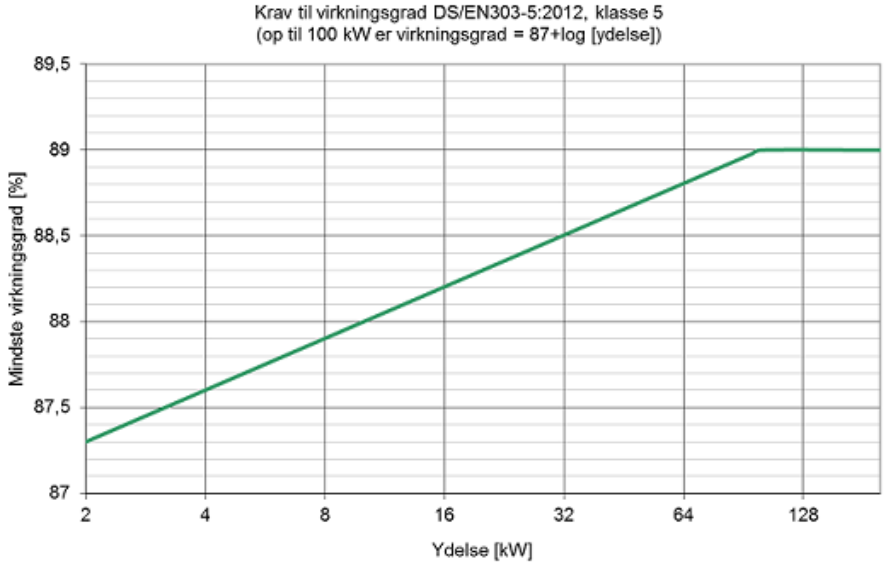
share of pollution and that can be beneficially replaced with wood pellet boilers or heat pumps. The proposal from DØR is not assessed to enjoy political support.

Building regulations On 1 January 2013 the executive order BEK no. 1314 to amend the building regulations entered into force. BR10 Section 8.5.1.4, sub-section 7 states: "Boilers fired with coal, coke, biofuel and biomass must as a minimum fulfil the requirements of efficiency and safety for boiler class 5 in DS/EN 303-5 named 'Central heating boilers for solid fuel, fired manually or automatically, with a nominal heat output of up to 500 kW, Terminology, requirements, testing and labelling'."

This expands the building regulations' requirements to include boilers up to 500 kW. New requirements concerning efficiency apply as from 1 July 2013[32].

Efficiency must as a minimum comply with class 5 in DS/EN 303-5. For automatic boilers the requirement applies to both nominal and low load. For manually fired boilers with accumulation tanks the requirement solely applies to nominal load. The lowest permitted efficiency depends on the installation's output and can be read from the table below. At an output over 100 kW the requirement is always 89%.

Table 10 Efficiency requirement EN 303-5:2012, class 5 (up to 100 kW is efficiency = 87+log (output)



Norway

Norway has new building regulations that, among other things, prohibit the installation of oil-fired heating as the basic heating and that require a certain proportion of the heating requirement to be other than direct electrical heating. In new production, for example 60% of the heating requirement must be covered by renewable energy. Norway makes various requirements of wood- and pellet-fired boilers, depending on their output. Boilers > 50 kW must fulfil the emission requirements in accordance with Norwegian Standard NS 3059 for closed wood stoves, but are tested according for combustion design according to NS-EN 14 758. Boilers that exceed 50 kW and up to 300 kW must be tested according to NS EN 303-5 and fulfil the emission requirements for class 3, i.e. equivalent to the requirement level for OGC as the Swedish National Board of Housing, Building and Planning.

[32] http://www.teknologisk.dk/ydelser/faq-om-biomassekedler-og-stokere/krav-til-virkningsgrader/33716,3

More and more Norwegian municipalities are preparing and adopting so-called climate plans with various measures to reduce greenhouse gas emissions. The municipalities may even have Energy Efficiency Unit (Energy Economisation Office, ENÔK) to guide and encourage both private individuals/households and the business community. The climate plans are created in accordance with guidelines from the Norwegian Ministry of the Environment and they point to increased expansion of and connection to district heating, as well as various local biobased (local) energy centres as key measures to reduce climate impacts. Hydronic systems may be required for the municipality's own buildings or buildings erected on municipal land. For other types of buildings too, the municipalities have the opportunity to encourage the installation of hydronic heating.

Finland:

In Finland there is no national environmental legislation for boilers, wood-burning stoves and similar products. Environmental legislation follows the EU's environmental requirements.

4.5 Other labelling schemes and instruments

This chapter describes the largest/most important labelling schemes for products in this product group. They should be viewed as competing labelling schemes, or in other cases as supplementary labels to the Nordic Ecolabel. There are also national labels that may be competitors, such as the Finnish "Avainlippu" label, which means made in Finland.

4.5.1 EU Ecolabel

Since November 2011 there has been a proposal for European ecolabelling criteria for heat source:[33] "EU Ecolabel for Hydronic Central Heating Generators". Proposed criteria were approved in November 2013. These criteria make it possible to ecolabel boilers for biofuel (maximum 400 kW power output) in additional to heat pumps, gas-fired boilers, oil-fired boilers, CHP boilers and solar heating, which are also included in the product group.

The proposal includes the following requirements for biofuel boilers:

- The seasonal space heating energy efficiency, n_s must be at least79%
- Emission thresholds:
  - Nitrogen oxides, NOx < 150 mg/Nm^3.
  - Organically bound carbon, OGC < 7 mg/m^3.
  - Carbon monoxide, CO < 175 mg/m^3 (automatically fed boilers), CO < 250 mg/m^3 (manually fed).
  - Particles, PM < 20 mg/m^3.
- Requirement for "Greenhouse gas (GHG) emission": 200 g CO_2-equivalent/kWh heating output.
- The "standardised" requirements for content of hazardous substances that the EU Ecolabel has in all relevant criteria documents.
- Requirements of installation manual, operating and maintenance instructions, information on handling on scrapping, and information on appropriate dimensions of heat sources for various buildings and heating requirements.

[33] http://susproc.jrc.ec.europa.eu/heating/index.html

4.5.2 Der Blaue Engel

The German ecolabelling scheme, Der Blaue Engel, has criteria for wood pellet boilers[34]. The criteria set requirements for efficiency, power requirement in standby mode, and emissions of NOx, CO and particles, See the table below.

Table11 Requirements for wood pellet boilers marketed with Der Blaue Engel.

Requirement	Threshold	
Efficiency	90% (full load) for all boilers 89% (30% last) for boilers ≤ 12kW	
NOx	150 mg/Nm^3	
OGC	5 mg/Nm^3	
CO	Boilers < 50kW	Boilers > 50kW
	80 mg/Nm^3 at full load 180 mg/Nm^3 at 30% load	70 mg/Nm^3 at full load 150 mg/Nm^3 at 30% load
Particles	20 mg/Nm^3 at full load 40 mg/Nm^3 at 30% load	

As the above table shows, the threshold values are significantly tighter that those of the Nordic Ecolabel. The Nordic Ecolabel threshold requirements are stated in table 4 for OGC, CO and particles.

At the time of writing, ten companies hold licences, with a total of 73 approved boilers (2013-12-04).

4.5.3 Umweltzeichen 37 in Austria

The criteria for the Austrian ecolabel are called the Austrian Umweltzeichen 37, wood-fired stoves and boilers [35](holzheizungen). Today, 15 manufacturers hold licences for a number of automatically fired boilers, while nine hold licences for a number of manually fired boilers[36]. None of these hold Nordic Ecolabel licences. Like the Nordic Ecolabelling criteria, the Austrian ecolabel sets requirements of CO, OGC, NOx, particles and efficiency, which are tested at several loads.

Table 12 The Austrian ecolabel Umweltzeichen 37's emission and efficiency requirements for automatically fired boilers.

Automatically fired boilers	Nominal load	Low load (30%)
Efficiency	>90%	-
NOx	≤ 100 mg/MJ (≈150 mg/Nm^3)	-
CO	≤ 60 mg/MJ (≈90 mg/Nm^3)	≤ 135 mg/MJ (≈202 mg/Nm^3)
OGC	≤ 3 mg/MJ (≈4.5 mg/Nm^3)	≤ 3 mg/MJ (≈4.5 mg/Nm^3)
Particles	≤ 15 mg/MJ (≈22.5 mg/Nm^3)	-

[34] Criteria document RAL-UZ 112
[35] http://www.umweltzeichen.at/richtlinien/Uz37_R5a_Holzheizungen_2012.pdf
[36] http://www.umweltzeichen.at/cms/home/produkte/gruene-energie/content.html?rl=26

Table 13 The Austrian ecolabel Umweltzeichen 37's emission and efficiency requirements for manually fired boilers.

Manually fired boilers	Nominal load	Low load (50%)
Efficiency	79 -89%	-
NOx	≤ 120 mg/MJ (≈180 mg/Nm^3)	-
CO	≤ 250 mg/MJ (≈375 mg/Nm^3)	≤ 750 mg/MJ (≈1125 mg/Nm^3)
OGC	≤ 30 mg/MJ (≈45 mg/nm^3)	-
Particles	≤ 30 mg/MJ (≈45 mg/Nm^3)	-

4.5.4 P mark

The P mark is a voluntary Swedish labelling scheme with regulations and testing methods drawn up by SP (Technical Research Institute of Sweden) in cooperation with manufacturers and the authorities concerned in Sweden. The regulations set requirements for:

- emissions
- efficiency
- safety functions
- operating reliability

Requirements are also made of the technical documentation and the content of installation and maintenance instructions, and of quality assurance in the manufacturing process. The system also includes requirements of supervisory manufacturing inspection, which is performed once a year. This is to ensure that P-marked products are still the same as the tested products. Today, there are P-marking regulations for pellet burners and pellet boilers up to 100 kW, as well as pellet stoves. It was previously also possible to P-mark wood-fired boilers.

P marking entails that boilers, pellet burners and stoves subject to SP testing fulfil the current emission requirements in accordance with the Swedish National Board of Housing, Building and Planning's building regulations for the heating of detached homes (see section 7.1). Products marked "TG" are type-approved products. Besides fulfilling the emission requirements, they have also been subject to safety testing. Type approval also entails that SP has a manufacturing inspection agreement with the supplier.

Many municipalities refer to P-marked solid fuel boilers as "environmentally-approved" and require that only environmentally-approved systems are installed on new installation and when systems are replaced.

4.5.5 Solar Keymark

The European standardisation organisation CEN has a certification system and the Keymark certification label. In Sweden, SP (Technical Research Institute of Sweden)) via SIS (the Swedish Standards Institute), as a member of CEN, is the authorised "empowered body" for solar collectors.

In brief, the label entails independent European third-party certification. Solar collectors must be designed and manufactured in accordance with the EN 12 975/76 standard ad manufactured within the framework of a quality management system (QMS). In January 2011, more than 1,200 Solar Keymark licences had been issued.

5 About the criteria revision

Objective of the revision

Greater use of bioenergy is an important parameter for achieving the UN's climate targets and thereby reducing emissions of carbon dioxide and other greenhouse gases. Biofuels are considered to be carbon-dioxide neutral on complete combustion. They also contribute to emissions of, among other things, particles, volatile hydrocarbons (OGC), carbon monoxide (CO) and NOx on combustion. It is therefore important that increased combustion of biofuel does not increase emissions to the air and derived health effects. Solid fuel boilers are an alternative to local heating of buildings (alternative to oil/gas boilers), but can also be used in larger units, such as hotels. All Nordic countries are working actively to reduce heating based on fossil fuels.

Life cycle analyses[37],[38] show that the largest element of the environmental impact occurs during operation of the fireplace, i.e. as emissions.

Emission and efficiency data from licence holders and equivalent manufacturers show that it is possible to tighten the Nordic Ecolabel's current requirements of particles, CO, OGC, NOx and efficiency. Tightening of national legislation for emissions from solid fuel boilers in Denmark, for example, and the development of the EU Flower criteria, as well as ecodesign and energy labelling regulations for boilers, emphasise the need for revision of the criteria, so that Nordic Ecolabelled boilers for solid biofuel still exceed the legislative requirements for these important parameters.

