Introduction

1.1 Background

The project website www.ecoboiler-review.eu presents the objectives, timeline and work plan of the project.

1.2 Topics to be discussed in WG 1

This document is meant as discussion document for the 1st WG1 meeting of the project, presenting the topics and some background information. Most topics are based on the Task 6 ‘Options’ report of the preceding review study on central hydronic space heaters.¹

The table below lists these (known and additional) topics and their location in this document.

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Note that the above list is not a closed list, meaning that topics (and working groups to which they are assigned) can change during the course of the project.

¹ VHK, Space- and Combination heaters – Review study of Commission Regulation (EU) No. 813/2013 (Ecodesign) and Commission Delegated Regulation (EU) No. 811/2013 (Energy Label), VHK in Collaboration with BRG Building Solutions for the European Commission, TASK 6 REPORT, July 2019. The question in Task 6 of the preparatory study is whether, despite of the caveats there should be an effort to include biogas or biofuel boilers, at least the ones where a technical distinction can be verified, in the Energy Label regulation in order to make consumers aware of this option.
1.3 Ecodesign and energy labelling requirements in support of the decarbonisation of the gas-grid

The main question will be to establish what Ecodesign and labelling measures are needed to keep the option of distributing carbon-neutral energy carriers through the existing European gas-grid instead of natural gas, if indeed this option should be included – at least as a precautionary measure under EU law.

The subject has been discussed extensively in the Task 6 report of the preparatory review study under the heading hydrogen and biofuels. The study brought forward a policy option that would support the conversion of the natural gas-grid to 100% hydrogen grids, by proposing a labelling factor/bonus for hydrogen-ready boilers\(^2\) as a transitional measure and make hydrogen-ready boilers mandatory from 2025 onwards.

The views on these policy options were divergent:

- None of the stakeholders supported a factor/bonus on the label
- Most stakeholders did not agree with mandatory hydrogen-ready boilers from 2025 onwards, however they would support some kind of hydrogen-promotion
- Some stakeholders did not see any benefit of promoting hydrogen for space heating

There was, however, a consensus that further investigation is needed into how ecodesign and energy labelling policies could potentially support the decarbonisation of the gas-grid.

Hence, the intention of the topic is evaluating the potential ecodesign and energy labelling policy options in support of the decarbonisation of the gas-grid. This evaluation will include the hydrogen option, but also other potential solutions to decarbonise the gas-grid.

New developments in hydrogen since the finalisation of the review study can be found in the Annex.

Questions

1. Based on today’s technical, economic and environmental knowledge, do we recommend to leave to keep – as a precautionary measure -- the policy option to support a 100% hydrogen gas-grid on the table or not? On what grounds?

2. What would an alternative policy option for decarbonising the gas grid? On what grounds?

3. Based on today’s knowledge, do we recommend policy makers to include the ‘hydrogen-ready’ feature or any other feature to support a decarbonised gas grid in any form or the other in new Energy Label and/or – possibly at a later stage— mandatory Ecodesign regulations for space- and water heaters. On what grounds? What information, which is out there, is possibly missing and should be retrieved by the study team before a decision can be made?

4. If the answer to both questions above is positive, how should the ‘hydrogen ready’ feature and/or feature to support a decarbonised gas grid be shaped in the

\(^2\) The objective of ‘hydrogen-ready’ boilers relates the conversion of normal (or hybrid) natural gas-fired boiler to a 100% hydrogen-fired boiler at minor extra cost. It does not relate directly to the use of hydrogen in cogeneration, although evidently also that technology would benefit from – at one time — the current gas-grid being converted to hydrogen.
measures, i.e. exact criteria and boundary conditions, mandatory or voluntary, possible energy label factor, possible icon on the energy label, timing, etc..

5. Should the boiler be more than ‘just’ ready for conversion from natural gas to 100% hydrogen (after a minor installer intervention) or should it be ready or able to cover also the intermediate stages between 30% (probably possible without adjustments to a standard gas boiler) or 100% hydrogen. The latter could be relevant if utilities want to have staged hydrogen implementation in the 30-100% range and will of course come at a considerably higher extra price for the boiler. Is that economically and technically feasible?

1.4 Primary energy factor, impact on limits

In the context of the recast of the Energy Efficiency Directive (EED, preamble) the Commission decided, with also allowances for country-specific factors, to use a primary energy factor (PEF) of 2.1 instead of 2.5 for the electricity generation and distribution from fossil energy sources.

In order not to comply with this new factor and also not to downgrade the current Ecodesign limits for central, hydronic space-heaters, the preparatory study made an estimate for the various technologies what the share is of electricity and thus what the new PEF-corrected Ecodesign limits should be (see Task 6, Table 1). For fossil fuel boilers, with only a low share of electricity, this resulted in a small correction of 1% point extra. For electric resistance boilers the limit would move from 36 to 43% to maintain the old ambition level. For electric heat pumps the corrections would be from the current 125% to a PEF-corrected 150% for low temperature (LT) heat pumps and from 110% to 130% for the other heat pumps. It is also suggested that the new limits for LT heat pumps, i.e. the distance to the other heat pumps, could be more ambitious at e.g. 170-175%.