Evaluation of today's criteria for Nordic Ecolabelled boilers for solid biofuel (autumn 2012/spring 2013) resulted in a proposal to revise the criteria, primarily by tightening the present emission requirement limits, as well as efficiency requirements.

Based on recommendations from the evaluation report, the revision has the following objectives:

- Tighten the requirement for emissions to air of emissions that are hazardous to the environment and health.
- Clarify and harmonise the efficiency requirement with the product standard (EN 303-5:2012) and tighten the requirement level.
- Harmonise the output limit in the product group definition with the EU's proposal for ecodesign and energy labelling, as well as the product standard. In contrast to the present criteria, differentiated threshold values (for emissions and efficiency) based on output should be introduced.
- Develop the requirements for product design, production and materials even though the operating phase is the most important, seen from an LCA perspective.
- Develop requirements of the distributors' competence, as well as information in installation and user manuals, such as the requirement that installation technicians are certified.

[37] Solli, Chr. et al. "Life Cycle Assessment of Wood Based Heating in Norway" Int J Life Cycle Assess (2009) 14:517–528

[38] Cleaner Product Development Based on Life Cycle Assessment: Lithuanian Experience", Jurgis Staniskis, Visvaldas Varzinskas, Institute of Environmental Engineering (APINI), Kaunas University of Technology, 2005

About this revision

The revision is undertaken by product group officer (PA) Thomas Christensen (DK) as project manager and Harri Hotuleinen (Fin) as project adviser (PR). Mogens Stibolt (DK), Ola Rise (N), Björn Simons (S) and Elina Ojala (Fin) are national contact persons (NCP).

6 Production requirements

6.1 Introduction to the materials requirements

The materials used in closed fireplaces for solid biofuel are cast iron, steel/iron, stone, tiles, glass and insulation and sealing material. Plastic is used to a smaller extent, and in such case this is usually in connection with enclosure of the electronics. A wood pellet-fired boiler contains more electronics than a wood-fired boiler. The outer metal panels are surface-treated with paint/varnish in the form of powder coating or wet coating. From an environmental viewpoint, powder coating is a better alternative as this technology does not require organic solvents. Stone, ceramic material and other special materials are used for the insulation of the actual combustion chamber. Insulation material, normally mineral wood, is used in small quantities (by weight) in side/top surfacing, and other sealants are used for connections to smoke flues, etc. Glass is used in limited quantities.

The report "Task 4: Technical analysis of existing products" which is background material to the LOT EuP directive,[39] compares different materials ("build of material", BoM, in different types of boilers. According to the report, boilers for solid biofuel (firewood) on average comprise 86% steel, 7% stone, 5% cast iron and approximately 1% electronics and insulation material. Wood-pellet boilers on average comprise 92% steel, 2% insulation material, 1.5% stone, 1% glass, 0.5% cast iron and approximately 1.5 % electronics and plastic.

Nordic Ecolabelling has considered introducing requirements of all of the materials used in the production of boilers and of the production conditions. Appendix 2 presents further information on the environmental issues and the opportunity to make production requirements. In this version of the criteria, Nordic Ecolabelling continues to set a number of limited requirements for the production process and the materials used. Most of the material requirements concern the use of chemicals in the production process.

Requirements of materials in the present criteria.

The requirements of materials in the present criteria (see chapter 1.4 in criteria version 2.2) comprise requirements of the labelling of plastic elements heavier than 50 g, requirements of heavy metals, as well as solvents in surface treatment, and the prohibition of the use of chlorinated plastics in plastic packaging.

The requirements of materials are documented by the stove manufacturer via declarations of compliance with the requirements in question.

[39] Task 4 in the EuP directive on Solid Fuel Small Combustion Installations, (Lot 15). http://www.eceee.org/ecodesign/products/Lot_20_local__room_heating__products (16-9-2013)

6.2 Revised requirements and new requirements of materials

Proposed requirement

O1 Description of the production process

Requirements in the criteria document:

The production process for the Nordic Ecolabelled boiler must be described.

The description must include the following:

- Name and contact details of:
  - production location(s) for final manufacture of boilers
  - subsuppliers for surface treatment
  - subsuppliers of other components subject to the requirements
- A description of the production process for the boiler stating the various process stages, including cleaning technique. Production technique and cleaning technique for surface finishing and metal coating must be stated.
- Copy of environmental licence/permit or inspection report from the environmental authority concerning final production, with details of emissions subject to the licence during the past year.

Final production of the boiler does not apply to the production of raw materials such as steel, cast iron, stone/ceramics, glass or plastic elements.

✉ A description of the boiler's production process according to the requirement. Copy of the environmental licence/permit or inspection report from the environmental inspection authority concerning final production, with details of emissions subject to the licence during the past year.

Background to the requirement

The requirement is new. Manufacturers of boilers for solid biofuel have experienced tougher competition in the existing markets. This has resulted in mergers and acquisitions of competitors, as well as the transfer of production to especially Eastern and Southern Europe to an increasing extent. Nordic Ecolabelling has knowledge of boiler manufacturers that produce both semi-manufactures (such as combustion chambers, etc.) and complete boilers via subsuppliers in Eastern and Southern Europe. In many cases, production is distributed on several sub suppliers. With this requirement, Nordic Ecolabelling ensures a full overview of the production processes and the sub suppliers involved.

Nordic Ecolabelling will have a description of the production process comprising the entire production flow (planning of production, technical drawings/purchasing of components, assembly of components, post-treatment (surface treatment), final assembly, storage and transport). Further documentation may consist of production diagrams presenting the individual production stages (with raw materials and semi-manufactures).

To get a better overview of the sub suppliers used for surface treatment and production of other components (which are subject to the requirements), these must be stated by name and production location, as well as a description of what they produce.

Nordic Ecolabelling requires information on the environmental licences held by the manufacturers for the production of boilers (at final production) or control reports by the relevant environmental authority, as well as details of licensed emissions during the past year. Experience from the requirement in the present criteria version 3 shows that

there can be large national variations in which licensed emissions the individual production may be subject to. Emissions typically regulated are VOC, NOx and possibly wastewater.

The Nordic Ecolabel works with energy/energy consumption and related environmental impacts such as global warming, acidification, over-fertilisation, etc. Based on life-cycle analyses, as previously stated (chapter 3) the greatest share of the environmental impact occurs during the operating phase (> 50%). Energy production during the actual manufacture of boilers for solid biofuel thus accounts for a small share of the total environmental impact, although it does have some significance. A new requirement of energy consumption in the manufacture of boilers has been discussed. The requirement might, for example, comprise energy consumption per unit produced. As the manufacturers use many different subsuppliers, it is very difficult for the licence holders to gain energy data for the various materials and semi-manufactures. In such case, a specification of the elements of production included in the required would be needed. The Nordic Ecolabel's view is that it is not possible at the present time to set requirements to restrict energy consumption in production. This is especially due to the problem with many sub-suppliers. A new requirement for the energy consumption in the production of boilers should be investigated more closely in conjunction with the next revision of the criteria.

O2 Materials

Requirements in the criteria document:

The manufacturer must draw up a list of all of the elements included in the boiler, stating the type and material, as well as technical drawings with measurement dimensions.

Materials and construction must comply with relevant requirements in the current standard, EN 303-5:2012. The requirement includes, for example, quality, thickness of materials, durability and temperature control (safety) in the boiler and materials.

A guarantee for materials and construction faults of at least five years must be given for the bearing structure (excluding the interior of the combustion chamber) on normal use.

✉ A description of materials for all of the elements included in the boiler, as well as technical drawings with measurement dimensions approved by the test laboratories in connection with testing of the boiler.

✉ Declaration from the manufacturer that the requirements of the materials and construction have been fulfilled. Appendix 2 may be used.

Background to the requirement

The requirement is new. The requirement ensures that Nordic Ecolabelling gains an overview of all materials used in boilers, and that all elements are documented, so that it is easier to make relevant requirements of materials in connection with future revisions of the criteria. It has now been emphasised as the documentation requirement that the Nordic Ecolabel requires the materials description and the technical drawings approved by the test laboratories in conjunction with testing of the boilers Lists of materials and technical drawings approved by the test laboratories are today an important element of the laboratories' control. Technical drawings approved by the test laboratories are also an important element of the Nordic Ecolabelling's inspection/post-inspection of licence holders.

The boiler and the insulation solutions must give space for heat expansion. The boiler's shell and pipes are in constant movement due to heat expansion and vibration. The

equipment connected to the boiler, such as burners and fans, create vibration. Besides the very high temperatures in the boiler, the temperatures can also vary in the other parts of the structure. The right insulation solution reduces the heat loss in the boiler and prevents overheating of the boiler room, which increases the boiler's efficiency. Design the insulation solution according to the boiler type and the boiler manufacturer's specifications. In accordance with the standards, boilers must be insulated with two to three layers of insulation, and the overall insulation thickness should be 200-300 mm.

The interior insulation panels in the combustion chamber are one of the spare parts that can be purchased by customers. The panels are sold in both special packages designed for the individual boilers or individually, whereby the customer must cut the panel to fit. The panels are, among other things, produced from a silicate material called Vermiculite[40]. The material is porous and does not withstand knocks or blows. Cracks are usually due to the material being knocked with a piece of wood or similar. This does not affect the insulating effect for as long as the panels are still placed correctly in the boiler. The panels should be replaced when they are worn down to approximately half their thickness. After this, they can no longer provide optimum insulation and therefore cannot ensure the right combustion temperature, or protect the wood-burning stove from the high temperatures in the combustion chamber.

Ceramic stone (used in so-called ceramic hardener) is another type of material that is most often used in wood-fired boilers that can tolerate very high temperatures. Chamott is another type of material that absorbs heat, however, which can entail that it takes longer to achieve a high combustion temperature in the chamber. Another material is Termott, which is strong and has good insulation properties. In this version of the criteria, Nordic Ecolabelling has added information requirements in the operation and maintenance requirement (O16) concerning the importance of the correct position of the insulation panels in the fireplace, and that they should be replaced when they are worn down to approximately half their thickness.

Requirements of materials and construction are stated in EN 303-5, such as requirements of the quality of materials, thickness of materials, durability of materials (but not insulation panels and ceramic stone), temperatures, fire safety and electrical safety. Manufacturers of boilers must declare that materials fulfil the requirements laid down in the standard.

Nordic Ecolabelling has focus on quality and therefore requires the boiler's manufacturer to provide a guarantee for material and construction faults for at least five years for the bearing structure (excluding the interior of the combustion chamber) on normal use. The guarantee must be stated in operating and maintenance instructions (O20). The exemption applies to the interior parts of the combustion chamber that are exposed to wear (such as insulation panels/stone). Glass is also exempt from the requirement.

The reason that the manufacturer must declare that materials fulfil the requirements of the relevant standard is to ensure low environmental effects in the longer term. It is important to ensure that the quality of the boiler does not deteriorate and that it fulfils the Nordic Ecolabelling requirements during the term of validity of the licence. The test laboratories' ongoing quality control helps to safeguard the quality of the boiler.

[40] ”Das Industriemineral Vermiculit – Einfluß der Rohstoffmineralogie auf die Deund Rehydratation bei der Herstellung von Hochtemperaturdämmstoffen” , Thomas Doege, Der Fakultät für Bergbau, Hüttenwesen und Geowissenschaften der Rheinisch-Westfälischen Technischen Hochschule Aachen.

O3 Chemical products, classification

Requirements in the criteria document:

The manufacturer must draw up a list of the chemicals used in the final production (painting, installation and final inspection) of boilers and for surface treatment. Chemical products such as glue, sealant, cleaning/degreasing products, paints and varnishes used in the final production of the boiler and for surface finishing may not be classified according to the table below.

Final production of boilers does not apply to the production of raw materials such as steel, cast iron, glass or plastic elements.

Table 14 List of non-permitted classification of the final chemical compound used in the product, in accordance with the CLP regulation 1272/2008, or later.

Signal word	Hazard phrase	Hazard description	Risk phrase
		Environmentally hazardous	
Warning, Aquatic acute 1	H400	N	R50
Warning, Aquatic chronic 1	H410	N	R50/53
Warning, Aquatic chronic 2	H411	N	R51/53
-, Aquatic chronic 3	H412	-	R52/53
-, Aquatic chronic 4	H413	-	R53
-, Ozone	EUH059	N	R59
		Carcinogenic	
Hazardous, Carc. 1A or 1B	H350	T	R45 and/or
Hazardous, Carc. 1A or 1B	H350i	T	R49
Warning, Carc. 2	H351	Xn	R40
		Mutagenic,	
Hazardous, Muta. 1A or 1B	H340	T	R46
Warning, Muta. 2	H341	Xn	R68
		Reprotoxic	
Hazardous, Repr. 1A or 1B	H360	T	R60
Hazardous, Repr. 1A or 1B	H360	T	R61
Warning, Repr. 2	H361	Xn	R62 and/or
Warning, Repr. 2	H361	Xn	R63
-	H362	-	R33
-	H362	-	R64
		Very toxic	
Hazardous, Acute Tox. 1 or 2	H330	Tx (T+ in Norway)	R26
Hazardous, Acute Tox. 1	H310	Tx (T+ in Norway)	R27
Hazardous, Acute Tox. 2	H300	Tx (T+ in Norway)	R28 and/or
Hazardous, STOT SE 1	H370	Tx (T+ in Norway)	R39
		Toxic,	
Hazardous, Acute Tox. 2 or 3	H330 or H331	T	R23
Hazardous, Acute Tox. 3	H331	T	R24
Hazardous, Acute Tox. 3	H301	T	R25
Hazardous, STOT SE 1	H370	T	R39 and/or
Hazardous, STOT SE 1	H372	T	R48
		Sensitising	
Hazardous, Resp. Sens. 1	H334	Xn	R42
Warning, Skin sens. 1	H317	Xi	R43

The classification applies in accordance with the EU's dangerous substances directive 67/548/EC with subsequent amendments and adjustments, and/or CLP regulation 1272/2008 with subsequent amendments. During the transition period, i.e. up to 1 June 2015, classification in accordance with the EU's dangerous substances directive or the CLP regulation may be used. After the transition period, only classification in accordance with the CLP regulation will apply.

Metal coating of parts is exempt from the requirement- On metal coating of parts, requirement O5 must be fulfilled.

- ✉ List of chemicals used in final production and for surface finishing.
- ✉ Safety datasheet no less recent than three years for the final chemical compound used in the Ecolabelled product in accordance with Annex II of Reach (regulation 1907/2006/EC, with later amendments and additions).

Background to the requirement:
The requirement is new. Nordic Ecolabelling seeks to ensure that the health and environmental impact of the products is as low as possible. Therefore prohibition requirements are made concerning specific classifications of the products. Requirements of chemicals (the product) will not prevent a product from containing substances with the undesired classification. But in such case, the classified substance is included as such a small amount that the final product is not classified.

In final production, typically chemical products such as glue, sealant (silicone, putty) and cleaning/degreasing products are used for the panels. Glue containing naphtha and zinc oxide(H410), can be classified by H411 and H412, sealant with naphtha is classified by H411, sealant (without silicone) with zinc oxide by H410, and cleaning products containing naphtha are classified by H411. Varnishing/surface treatment does not usually take place in final production, but is purchased as final varnishing from subsuppliers.

On surface treatment of boilers, paint and varnish are used. In many cases, powder varnish is used instead of traditional wet varnish that contains solvents. The use of powder varnish thus limits the amount of solvent, which reduces VOC (volatile organic compound) emissions. In a typical powder varnishing system, the parts are transported through the process on a "conveyor". First, the parts come into a cleaning tunnel in which the metal surface is pre-treated. There may be one single or several cleaning stages, with chemical conversion of the metal's surface. Then the elements are led into a drying furnace before they come into the powder varnishing cabinet, where the varnish is applied. During spraying, small grains of powder are strongly electronically loaded in the spray guns. The powder adheres to the surface by electronic attraction between the elements and the powder grains. When the powder comes into the hardening furnace, it melts to form a strong coating. There are various types of powder varnish. The most often used are polyester varnish, epoxy varnish and combinations thereof. Pre-treatment before powder varnishing takes place using chemicals. Wet paints and varnishes with naphtha are classified as H411, while powder varnish is classified as H412. There is powder varnish that is not classified as environmentally hazardous.

The requirement of chemical products solely concerns chemicals used in final production (painting, assembly and final inspection) of boilers, and for surface treatment. This is because it can be very difficult for the manufacturer of the boiler to get information from all subsuppliers (for example approximately 20 suppliers) on which chemical substances have been used in raw materials production. Manufacturers of fireplaces can, on the other hand, control their own production. Surface treatment by subsuppliers is subject to the requirement, however.

Chemical products including degreasing agents and paint/varnish (in the painting process), glue, sealants (silicone, heat-resistant sealant, other sealant), as well as cleaning/degreasing products in the assembly and final inspection process. Lubricants, anti-corrosives, drilling oil and oil spray are thus not subject to the requirement.

O4 Component substances in chemical products

Requirements in the criteria document:

The following substances may not be included in the chemical products (e.g. glue, sealant, cleaning/degreasing products, paint and varnish) that are used in the final production of the boiler, as well as for external coating:

- lead (Pb), mercury (Hg), chromium IV (CrIV), cadmium (Cd) and compounds thereof
- halogenated organic compounds
- alkylphenols, alkylphenol ethoxylates or other substances that can build alkylphenols or alkylphenol ethoxylates
- phthalates
- nanoparticles (from nanomaterials*)
- substances on the EU's candidate list in accordance with REACH, 1907/2006/EC article 59, section 10 on the website of the European Chemicals Agency (ECHA). In the background document there is a link to the list.

There is exemption from the list for metal coating of parts. On metal coating of parts, requirement O5 must be fulfilled.

The following definition must be used concerning "included" Unless otherwise stated, included substances are all substances in the product, including additives (such as preserving agents or stabilisers) in the raw materials, but not contaminants from raw materials production. Contaminants are residual substances from raw materials production that are included in the finished product in concentrations below 100 ppm (0.0100% by weight, 100 mg/kg), but not substances added deliberately to a raw material or product for a purpose, irrespective of the quantity. Known degradation products from constituent substances are also considered to be included.

**The definition of nanomaterial follows the European Commission's definition of nanomaterial from 18 October 2011, with the exception of the threshold for the distribution of particle size, which is now reduced to 1%: Nanomaterial is a naturally accidentally or deliberately produced material that contains particles in their free state, or as aggregate or agglomerate, where at least 1% of the participles in the distribution by size has one or more dimensions in the size range of 1 - 100 nm. This definition applies to all of the material, even particles outside the range of 1 - 100 nm, for as long as 1% of the material is particles in the range of 1 - 100 nm. The definition concerns nanoparticles in both bound and unbound state.*

✉ Declaration or other equivalent documentation from the chemicals producer/supplier. Appendix 3 may be used.

Background to the requirement:

The requirement is changed from the previous version. In criteria version 2 there are requirements that paint/varnish may not contain pigment based on lead, cadmium, chromium, mercury or their compounds. The substance may not contain more than 5% (w/w) organic solvent. The requirement concerning heavy metals is now included in requirement O4 of (component substances in chemical products), while O3 (classification of chemical products) concerns chemicals with a VOC content. Requirements of halogenated organic compounds, alkylphenols, alkylphenol oxylates or other substances that can build alkylphenols or alkylphenol oxylates, phthalates, nanoparticles and candidate list substances are completely new.

Heavy metals and their compounds.

The substances in question are lead, mercury, chromium IV and cadmium. The requirement especially concerns heavy metals that are detrimental to the environment and health that are specified in the text. These are toxic for human beings and other organisms. Heavy metals are a burden on the environment, so it is important to reduce discharges as far as possible. It is therefore relevant to ensure that substances added to

the chemical products used in final production do not contain heavy metals such as mercury, chromium IV, lead or cadmium.

Halogenated organic compounds:
Halogenated organic compounds are organic compounds that contain halogenated compounds such as chlorine, bromine, fluoride or iodine. Halogenated organic compounds comprise many substances that are hazardous for the environment and health. They are highly toxic for aquatic organisms and are also carcinogenic or hazardous to health in other respects. It is very hard to break down the halogenated organic compounds, which increases the risk of hazardous effects of the substances. The requirement entails, among other things, that halogenated flame retardants, chlorinated paraffins, perfluoroalkyl compounds (such as PFOA and PFOS) and halogenated organic compounds may not be added.

Alkylphenol ethoxylates (APEO) and alkylphenol derivatives (APD):
APEO and APD (background): Alkylphenol ethoxylates (APEO) are excluded because their degradation products are not easily degradable, and some degradation products are declared by the EU to be endocrine disrupters (such as nonylphenol). Alkylphenol derivatives (APD) are substances derived from APEO and excluded because they are hazardous to health or are not easily degradable. APEO and APD are on the List of Undesirable Substances and the basis for this is: "Nonylphenol, octylphenol and nonylphenol ethoxylate are on the EU's priority list of substances that must be investigated further for endocrine disrupting characteristics. Some octylphenol compounds have problematic characteristics in accordance with the Indicative List for Self-Classification. N; R50/53 and one compound also have R43. The substances are only partly subject to application limitation, but other applications are also considered to be environmentally questionable."

Phthalates:
Many phthalate compounds have undesirable health and environmental effects. A number of phthalates are on the EU's priority list of substances that are to be investigated further for endocrine-disrupting effects - and for a number these effects have already been found. Phthalates are also the subject of considerable media attention and may therefore, for many reasons, be undesirable in environmentally labelled products. Some phthalates are on the list of List of Undesirable Substances, and these are diethylhexyl phthalate (DEHP), dibutyl phthalate (DBP), benzyl butyl phtalate (BBP), dimethoxyethyl phthalate (DMEP) and diisobutyl phtalate (DiNP) on the following grounds: "All five phthalates have problematic characteristics in terms of the List of Undesirable Substances. In addition, DEHP, DBP and BBP are on the EU's priority list of substances to be investigated further for endocrine-disrupting characteristics."

Nano:
Nanotechnology, which also includes nanoparticles, is increasingly used in the construction and interior design industry. Giving most grounds for concern is the use of nanoparticles that can be released and thereby affect both health and the environment. Nanoparticles can, for example, penetrate fresh cells where they can damage cells, or their DNS in the cell nucleus. Nano-level particles have special characteristics and are increasingly use in various consumer products such as paint and coatings. Nanoparticles may also present undesired risks to health and the environment. The particle form makes it possible, for example, to reach parts of the body or environments that are otherwise

usually protected[41]. In addition, their size can lead to increased reactivity, since in relative terms small structures will have a far larger available surface compared with larger particles.

Research of the risk of using nanomaterials has focused mainly on health effects, an some cases adverse effects have been shown[42]. It has been shown, for example, that nanoparticles may penetrate cells and damage them[43]. This does not mean that all nanoparticles will have adverse effects. Today there is a lack of knowledge of the health and environmental effects of nanoparticles, especially the long-term effects[44]. Nordic Ecolabelling applies the precautionary principle to the use of nanomaterial.

Candidate list substances

The use of candidate list substances in the chemical compound is prohibited. In article 57, REACH defines the criteria for assessment when substances are assessed to be particularly problematic, Substances of Very High Concern (SVHC). These substances may be included in the candidate list. There is no list of SVHC substances. Only a set of criteria for when substances are considered to be VHC. The inclusion of a substance on the candidate list does not have any regulatory consequences in itself, but indicates that the substance may be included on the Approved List (see below).

The candidate list is published in accordance with article 59 of REACH on the website of the European Chemicals Agency (ECHA). Here is a link to the list:
http://echa.europa.eu/candidate-list-table?p_p_id=substancetypelist_WAR_substanceportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_pos=2&p_p_col_count=3&_substancetypelist_WAR_substanceportlet_delta=75&_substancetypelist_WAR_substanceportlet_keywords=&_substancetypelist_WAR_substanceportlet_advancedSearch=false&_substancetypelist_WAR_substanceportlet_andOperator=true&_substancetypelist_WAR_substanceportlet_orderByCol=inclusiondatecl&_substancetypelist_WAR_substanceportlet_orderByType=desc&_substancetypelist_WAR_substanceportlet_cur=1

O5 Metal coating of parts

Requirements in the criteria document:

> Parts of metal may not be coated with lead(Pb), mercury (Hg), cadmium (Cd), chromium VI (CrVI), nickel (Ni) or compounds thereof.
>
> Exceptionally, parts may be coated with chromium III, nickel or compounds thereof in cases where this is necessary due to chemical or mechanical wear, or other documented special technical requirements.
>
> Any chromium and nickel-plating processes must take place using cleaning techniques, ion-exchange techniques, membrane techniques or similar techniques, in order to be able to recover the metals to the greatest possible extent. Residual products from coating must be used for recovery schemes or waste handling. The system must be without a drainage system.

[41] The Danish Board of Technology, 2008: Nanomaterials, risk and regulation, report 2008
[42] The Danish Board of Technology, 2008: Nanomaterials, risk and regulation, report 2008
[43] Janne K. Folkmann, Lotte Risom, Nicklas R. Jacobsen, Håkan Wallin, Steffen Loft, Peter Møller; Oxidatively Damaged DNA in Rats Exposed by Oral Gavage to C60 Fullerenes and Single-Walled Carbon Nanotubes, Environ. Health Persp, 117(5), 2009
[44] Janne K. Folkmann, Lotte Risom, Nicklas R. Jacobsen, Håkan Wallin, Steffen Loft, Peter Møller; Oxidatively Damaged DNA in Rats Exposed by Oral Gavage to C60 Fullerenes and Single-Walled Carbon Nanotubes, Environ. Health Persp, 117(5), 2009

✉ Declaration from the manufacturer that the requirement of metal coating has been fulfilled. Appendix 2 may be used.

✉ Report on any need for metal coating and which cleaning technique may be used by the boiler's manufacturer.

Background to the requirement:
The requirement is new. Surface coating of metals has environmental impacts[45] (relevance). Substances that are hazardous to the environment and health are used in certain metal coatings, such as chromium coatings. When parts are metal coated, the environmental impact can vary, depending on the process used and the substances used for surface treatment (potential). Exceptionally, small parts (such as screws, discs and bolts) and surfaces may be chromium III or nickel-coated if this is required due to chemical or mechanical wear or other special technical requirements. The chromium- or nickel-coating of handles is not considered to be necessary on grounds of chemical or mechanical wear. Any chromium and nickel-plating processes must take place using cleaning techniques, ion-exchange techniques, membrane techniques or similar techniques, in order to be able to recover the metals to the greatest possible extent. Residual products from coating must be used for recovery schemes or waste handling. The system must be without a drainage system- Appendix 2 of the criteria document can be used by the manufacturer to document the requirement.

O6 Labelling of plastic elements

Requirements in the criteria document:

Plastic elements weighing more than 50 g must be labelled in accordance with ISO 11469.

Cables are not subject to the requirement.

✉ Declaration from the manufacturer of the boiler that the requirement is fulfilled. Appendix 4 may be used to document the requirement.

Background to the requirement:
The requirement is unchanged from the previous version of the criteria (version 2). The requirement must ensure that plastic elements are correctly sorted at source and reused on the disposal of the boiler.

O7 Product and transport packaging

Requirements in the criteria document:

It must be possible to recycle or reuse materials in product and transport packaging. The manufacturer must submit a description of the packaging, as well as instructions for how the packaging is to be handled in the Nordic countries in which the Nordic Ecolabelled boiler is sold.

Chlorine-based plastic and biocide-treated/impregnated wood may not be used in the product and transport packaging.

✉ A description of the product and transport packaging and instructions for handling in the individual Nordic countries can be found in the installation manual, see O19.

Background to the requirement:
The requirement has been changed slightly from the previous version of the criteria. It must be possible to recycle or reuse materials in product and transport packaging. The

[45] Surface coating of metal BAT: http://eippcb.jrc.es/reference/stm.html

material may not contain halogenated plastics such as chlorine-based plastic or biocide-treated/impregnated wood. This is in accordance with the Nordic Ecolabelling principle to limit these types of materials in packaging as they constitute an environmental impact. This requirement is repeated in many of the Nordic Ecolabelled product groups. Boilers are often transported on wooden pallets enclosed by a wooden skeleton to protect the fireplace. To further protect/stabilise the fireplace, cardboard and polystyrene, as well as plastic, are used to give protection from the wind and weather.

O8 Waste

Requirements in the criteria document:

The manufacturer must perform sorting at source of the various waste fractions occurring in the production of boilers, such as waste wood, waste glass, waste electronics, plastic and metal. A waste plan with a description of waste fractions and of how the waste is handled (such as reuse, depositing and incineration) must be submitted.

✉ A waste plan with a description of waste fractions and waste recipients for the company (who collects the individual waste fractions) from the manufacturer of the boiler.

Background to the requirement:
The requirement is new. Waste minimisation and correct waste handling are important environmental parameters that can be undertaken by the manufacturer or a subsupplier.

To ensure quality management, waste handling requirements may be directed at the final producer.

The manufacturer must perform sorting at source of the various waste fractions occurring in production. To facilitate waste sorting, the fireplace manufacturer must draw up a waste plan with a description of the individual waste fractions and waste recipients. The requirement does not apply to subsuppliers of sub-elements in this revision. The requirement applies to all manufacturers and companies that undertake final production of boilers. If a licence holder has production (final production) of boilers at several different factories, these are also subject to the requirement.

6.3 Requirements of control of optimum combustion

O9 Electronic control

Requirements in the criteria document:

The boiler must be equipped with a lambda probe or equivalent sensor system to ensure optimum combustion.

✉ Description of sensor system to ensure optimum combustion.

Background to the requirement:
The requirement is new. Incomplete combustion is the reason for the large amount of health-hazardous substances (CO, OGC, NOx and particles, etc.). Measurement of the level of uncombusted carbon monoxide (CO) in the flue gas is a good indication of how complete combustion is, as well as how high the level of hazardous substances is.

Without control, and perfectly adjusted, during laboratory testing the wood-fired boilers can achieve a CO average value of around 1,300 mg/m^3 and an NOx average value of 250 mg/m^3. With a lambda control (lambda probe, servomotors and electronic regulation) they can achieve average values for CO emissions of around 300 mg/m^3 and NOx of 90-180 mg/m^3 [46]. For comparison, the official requirement in Denmark (class 3 according to EN 303-5) is that the boiler must burn with a CO average of maximum 5,000 mg/m^3 for a manual wood-fired boiler with an output below 50 kW.

The reduction of emissions with a lambda control is achieved by one servomotor controlling the primary air intake, so that the degasification from the wood, and thereby the output, is held constant during combustion. A lambda probe measures the oxygen content of the flue gas leaving the boiler, and controls another servomotor which adds secondary air that matches the actual requirement to achieve good combustion.

The Danish Environmental Protection Agency has published a report[47] based on ongoing touch-free measurement of temperature and gas composition using an IR sensor (Infrared sensor) placed on the smoke pipe from the wood-burning stove. With a time resolution of approximately 1 second, this measurement can deliver control signals to an automatic air control system. In the project, an IR sensor to measure CO in flue gas from the wood-burning stove has been developed and used. Tests at the Danish Technological Institute showed that there was good agreement between direct optic measurement of CO in flue pipes and their extractive gas measurement. The IR sensor can be used in existing wood-burning stoves or boilers, and is used with automatic air control, so that the user can fire the stove or boiler correctly and achieve high energy efficiency and low emissions of air-polluting substances. The IR sensor has not yet been fully developed for commercial use.

A Nordic Ecolabelled boiler must always have optimum combustion, which is ensured with, among other things, a lambda probe that measures the oxygen content of the flue gas leaving the boiler, and subsequent automatic control of the air intake to the combustion chamber. There are similar sensor technologies that, instead of oxygen, measure the CO content of the flue gas and that ensure the same optimum combustion in the combustion chamber. With the proposed requirement, Nordic Ecolabelling does not wish to set the requirement of a specific sensor technology (lambda probe) but open up the use of other technologies to ensure optimum automatic control of the combustion air.

6.4 Supplementary heating system components

O10 Accumulation tank

Requirements in the criteria document:

Manually fired boilers must be equipped with an accumulation tank. The accumulation tank must be dimensioned to store heat from a fully loaded combustion chamber. This entails that the accumulation tank must be at least 15 times the boiler's combustion chamber volume.

✉ The instruction manual must include the information that manually fired boilers must be installed with an accumulation tank, and the size of the accumulation tank.

[46] Environmental project no. 1437, 2012, Danish Ministry of the Environment.
[47] The Danish Environmental Protection Agency, Regulation and monitoring of wood burning with new IR combustion sensor. Environmental project no. 1461, 2013

Background to the requirement:
The requirement is unchanged from the previous version of the criteria (version 2). A heat supply system should continuously supply the building with heating at the required rate. An automatically fired boiler or heat pumps ensure the ongoing production and delivery of heating, to meet the building's requirements.

As stated, it must be possible to manually fire a manually fired boiler. If the wood-fired boiler is to give a steady supply of heat, firewood must be added frequently and in small portions. In practice, this is not possible. Instead, the boiler's combustion chamber is usually filled up completely with firewood. The heat production is then controlled by the temperature of the water in the boiler, where the temperature either controls a draught regulator or an electric fan. When no heat production is required, the air supply is closed off. In non-optimum conditions, combustion will be incomplete and there will be a build-up of CO, particles, volatile organic compounds, dioxins, carbon black and PAH.

The accumulation tank thus makes it possible to allow the boiler to work at full load during the time it takes to burn the fuel. This gives good utilisation of the firewood's energy content.

Swedish laboratory trials [48,49] from 2003 have indicated that older boilers have significantly higher emissions than newer boilers. The measurements were made on undiluted direct chimney outlets with externally heated filters. The old boilers were non-environmentally-approved through combustion boilers, while the new boilers were environmentally approved or Nordic Ecolabelled boilers with reverse combustion. In the study, the new boilers were only tested with accumulation tanks, while the old boilers were tested with three different combustion techniques. The study shows that boilers without accumulation tanks pollute significantly more than boilers with accumulation tanks and that old boilers pollute more than new boilers when there are accumulation tanks. It could also be seen that correct combustion technique, adjusted combustion, can compensate to a significant degree for any lacking accumulation tank.

The requirement for the accumulation tank to be at least 15 times the boiler's combustion chamber volume was laid down in the previous criteria version 2 on the basis of dialogue with SP (Technical Research Institute of Sweden), the Swedish Energy Agency, the Swedish Environmental Protection Agency and ÄFAB in Sweden, on the basis of legislation in Sweden. This legislation is still in force[50] so that the required is maintained in this criteria version.

Information on the recommended size of the accumulation tank can be found in the instruction manual.

O11 Solar collector

Requirements in the criteria document:

If the heating system includes a solar collector, this must be type approved according to EN 12975.

✉ Declaration from the manufacturer of solar collectors, see Appendix 5.

[48] Johansson, Linda et al.: ”Emission characteristics of modern and old type residential boilers fired with wood logs and wood pellets”, SP, Chalmers, IVL, 2004

[49] Johansson, Linda et al.: “Emissioner från småskalig biobränsleeldning”, SP 2003

[50] https://lagen.nu/2003:1204

Background to the requirement:
The requirement was also included in the previous version of the criteria. A solar collector delivered with a fireplace must be type-approved in accordance with the EN 12975 standard.

A manually fired boiler (with accumulation tank) combined with solar heating may be an alternative to the traditional heating system. The solar collector plant consists of a panel of solar cells and a combi water tank with a coil for the solar collector below and a coil for the boiler above. An electrical heating rod for emergency supply is also installed. During the summer period, the solar collector alone heats domestic water. In the spring and autumn, this is supplemented with the boiler, which supplies heat to the water system and supplements the solar collector by heating the water in the top part of the accumulation tank. In the winter period, the boiler takes care of almost all of the supply of heat.

O12 Fuel pellet hopper

Requirements in the criteria document:

The manufacturer of the Nordic Ecolabelled pellet stove must inform the customer of how a hopper for the wood pellets should be designed

- to ensure that the recommended fuel retains its quality when the fuel pellets are emptied into the customer's storage hopper.
- so that carbon monoxide that may occur when wood pellets are stored does not entail a health risk or mortal danger.

☒ Information must be provided in the instruction manual.

Background to the requirement:
The requirement was also included in the previous version of the criteria. The manufacturer of the pellet stove must inform the customer of how a hopper for the wood pellets should be designed for the recommended fuel.

7 Operation of the Nordic Ecolabelled boiler

7.1 Electricity consumption

O13 Electricity consumption

Requirements in the criteria document:

The boiler's electricity consumption during operation with maximum heat output may not exceed the threshold values in the following table:

Table 15: Threshold values for the boiler's electricity consumption during operation at maximum heat output.

Manually fired boiler ≤ 20kW	Max 125 Watt
Manually fired boiler > 20kW	≤ 0.6% of nominal output
Automatically fired boiler ≤ 20 kW	Max 150 Watt
Automatically fired boiler > 20 kW	≤ 0.75% of nominal output

Test in accordance with EN303-5:2012. The electrical consumption is determined according to EN 15456.

☒ Full test report in accordance with EN303-5 and EN15456.

Background to the requirement:
The requirement is new. Nordic Ecolabelling wishes to set requirements for the boiler's electricity consumption during operation at maximum heat output. This is to ensure that the boilers overall have high efficiency. Manually fired boilers are usually equipped with one or more electrical fans, while automatically fired boilers also have a screw aggregate for manual filling of wood pellets or chips.

Data from boiler producers[51] shows strong variation in electricity consumption between the various boiler and fuel types, and the boiler's output. The variations are partly due to the difference in the number of fans/screw aggregates in the individual boiler type, but also the energy efficiency of the individual electrical unit. Small boilers ≤ 20 kW use relatively more electricity than large boilers, so that the Nordic Ecolabel proposes an absolute requirement limit of 125 Watt for for manually fired boilers and 150 Watt for automatically fired boilers, respectively. For boilers larger than 20 kW, in percentage terms more electricity must be used. A manually fired boiler of 40 kW may thus used a maximum of 240 Watt. As automatically fired boilers are also equipped with a screw aggregate, the maximum permitted electricity consumption is greater than for the manually fired boilers.

The boiler's electricity consumption must be tested according to EN 15456 in accordance with EN303-5.

7.2 Emissions from boilers for solid biofuel

The chapter below describes various problems concerning emissions to air. PAH designates PolyAromatic Hydrocarbons, which is a blanket term for several chemical substances consisting of carbon and hydrogen (also called tar substances). CO refers to carbon monoxide, OGC refers to the total content of organic gaseous carbon, and NOx refers to NO and NO_2.

Complete, efficient combustion is necessary to utilise wood as environment-friendly fuel. Besides high energy utilisation, the combustion process must therefore ensure destruction of the wood and avoid the formation of environmentally adverse compounds. On complete combustion, carbon monoxide (CO_2) and water (H_2O) are formed. Efficient combustion requires a sufficiently high temperature, oxygen surplus, length of time, and mixture (mixture of fuel and oxygen). Factors affecting combustion emissions are primarily; air intake, the temperature in the combustion chamber and the temperature in the flue gases emitted. In non-optimum conditions, combustion will be incomplete and there will be a build-up of CO, particles, volatile organic compounds, dioxins, carbon black and PAH.

Overall, the smoke from wood-burning stoves consists of gases and particles.

Gases:

- Carbon dioxide, CO_2
- Carbon monoxide, CO
- Non-combusted gases – CH_4, tar, PAH, etc.
- Evaporated inorganic salts

[51] http://www.biomasse.teknologisk.dk/kedler/listen_soegning.asp, visited 21/11-2012

Particles:

- Soot (black carbon)
- Condensed tars
- Ash
- Condensed salts

The non-combusted gases (CH_4, tars, PAH, etc.), soot and condensed tars are the main reason for air pollution.

The majority of the particles from wood-burning stoves and boilers are fine particles, i.e. they are included in PM2.5[52]. It is normally assumed that 90% of the wood-burning stove's and boiler's emissions are as PM2.5, while the remaining 10% are coarser particles. Typical particle diameters in PM2.5 from the smoke from wood-burning stoves are in the range of 0.2-0.5 µm. This applies to the particles' mass. When the particles are measured as a number, as for all other primary combustion particles, the largest number in the ultrafine range below 0.1 µm is found. When combustion is optimum, the wood smoke particles, in terms of number, will be small, with a typical size of around 0.020 µm. When combustion is poorer, there will be significantly more, and larger, particles (around 0.100 µm)[53].

These results are completely in line with results from field measurements in detached home areas in Denmark[5455], where the size distributions in the outdoor air were measured and where the firewood smoke's contributions were measured. In the project, flue gas samples were taken directly in the output from private wood-burning stoves or wood-burning boilers. The samples were analysed for dioxin, PAH and particle mass.

The result from the project shows strong variations in the emissions, which is due to stove type, firewood and users' combustion habits, even though the relation is unclear. There is a tendency for newer wood-burning stoves to have lower emissions of dioxin and PAH than older stoves, while the picture is less certain for particles. The field measurements did not measure sufficient new stoves to assess whether one new stove is better than another. However, the general picture is that new stoves pollute less than old stoves[56].

Generally, the results of the measurements in detached house areas show that a few individual sources contribute to the majority of the emissions. Among the stoves investigated in Gundsømagle, it could be seen, for example, that two out of 19 homes/stoves accounted for 61% of the pollution with PolyAromatic Hydrocarbons, also called PAHs. It is thus possible to reduce the emissions considerably by targeting measures at the sources of pollution.

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52 From the Danish report entitled "Contribution of wood combustion to air pollution - Some results from project wood use, Annual Report from DCE (Danish Centre for Environment and Energy), 2010 no. 779
53 From the Danish report entitled "Emissions from wood-fired wood-burning stoves and boilers". Carlbro Environmental Project, 1324, 2010
54 From the report Dioxin, PAH and particles from wood-burning stoves, Working Report from DCE (Danish Centre for Environment and Energy) no. 212.
55 From the report Particles and organic compounds in wood burning, Working Report from DCE (Danish Centre for Environment and Energy) no. 235
56 From the report Air pollution with particles - a health problem, DCE (Danish Centre for Environment and Energy) 2009.

For the sake of completeness it must be stated, however, that even a modern wood-burning stove pollutes far more than industrial facilities per kilo of wood burned. For example, the discharge from a manually fired boiler that just manages to comply with the Danish Executive Order on wood-burning stoves (150 mg/m^3), is several hundred times as high as from a CHP station. Combustion of wood in private facilities is a dominating source of emissions of health-hazardous air pollution, According to a report from 2009,[57] combustion of wood accounts for approximately:

- 85% of Danish tar emissions.
- 65% of Danish fine particle emissions.
- 55% of Danish dioxin emissions.

For comparison, CHP plants discharge 2-3% of Danish fine particle emissions.

There is a clear statistical relation between PM2.5 and health effects (mortality and death). Wood burning is thus responsible for 150-200 deaths in Denmark and 400-500 abroad[58]. There is a lack of knowledge, which prevents certainty concerning the risk represented by the various components of PM2.5. It is very likely that various types of particles have various hazardous health effects, but on a scientific basis there are no grounds to exempt specific components from having any health significance. Particles from wood smoke cannot be exempted in this respect. They contain, among other things, PAH (tar), which definitely has an adverse health impact.

CO is an important parameter with regard to combustion, even if combustion entails a higher CO level. The measurement method for CO is inexpensive and is therefore used as a control parameter (with threshold values) in all types of combustion plant. CO itself is toxic and to be avoided.

PAH occurs when combustion is poor and some of the pollution is toxic (some are also carcinogenic). Several studies have been made that unanimously prove a relation between PAH and particles. The higher the PAH, the higher the particle ratio[59].

The Nordic Ecolabel makes a direct requirement of particles, while the risk for PAH is also assessed on the basis of CO and OGC. Other studies have previously shown that PAH are formed in similar conditions as CO and OGC. Since analysing PAH is very expensive and time-consuming, the combination of measuring particles, CO and OGC is still a good method to assess the health and environmental risk.

NOx is a joint term for NO and NO_2, which mainly come from car exhaust, power stations and incineration plant. Pollution from petrol-fuelled vehicles has decreased as more and more vehicles are equipped with catalytic converters. The so-called SCR catalytic converters on heavy diesel lorries and buses significantly reduce NOx pollution, but on the other hand the steadily increasing number of diesel-driven passenger vehicles increase pollution. Filters and catalytic converters on diesel vehicles remove particles, but increase nitrogen dioxide pollution. Nitrogen dioxide and particles are the most health-hazardous components of air pollution. Nitrogen dioxide irritates the airways, causes respiratory problems, reduces pulmonary function and increases the risk of lung

[57] NERI, Technical Report no. 744, 2009, DMU
[58] From the Danish report Health effects assessment of exposure to particles from wood smoke, working report 1235, 2008, Danish Environmental Protection Agency.
[59] From the report: Air pollution with particles - a health problem, DCE (Danish Centre for Environment and Energy) 2009.

infections. NO_2 is a particular problem for people with asthmas and COPD, as well as children and young people[60].

NOx formation on combustion of firewood is mainly as "fuel NOx". I.e. as oxidation of the fuel's NOx, which to a great extent is found in the wood's bark. Wood without bark thus has a lower NOx content. Formation of thermal NOx (oxidation of nitrogen in the air) requires high temperatures (over 1200ºC), which are not normally achieved in small boiler systems[61]. Large manually fired boilers and automatically fired boilers can achieve very high temperatures that increase emissions of NOx. It is not advisable to go higher than 1000 degrees since besides slag formation this also pollutes with nitrogen oxides when atmospheric nitrogen combines with oxygen to form these toxic gases. It is not a good idea to go below 800 degrees either, as this results in a high degree of CO that is also toxic.

The current Nordic Ecolabelling criteria (version 2) do not include requirements of the emission limits for NOx. Nordic Ecolabelling wishes to continue to make requirements of emissions of NOx in this version of the criteria.

Climate effects - Black Carbon (BC)

Black Carbon (BC) is small soot particles formed on combustion. BC can be transported by the wind to the Arctic, for example, where the particles are deposited on the ice, turning it grey. Private wood burning and diesel motors are the dominant sources of pollution by BC in Scandinavia. In other countries, energy production, industry and field burning are also significant pollution sources. BC deposited on the inland ice increase the amount of sunlight absorbed by the ice and converted to heat. This increases the melting of the ice. When the permafrost dries, methane and CO_2 are released, which further accelerates global warming. There is thus a risk of self-reinforcing global warming[62]. BC also contributes to health-hazardous air pollution, which leads to cardiovascular disease, respiratory conditions, etc[63].

Emissions of BC have probably decreased in the Nordic region, compared to previously, due to tighter requirements for filters on diesel vehicles. No Nordic country currently measures the surrounding BC emissions on a regular basis, among other things because the smallest particles, measured regularly, only comprise PM2.5 (BC are around the same size as PM1.0)[64]. Due to the differences in the formation of particles in general and BC, all of the measures to reduce BC will also proportionally reduce PM2.5. Measures to reduce PM2.5 will not necessarily reduce BC emissions. This means that a tight requirement for emissions of particles will not necessarily lead to a reduction of BC emissions.

Currently there is no jointly accepted standard for measurement of BC. The work of developing a standard is underway, however, on the basis of the Norwegian method (use of dilution tunnel, measurement in cold air, and at different loads).

[60] http://dinhverdag.astma-allergi.dk/luftforurening/hvilkestofferforurener
[61] Presentation: Opportunities for NOx reduction, Ole Schleicher, Force Technology, 2009
[62] Conference: Wood Burning: Nordic Solutions for Climate and Health, the European Environment Agency, 8. May 2012
[63] Janssen N, et al: Health effect of black carbon, WHO 2012
[64] International Cryosphere Climate Initiative: Legislation and Regulations in Nordic Countries to Control Emissions from Residential Wood Burning: An Examination of Past Experience, DRAFT October 2013

Atmospheric particles in the air can probably also affect the climate indirectly. The clouds in the lower atmosphere consist of a lot of tiny water drops that are built up around particles. If the volume of particles in the air increases as a consequence of human beings' discharges, the number of water drops in the clouds can increase, thereby making them better able to reflect sunlight. In such cases the particles contribute to a cooling effect[65].

7.3 Emissions to air

O14 Emissions to air

Requirements in the criteria document:

The boiler may not exceed threshold values for carbon monoxide (CO), organic gaseous carbon (OGC), particles and NOx in the following table.

Boilers ≤ 20 kW:

- CO and OGC are only tested at nominal load
- Particles and NOx are tested at nominal load and low load

Boilers > 20 kW:

- CO, OGC, Particles and NOx are tested at nominal load and low load

Low load: 30% of nominal load

Table 16 Threshold values for Nordic Ecolabelled boilers tested at 10% O_2.

	CO	OGC	Particles	NOx
	mg/m^3	mg/m^3	mg/m^3	mg/m^3
Manually fired boiler ≤ 20kW	250	10	40/60	180/180
Manually fired boiler > 20kW	250/400	10/20	40/60	180/180
Automatically fired boiler ≤ 20 kW	90	7	20/40	180/180
Automatically fired boiler > 20 kW	90/200	7/7	20/40	180/180

Test instructions are stated in Appendix 1.

Test of CO, OCG and particles in accordance with EN303-5:2012.

Test of NOx in accordance with EN14792.

✉ Full test report in accordance with the standards.

Background to the requirement:
The requirement was also included in the previous version of the criteria.

Manually fired boiler ≤ 20 kW: On the basis of requirement levels in relevant official requirements and other labelling schemes, a tightening of the emission limits for CO, OGC and particles is proposed. The limit for division of boilers with low output has moved from 100 kW (in criteria version 2) to 20 kW after dialogue with the Danish Technological Institute. In the draft ecodesign requirements for boilers a limit of 20 kW was also used to define small boilers.

The small boilers share in common that they generally have difficulty in achieving low emissions at low lad. This is particularly apparent for emissions of CO and OGC, so that test and threshold values only at nominal load are proposed.

[65] http://www.naturvardsverket.se/Sa-mar-miljon/Klimat-och-luft/Klimat/Varlden-blir-varmare/Manniskans-klimatpaverkan/Partiklar-kan-bade-varma-och-kyla/

EU Ecolabel makes requirements of weighted annual emissions for CO, OGC, particles NOx for boilers that can be operated at 50% of nominal load. The weighting is distributed on 85% low load and 15% nominal load. Boilers that cannot be operated at 50% of nominal load tested at nominal load. Nordic Ecolabelling has set emission requirement limits for the measured value at low load. EU Ecolabel does not differentiate its requirements between manually fired boilers and automatically fired boilers.

The CO requirement is tightened from 2000 mg/m^3 to 250 mg/m^3, which is the same quality level as the EU Ecolabel. The requirement is tighter than the Austrian ecolabel (Umveltzeichen 37), where the CO requirement is 375 mg/m^3 at nominal load and 1125 mg/m^3 at low load. The CO requirement in EN 303-5, class 5 is 700 mg/m^3.

The requirement of OGC s tightened from 70 mg/m^3 to 10 mg/m^3. The requirement is tighter than the Austrian ecolabel, where the OGC requirement er 45 mg/m^3. The OGC requirement (energy class 5) in EN 303-5 is 30 mg/m^3. The OGC requirement in EU Ecolabel is 7 mg/m^3 or weighted nominal/low load.

The particle requirement is tightened by 70 mg/m^3 to 40 mg/m^3 at nominal load and 60 mg/m^3 at low load The requirement is tighter than the Austrian ecolabel, where the particle requirement is 45 mg/m^3 at nominal load. The particle requirement (energy class 5) in EN 303-5 is 60 mg/m^3, which applies to both nominal and low load. The particle requirement in EU Ecolabel is 20 mg/m^3 at nominal load or weighted nominal/low load.

The NOx requirement is tightened from 340 mg/m^3 to 180 mg/m^3 at both nominal and low load, which is at the level of the Austrian ecolabel, where the NOx requirement is 180 mg/m^3 at nominal load. The NOx requirement in the EU Ecolabel is 150 mg/m^3 at nominal load or weighted nominal/low load. EN 303-5 does not make NOx requirements.

Manually fired boiler > 20 kW: It is proposed to tighten the emission limits for CO, OGC, particles and NOx.

The CO requirement is tightened from 1000 mg/m^3 to 250 mg/m^3 at nominal load and 400 mg/m^3 at low load, which is at the level with the EU Ecolabel. The requirement is tighter than the Austrian ecolabel (Umveltzeichen 37), where the CO requirement is 375 mg/m^3 at nominal load and 1125 mg/m^3 at low load. The CO requirement in EN 303-5, class 5 is 700 mg/m^3.

The OGC requirement is tightened from 50 mg/m^3 to 10 mg/m^3 at nominal load and 20 mg/m^3 at low load. The requirement is tighter than the Austrian ecolabel, where the OGC requirement er 45 mg/m^3. The OGC requirement (energy class 5) in EN 303-5 is 30 mg/m^3. The OGC requirement in EU Ecolabel is 7 mg/m^3 or weighted nominal/low load.

The particle requirement is tightened by 70 mg/m^3 to 40 mg/m^3 at nominal load and 60 mg/m^3 at low load The requirement is tighter than the Austrian ecolabel, where the particle requirement is 45 mg/m^3 at nominal load. The particle requirement (energy class 5) in EN 303-5 is 60 mg/m^3, which applies to both nominal and low load. The particle requirement in EU Ecolabel is 20 mg/m^3 at nominal load or weighted nominal/low load.

The NOx requirement is tightened from 340 mg/m^3 to 180 mg/m^3 at both nominal and low load, which is at the level of the Austrian ecolabel, where the NOx requirement is

180 mg/m^3 at nominal load. The NOx requirement in the EU Ecolabel is 150 mg/m^3 at nominal load or weighted nominal/low load. EN 303-5 does not make NOx requirements.

Automatically fired boiler ≤ 20 kW:
The CO requirement is tightened from 400 mg/m^3 to 90 mg/m^3 at nominal load. The requirement is at the level of the Austrian ecolabel (Umveltzeichen 37) where the CO requirement is 90 mg/m^3 at nominal load and 202 mg/m^3 at low load. The CO requirement in the EU Ecolabel is 175 mg/m^3 at nominal load or weighted nominal/low load. The CO requirement in Der Blaue Engel (<50kW) is 80 mg/m^3 at nominal load and 180 mg/m^3 at low load. The CO requirement in EN 303-5, class 5 is 500 mg/m^3.

The OGC requirement is tightened from 25 mg/m^3 to 7 mg/m^3 at nominal load. The requirement is at the level of the EU Ecolabel where the OGC requirement is also 7 mg/m^3 or weighted nominal/low load. The OGC requirement in the Austrian ecolabel is 4.5 mg/m^3 at both nominal and low load. The OGC requirement in Der Blaue Engel is 5 mg/m^3 at both nominal and low load. The OGC requirement (energy class 5) in EN 303-5 is 20 mg/m^3.

The particle requirement is tightened by 40 mg/m^3 to 20 mg/m^3 at nominal load and 40 mg/m^3 at low load The requirement is at the level of the Austrian ecolabel and Der Blaue Engel, where the requirement of particles is respectively 22.5 mg/m^3 at nominal load and 20 mg/m^3 at nominal load, and 40 mg/m^3 at low load. The particle requirement (energy class 5) in EN 303-5 is 40 mg/m^3, which applies to both nominal and low load. The particle requirement in EU Ecolabel is 20 mg/m^3 at nominal load or weighted nominal/low load.

The NOx requirement is tightened from 340 mg/m^3 to 180 mg/m^3 at both nominal and low loads, which is above the level of the Austrian ecolabel, Der Blaue Engel and the EU Ecolabel, where the equivalent NOx requirement is 150 mg/m^3 at nominal load. EN 303-5 does not make NOx requirements.

Automatically fired boiler > 20 kW:
The CO requirement is tightened from 400 mg/m^3 to 90 mg/m^3 at nominal load and 200 mg/m^3 at low load. The requirement is at the level of the Austrian ecolabel (Umveltzeichen 37) where the CO requirement is 90 mg/m^3 at nominal load and 202 mg/m^3 at low load. The CO requirement in the EU Ecolabel is 175 mg/m^3 at nominal load or weighted nominal/low load. The CO requirement in Der Blaue Engel (>50kW) is 70 mg/m^3 at nominal load and 150 mg/m^3 at low load. The CO requirement in EN 303-5, class 5 is 500 mg/m^3.

The OGC requirement is tightened from 25 mg/m^3 to 7 mg/m^3 at nominal load and 7 mg/m^3 at low load. The requirement is at the level of the EU Ecolabel where the OGC requirement is also 7 mg/m^3 or weighted nominal/low load. The OGC requirement in the Austrian ecolabel is 4.5 mg/m^3 at both nominal and low load. The OGC requirement in Der Blaue Engel is 5 mg/m^3 at both nominal and low load. The OGC requirement (energy class 5) in EN 303-5 is 20 mg/m^3.

The particle requirement is tightened by 40 mg/m^3 to 20 mg/m^3 at nominal load and 40 mg/m^3 at low load The requirement is at the level of the Austrian ecolabel and Der Blaue Engel where the particle requirement is respectively 22.5 mg/m^3 at nominal load and 20 mg/m^3 at nominal load, and 40 mg/m^3 at low load. The particle requirement (energy

class 5) in EN 303-5 is 40 mg/m^3, which applies to both nominal and low load. The particle requirement in EU Ecolabel is 20 mg/m^3 at nominal load or weighted nominal/low load.

The NOx requirement is tightened from 340 mg/m^3 to 180 mg/m^3 at both nominal and low loads, which is above the level of the Austrian ecolabel, Der Blaue Engel and the EU Ecolabel, where the equivalent NOx requirement is 150 mg/m^3 at nominal load. EN 303-5 does not make NOx requirements.

7.4 Efficiency

O15 Efficiency

Requirements in the criteria document:

> Efficiency, (n_k), at nominal load and low load (30% of nominal load) must be tested according to the respective standard and must be at least:
>
> Manually fired boiler ≤ 20 kW
>
> - 90% at nominal load according to EN 303-5:2012
> - 89% at low load (30% of nominal load) according to EN 303-5:2012
>
> Manually fired boiler > 20 kW
>
> - 90% at nominal load according to EN 303-5:2012
> - 90% at low load (30% of nominal load) according to EN 303-5:2012
>
> Automatically fired boiler ≤ 20 kW:
>
> - 91% at nominal load according to EN 303-5:2012
> - 90% at low load (30% of nominal load) according to EN 303-5:2012
>
> Automatically fired boiler > 20 kW:
>
> - 91% at nominal load according to EN 303-5:2012
> - 91% at low load (30% of nominal load) according to EN 303-5:2012
>
> Requirements of laboratories, testing of fireplaces and measurement of efficiency are stated in Appendix 1.

☒ Full test report in accordance with EN 303-5:2012.

Background to the requirement:
The requirement was also included in the previous version of the criteria.

Manually fired boiler ≤ 20 kW On the basis of data from manufacturers and requirement levels in relevant official requirements and other labelling schemes, a tightening of the efficiency requirement is proposed. The efficiency requirement is tightened from approximately 80-85% to 90% at nominal load and to 89% at low load. In criteria version 2 the efficiency requirement was calculated on the basis of the formula n_k=73+6logQn, where Qn stands for the stated output at nominal load. The requirement is tighter than the Austrian ecolabel, where the efficiency requirement is 79-86%. The efficiency requirement (the so-called seasonal space heating energy efficiency, n_s) in the EU Ecolabel is >79%, calculated on the basis of the upper calorific value (GCV). EN 303-5:2012 uses the lower calorific value (NCV). The efficiency requirement (energy class 5) in EN 303-5 is up to 88% for boilers <20 kW.

Nordic Ecolabelling wishes to set one single efficiency requirement via testing requirements at nominal and low load. This is to make it easy for the manufacturer and consumer to compare the individual boilers as this calculation method is set by EN303-5:2012.

Manually fired boiler > 20 kW The efficiency requirement is tightened from approximately 80-85% to 90% at nominal load and to 90% at low load. The efficiency requirement in other standards and labelling schemes is unchanged with regard to manually fired boilers ≤ 20 kW.

Automatically fired boiler ≤ 20 kW: The efficiency requirement is tightened from 86% to 91% at nominal load and to 90% at low load. In criteria version 2 the efficiency requirement was calculated on the basis of the formula n_k=75+6logQn, where Qn stands for the stated output at nominal load. At the same time, the efficiency at three low loads (20, 40 and 60%) would be at least 86%. In this version, the requirement is made for testing of a low load (30% of nominal load), which reflects the boiler's efficiency up to nominal load. The requirement is tighter than the Austrian ecolabel, where the efficiency requirement is 90%. Der Blaue Engel's efficiency requirement (<50kW) is 90% for nominal load and 89% at low load (30% of nominal load). The efficiency requirement (the so-called seasonal space heating energy efficiency, n_s) in the EU Ecolabel is >79%, as for manually fired boilers. The efficiency requirement (energy class 5) in EN 303-5 is up to 88% for boilers <20 kW.

Automatically fired boiler > 20 kW: The efficiency requirement is tightened from 86% to 91% at nominal load and to 91% at low load. The requirement is tighter than the Austrian ecolabel, where the efficiency requirement is 90%. Der Blaue Engel's efficiency requirement (<50 kW) is 90% for nominal load and 90% at low load (30% of nominal load). The efficiency requirement (the so-called seasonal space heating energy efficiency, n_s) in the EU Ecolabel is >79%, as for manually fired boilers. The efficiency requirement (energy class 5) in EN 303-5 is up to 89% for boilers > 20 kW.

7.5 Consequence of emission and efficiency requirements

For manually fired boilers, the Nordic Ecolabel now proposes tighter requirements for emissions of CO, OGC and particles compared to class 5 in EN303-5:2012 and at the level of the requirements in the Austrian ecolabel. The efficiency requirement is tightened from 85% to 90% and 91% for large and small manually fired boilers, respectively, which is tighter than the EU Ecolabel and the Austrian ecolabel.

For automatically fired boilers, the Nordic Ecolabel proposes requirements for emissions of CO, OGC and particles at the requirement level of Der Blaue Engel, the Austrian ecolabel and the EU Ecolabel. The efficiency requirement is tightened from 86% to 91% for large and small automatically fired boilers, respectively, which is tighter than the aforementioned labelling schemes.

The consequence of the Nordic Ecolabel's proposals for emissions and efficiency is that one out of the Nordic Ecolabel's five licensed manually fired boilers complies with the

requirement. Data from manually fired approved boilers in the Danish market [66]shows that 50% (1/2) of small boilers comply with the requirement, while the figure for large boilers (2/13) is 15%.

Data from automatically fired approved boilers in the Danish market shows that approximately 19% of automatically fired boilers ≤ 20 kW comply with the requirement, while approximately 10% of automatically fired boilers > 20 kW comply with the requirement.

It should be noted that both the Austrian ecolabel and Der Blaue Engel have many licences (see section 4.5) that comply with similar emission requirement levels to those proposed by Nordic Ecolabel.

8 Customer information

8.1 Installation, operating and maintenance instructions

O16 Installation manual

Requirements in the criteria document:

There must be an installation manual for each boiler delivered. The installation manual must be written clearly in the national language in the Nordic country in which the boiler is sold and installed. The manual must also be available on the manufacturer and/or distributor's website(s). The manual must present recommendations and information on:

- the installation of the boiler in the designated way, and a recommendation for the boiler to be installed by an authorised/competent distributor/installation technician, as well as reference to the present
- technical information/specifications concerning the boiler
- the boiler's electricity consumption
- installation of accumulation tanks together with manually fired boilers
- information on the size of the accumulation tank (O10)
- the required volume of air for combustion, air volume in m^3 per hour
- distance to flammable material
- instructions for the type of smoke flue/chimney to which the boiler may be connected in terms of flue gas temperature, drawing, dimension, height and position of the smoke flue/chimney
- instructions for the design of the wood pellet hopper, if this fuel type is used how the wood pellet hopper must be designed for the fuel to retain its quality on emptying and storage, and so that any carbon monoxide arising as a consequence of the storage of wood pellets does not present a health risk or mortal danger (O12)
- information on the heat cover that the heating system can achieve
- how the packaging is to be handled in the Nordic countries in which the boiler is sold.

66 http://www.biomasse.teknologisk.dk/kedler/listen_soegning.asp?braendsel=&yd_min=&yd_max=&order=braendsel.braendsel

☒ A copy of the installation manual must be included when the boiler is delivered to the installation technician and customer.

O17 Operating and maintenance instructions

Requirements in the criteria document:

Operating and maintenance instructions must be included with each boiler delivered. The instructions must be written clearly in the national language in the Nordic country in which the boiler is sold and installed. The instructions must also be available on the manufacturer and/or distributor's website(s). The instructions must include details of:

- information on how various fuel types (types, materials, quality, moisture content) affect output and emissions
- information on which type of fuel the boiler has been tested with
- fuel types suitable for the boiler, and that fossil fuels should not be used that Nordic Ecolabelled wood pellets should be used in automatically fired boilers
- recommendations for the handling and storage of firewood, wood pellets and any other solid biofuels
- how the boiler is lit
- instructions for filling and the volume and size of firewood on lighting/filling
- adjustment of air intake how, by which measures, sufficient combustion air to the boiler is ensured
- instructions for cleaning, inspection and maintenance of the boiler
- instructions describing the recommended maintenance
- content of the guarantee and validity in number of years must be stated. The guarantee must fulfil the requirement in O2

☒ A copy of the operating and maintenance instructions must be included when the boiler is delivered to the installation technician and customer.

Background to the requirements:
The requirement (O16 and O17) is adjusted slightly from the previous criteria version. Certain requirements in the criteria are documented in the installation manual. These requirements are primarily intended to ensure that the boiler is installed and used in the correct way, to minimise the environmental impact. Even if a boiler yields good test values in the test laboratory, in practice its incorrect installation and use can entail major negative environmental impacts.

Requirements of competent installation technicians. The optimum situation would be that all Nordic Ecolabelled fireplaces were installed by certified installation technicians. From a market viewpoint, it has been impossible to make such a requirement. Instead, it is now emphasised that the manufacturer must recommend that the boiler is installed by an authorised/competent fitter or distributor. There must also be a reference to where the customer can find competent installation technicians.

This is completely in line with the renewable energy directive (2009/28/EG), which requires that installation technicians for boilers and stoves for biomass must have sufficient knowledge to:

- Meet the customer's needs for efficiency and reliability
- Present qualified professional skills
- Comply with current acts and regulations

Fuel: Information to the customer on how different types of fuel (types, materials, quality, moisture content) affect output and emissions is important, to ensure good combustion.

Correct firewood burning in manually fired boilers requires that only clean, dry wood is used[67]. If the wood is too wet, the stove will be cooled down and combustion will be incomplete. The fuel's water content should not exceed 18%. At the same time, the boiler and chimney will fill up with soot, which in the final analysis can set the chimney on fire. As a rule of thumb, newly felled wood must be stacked to dry for minimum 1 year. Wood with a diameter of more than 100 mm should also be cleaved.

Private individuals are not permitted to burn waste (refuse). This also applies to waste wood such as pallets, chipboard residue, old fences, garden furniture and other types of treated wood. Refuse and waste wood are not firewood, but waste - and must be submitted to the local recycling station or the municipal collection scheme.

9 Information to distributors and installation technicians

9.1 Competence requirements

O18 Competence requirements

Requirements in the criteria document:

The manufacturer of the boiler must inform the distributor/installation technician of the following:

- the boiler must be installed by a certified installation technician
- the importance of the customer/user being offered an annual service agreement
- the customer/user must have access to the installation manual and the operating and maintenance instructions.

✉ Information provided to the distributor or installation technician.

Background to the requirement:
The requirement is tightened from the previous criteria version so that the manufacturer is now required to inform the distributor/installation technician that the boiler is to be installed by a certified installation technician. The European renewable energy directive (2009/28/EC), article14, requires installation technicians for boilers and stoves (connected to a water system) and solar collectors to have sufficient knowledge to:

- Meet the customer's needs for efficiency and reliability
- Present qualified professional skills
- Comply with current acts and regulations

The directive also requires:

- Accredited training
- Personal certification with approved examination concerning both theory and practice
- Validity subject to time limitation

[67] http://www.mst.dk/Borger/luft/Braendeovne/saadan_fyrer_du_fornuftigt/Brug_rent_og_toert_trae.htm, visited on 7 October 2013

The requirement of competence and certification includes all boilers and stoves for biomass connected to a water system, as well as solar collectors. According to the renewable energy directive, each member states must have built up a functioning training and certification system by 31 December 2012 at the latest.

In Denmark the KSO scheme[68] is a quality assurance scheme for biofuel systems, solar heating plant and solar cell systems. The KO scheme is directed at companies that work with installation and service of biofuel, solar heating and solar cell systems. The purpose of the scheme is to ensure that installed systems fulfil the quality requirements and that the companies in the scheme can document this. A company can achieve membership of the KSO scheme if the company has one or more employees with a KSO installer certificate. The installer certificate is issued by the KSO scheme to persons who complete a KSO course and pass the subsequent test.

In Sweden, the Sweden Energy Agency, together with the Swedish National Board of Housing, Building and Planning, has created a voluntary training and certification system for installation technicians in Sweden, in accordance with the renewable energy directive[69]. The Swedish National Board of Housing, Building and Planning owns the specifications of requirements according to which the installation technicians can achieve certification.

In Finland, the Ministry of the Environment, together with Motiva, has drawn up a voluntary training and certification system for installation technicians who install solar heating and solar electricity, bioheating, heat pump and wood pellet systems in accordance with the RES directive.

In Norway, the Ministry and Climate and Environment, together with inter alia Norsk Varme, has drawn up a voluntary training and certification system for installation technicians who install boiler systems in accordance with the RES directive.

The manufacturer of the boiler must inform the distributor of the importance of the customer being offered an annual service agreement. Besides correct installation and maintenance, a clean burning, efficient boiler or heating system depends on ongoing maintenance and cleaning of the boiler/heating system in order to ensure efficient combustion and low emissions. An annual service agreement will ensure ongoing inspection and optimisation of the installed boiler in terms of both advisory services and technical service.

9.2 Dimensioning and design of the heating system

O19 Dimensioning and design of the heating system

Requirements in the criteria document:

The boiler's manufacturer must ensure that the installation technician has easy access to relevant information and technical data, so at to be able to perform correct dimensioning and design of the heating system. This also applies if the heating system is supplemented with a solar collector.

✉ Declaration from the manufacturer of the boiler that the requirement is fulfilled.

[68] http://www.kso-ordning.dk/
[69] http://www.energimyndigheten.se/sv/Foretag/Energieffektivt-byggande/Certifiering-av-installatorer-av-fornybar-energi-/

Background to the requirement:
The requirement was also included in the previous version of the criteria. As for other types of boiler, the heating system must be dimensioned correctly in relation to the building's heating requirement. If the heating system is too large, the room(s) will be too hot. If the problem is solved by turning down the combustion air to the fireplace, instead there is poorer combustion, with the risk of environmental hazards in the form of high emissions of particles, tar components and carbon monoxide, for example. Heath and environmental hazards can therefore be reduced by dimensioning the heating system according to the customer's home.

9.3 Spare parts

O20 Spare parts

Requirements in the criteria document:

Access to spare parts must be guaranteed for at least ten years after the manufacture of the boiler is discontinued.

☒ Declaration from the manufacturer of the boiler that the requirement is fulfilled.

Background to the requirement:
The requirement is new. The background to the requirement is to ensure a long lifetime for the boiler and that the boiler can be repaired if parts need to be replaced.

10 Changes from the previous version

Table 17 Overview of changes in the requirements on the revision of version 2 to version 3

Revised criteria (3.0)	Previous criteria (2.0)	Comment
General	General	The product group definition is changed and now comprises boilers with a nominal heat output of up to 500 kW, compared to the previous 300 kW. Separate burners now cannot gain the Nordic Ecolabel.
O1	New requirement	Requirement of description of the production process.
O2	New requirement	Materials requirement in relation to the EN 303-5:2012 standard. It is emphasised in the documentation requirement that materials descriptions and technical drawings approved by the test laboratory must be submitted. Requirement of a five-year guarantee for the bearing structure.
O3	New requirement	Chemical products used in the final production of the boiler and for external treatment may not be classified as hazardous to health and the environment.
O4	New requirement	A number of component substances may not be part of the chemical substances used in the final production of the boiler and for external treatment.
O5	New requirement	Requirement of metal coating of parts with lead, mercury, cadmium, chromium VI, nickel, or compounds thereof.
O6	K11	The requirement of marking of plastic elements is not changed in this version.
O7	K7	The requirement of product and transport packaging is not changed in this version.
O8	New	Requirement of waste sorting by the manufacturer of the boiler.

O9	New requirement	Requirement for the boiler to be equipped with a lambda probe or equivalent sensor system to ensure optimum combustion.
O10	K14	The requirement of accumulation tanks is not changed in this version.
O11	K15	The requirement of solar collectors is not changed in this version.
O12	K16	The requirement of wood pellet hoppers is not changed in this version.
O13	New requirement	Requirement of electricity consumption during operation at maximum heat output.
O14	K17	Emission requirement - threshold values tightened significantly in version 3.
O15	K18	Efficiency requirement - threshold values tightened significantly in version 3.
O16	K19	Requirement of installation manual adjusted slightly in the information requirements for installation technicians, electricity consumption and instructions for the type of smoke flue to which the boiler can be connected.
O17	K20	The requirement of operating and maintenance instructions is adjusted slightly. New requirement of information on suitable fuels and guarantee.
O18	K12, K23	The requirement is changed with information on how the boiler is to be installed by a certified installation technician, as well as the offer of an annual service agreement.
O19	K22	The requirement is not changed in this version
O20	New requirement	The requirement of access to spare parts for at least ten years after the manufacture of the boiler is discontinued.
O21-39	K1-10	Updated to the Nordic Ecolabel's latest wording of these general quality and environmental management requirements.

11 New criteria

In any forthcoming new criteria it will be relevant to include the following items in the evaluation:

- Materials and chemicals requirements
- RPS concerning whether the boiler is easy to dismantle for recycling
- Levels of emissions and efficiency required It must be investigated whether requirements are to be made of emissions of Black Carbon (BC)
- New technologies to improve the boiler's combustion
- Relation to EU ecodesign and energy labelling
- Impact of particle size on health

Glossary and definitions

Word	Glossary and definitions
BC	Black Carbon
CO	Carbon monoxide
OGC	Organically bound carbon/volatile hydrocarbons
PAH	Polycyclic aromatic hydrocarbons
NOx	Nitrogen oxides
VOC	Volatile organic compounds
RPS	Relevance, Potential and Controllability: Tool to analyse whether environmental problems are relevant, whether there is potential for improvement, and whether a licence holder has the control measures in place to achieve these environmental improvements.
PVC	Poly vinyl chloride
CMR substances	CMR substances are carcinogenic, mutagenic and reprotoxic substances
PM2,5	Threshold value for fine particles (PM2.5)

Appendix 1 Overview of the authorities' requirements and other labelling schemes

Table 18 Official requirements and requirements in other labelling schemes for manually fired boilers

	Standard measurement method	**Efficiency**	**CO**	**Particles***	**OGC**	**NOx**
	EN303-5:2012	Nominal/low load	Nominal/low load	Nominal/ low load	Nominal/ Low load	Nominal/ Low load
Order No. 1432 (DK)	<50	-	5000	150	150	-
	>50-150		2500	150	100	
	>150-300		1200	150	100	
Rev.proposal Order no. 1432, valid from 1/7-2016 (DK)		-	700 mg/Nm^3	60 mg/Nm^3	30 mg/Nm^3	-
EN303-5:2012	Class 5	Up to 88%	700 mg/Nm^3	60 mg/Nm^3	30 mg/Nm^3	-
Umweltzeichen 37 /Austrian		86%	375/ 1125 (30%) mg/Nm^3	45 mg/Nm^3	45 mg/Nm^3	180 mg/Nm^3
EU Ecolabel		79%*	250** mg/Nm^3	20** mg/Nm^3	7** mg/Nm^3	150** mg/Nm^3
Nordic Ecolabel (vers.3)	<20 kW	90/ 89%	250 mg/Nm^3	40/ 60 mg/Nm^3	10 mg/Nm^3	180/ 180 mg/Nm^3
	>20kW	90/ 90%	250/ 400 mg/Nm^3	40/ 60 mg/Nm^3	10/ 20 mg/Nm^3	180/ 180 mg/Nm^3

** Seasonal space heating energy efficiency, (ns) is calculated on the basis of the upper calorific value*

*** Boilers that can run at 50% of nominal output must be calculated as seasonal annual emissions*

Table 19 Official requirements and requirements in other labelling schemes for automatically fired boilers

	Standard measurement method	**Efficiency**	**CO**	**Particles***	**OGC**	**NOx**
	EN303-5:2012	Nominal/low load	Nominal/low load (30%)	Nominal/ Low load (30%)	Nominal/ Low load (30%)	Nominal/ Low load (30%)
Order No. 1432 (DK)	<50	-	3000	150	100	-
	>50-150		2500	150	80	
	>150-300		1200	150	80	
Rev.proposal Order no. 1432, valid from 1/7-2016 (DK)		-	500 mg/Nm^3	40 mg/Nm^3	20 mg/Nm^3	-
EN303-5:2012	Class 5	Up to 89%	500 mg/Nm3	40 mg/Nm^3	20 mg/Nm^3	-
Umweltzeichen 37 /Austrian		90%	90/ 225 mg/Nm^3	22.5 mg/Nm^3	4.5/ 4.5 mg/Nm^3	150 mg/Nm^3
Blau Engel*	<50 kW	90/ 89%**	50/ 80 mg/Nm^3	20/ 40 mg/Nm^3	5 mg/Nm^3	150 mg/Nm^3
	<50 kW	90/ 90%	70/ 150 mg/Nm^3	20/ 40 mg/Nm^3	5 mg/Nm^3	
EU Ecolabel		79%***	250**** mg/Nm^3	20**** mg/Nm^3	7**** mg/Nm^3	150**** mg/Nm^3
Nordic Ecolabel (vers.3)	<20 kW	91/ 90%	90 mg/Nm^3	20/ 40 mg/Nm^3	7 mg/Nm^3	180/ 180 mg/Nm^3
	>20kW	91/ 91%	90/ 200 mg/Nm^3	20/ 40 mg/Nm^3	7/ 7 mg/Nm^3	180/ 180 mg/Nm^3

** Measures emissions at 13% O_2, in contrast to other schemes that measure at 10% O_2.*

*** Here, the efficiency requirement differentiates between boilers below and over 12 kW.*

**** Seasonal space heating energy efficiency, (ns) is calculated on the basis of the upper calorific value.*

***** Boilers that can run at 50% of nominal output must be calculated as seasonal annual emissions.*

Appendix 2 Requirements that have been discussed, but not included in the criteria

Materials and production requirements

Metal

Cast iron and steel production (Reference BAT report: http://eippcb.jrc.es/reference/i&s.html)

Metal production has high local environmental impacts in the form of emissions, as well as high energy consumption. Generally, the use of waste iron (scrap) reduces energy consumption and equivalent emissions in metal production. In principle, fireplace manufacturers themselves can choose where they source metal, but the industry has many subsuppliers, which makes it difficult for small manufacturers of fireplaces to obtain this information.

Iron and steel production, approximately 20% recirculated iron/steel in metal production (in large-scale production for ore-based production). The production processes and the access to recirculated iron/steel vary considerably, which affects the ratio of recirculated iron/steel that can be used in production. Metal and scrap metal are a valuable material that is already recycled in iron/steel production today. The licence holders have little opportunity to control the development, so that it is not necessary for Nordic Ecolabelling to set requirements of the ratio of recycled metal.

Manufacturers of cast iron boilers already use 100% recirculated iron in their cast iron production. It is not necessary to set requirements for the ratio of recirculated metal.

Conclusion: The Nordic Ecolabel does not have sufficient opportunity to influence the development (and relevance) of the use of recirculated metal, as this is already incorporated in the production of iron/steel ad cast iron.

Glass production

Glass production (BAT: http://eippcb.jrc.es/reference/gls.html)

Borosilicate glass is the material most often used in fireplaces' glass doors and sides. It contains 70-80% SiO_2, 7-15% B_2O_3, 4-8% Na_2O or K_2O and 2-7% Al_2O_3. NB: Boro has characteristics that are hazardous to health and the environment. Lead hydrogen arsenate and triethyl arsenate are also used in the glass, and this cannot currently be substituted. Globally, there are two manufacturers of heat resistant glass for fireplaces: Schott Glass (Germany) and Keraglas (France).

The production of certain special types of glass may involve lead, arsenic, fluoride and other substances that the Nordic Ecolabel should prohibit in future criteria.

Conclusion: Glass in included in boiler in very small quantities. The Nordic Ecolabel does not make requirements of glass and components in glass in this criteria version. The Nordic Ecolabel does not have sufficient opportunity to influence the production of heat-resistant glass for fireplaces (only two manufacturers). Function (heat resistance) is important.

Requirements of energy consumption in production

The Nordic Ecolabel works with energy/energy consumption and equivalent environmental impacts such as global warming, acidification, over-fertilisation, etc. Based on life-cycle analyses, as previously stated, the greatest share of the environmental impact occurs during the use phase (> 50%). Energy production during the actual manufacture of boilers for solid biofuel thus accounts for a small share of the total environmental impact, although it does have some significance. A new requirement of energy consumption in the manufacture of boilers has been discussed. The requirement might, for example, comprise energy consumption per unit produced. As the manufacturers use many different subsuppliers, it is very difficult for the licence holders to gain energy data for the various materials and semi-manufactures. In such case, a specification of the elements of production included in the required would be needed. The Nordic Ecolabeling's view is that it is not possible at the present time to set requirements to restrict energy consumption in production. This is especially due to the problem with many subsuppliers. A new requirement for energy consumption in the production of closed fireplaces should be investigated more closely in conjunction with the next revision of the criteria.