For the Energy Labelling there is the consideration that after implementation of the Ecodesign limits several classes are now empty, while at the same time some stakeholders have asked for a larger differentiation in classes in the broad current A+ classes, which now covers a seasonal efficiency range from 98 to 125% with many competing technologies. And then there is the matter of a compensation that would balance the disadvantage in PEF-shift for ‘hydrogen-ready’ natural gas boilers/gas-fired heat pumps.³

During and after the 2nd stakeholder meeting there was plenty of dispute on all sides of the argument:

- Some manufacturers saw that the new proposal would put the condensing boilers in the C or D category, whereas they are now in ‘A’. They think it would give a wrong or anyway too early signal to the market that the condensing boiler in which they just invested is already suboptimal. Manufacturers of low-cost (and low-COP) heat pumps, e.g. in hybrids that would no longer be in a “+” or “++” category, would agree.

³ For water heaters (including combi-boilers) a new technology-specific approach was proposed and Ecodesign and Labelling Class limits should be discussed in WG4.

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• Other manufacturers see the need for a larger differentiation in the new technologies and a way forward to balance the PEF for advanced gas technologies.

• Green NGOs proposed an alternative labelling classification that goes much further than what the preparatory study proposes.

• There are policy makers that wonder why to bother with changing the space heating energy labelling regulation at all if in 2026 there should already be a new recast, following the stipulations of the 2017 energy labelling regulation.

• The problem of test- and calculation methods for ‘hybrids’ of different heat generators (e.g. heat pump and boiler), both for Ecodesign and Energy Labelling, still needs to be addressed in WG2 (testing) and WG3 (calculation). How can we discuss limits without having solved these other items first?

The topic is intended to discuss the energy efficiency classes for space heaters for this review. Seeing that the time is limited and that there are three meetings foreseen for WG1 we to hold an initial round of statements without further discussions followed by a written consultation with deadline of 14 March.

**Question**

1. In principle, and not to suggest that this will be the last word on limits (also because WG2 and 3 will have input), is the suggested PEF-correction of the Ecodesign limits correct or should is there another way to use the new PEF and not downgrade the current limits?

2. Given that it seems the prime argument against change of labelling class limits, how important –in view of realising policy goals-- is it to keep condensing fossil-fuel boilers in the ‘A’ class (and not lower)?

3. Given that it seems the prime argument in favour of changing of labelling class limits, how important is it –in view of realising policy goals--to have more differentiation in classes especially for the higher A+ etc. categories?

**1.5 Micro-cogeneration metrics**

The preparatory review study, especially in Tasks 1 and 6 as well as stakeholder consultations, has made a considerable effort to present the various views of stakeholders –and find convergence—on the topic of metrics for micro-cogeneration (‘mCHP’).

The latest proposal in the preparatory study is not to follow the fluctuations in primary energy factor, going down from 2.5 to 2.1 or lower, in the valuation of the benefits of the electricity generation by mCHP, because it would be detrimental for the future of mCHP, including the fuel cells. Instead it is proposed to keep the continuity of the factor 2.5 and even raise it to 2.65 when considering the fact that local mCHP avoids the distribution

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4 E.g. the Netherlands government is already proposing a PEF of at the most 1.6. In that context any electricity contribution of mCHP becomes more and more marginal in view of policy goals.
losses of the grid. The standardisation experts of the manufacturers disagree on principal
grounds, which may in certain contexts be valid but do not help in the context of general
policy goals aspired.

As such the proposal is a pragmatic compromise that aspires to make all diverging parties
equally dissatisfied and represent an acceptable solution for all.

The intention of the topic is to put the subject to rest so manufacturers have certainty in
their R&D processes and focus on better performance at a lower price. In this first meeting
of WG1 we propose to make a round of opinions on this first proposal without discussion.

**Question**

1. Can parties agree with the proposal? If not, apart from the proposals already known
to be diverging, what proposals are made to solve the issue?

The latter part of the question could be expanded upon, if necessary, in written documents
after the meeting up to 14th of March.

### 1.6 Shared chimney problem B1, C4 and C8

The current regulation has Ecodesign limits that lead, amongst others, to mandatory use
of fan-assisted condensing boilers and thus to the necessity to have chimneys that are
suitable for fan-propelled (positive pressure), condensing exhaust gases (flue gases). Un fortunately, without technical intervention these chimneys tend to be incompatible with
the existing chimneys for buoyancy-driven (negative pressure), non-condensing flue
gases.

To deal with the issue, especially in chimneys that are difficult to renovate, e.g. in historic
buildings in city centres, the regulation foresees an exception for non-condensing B1-type
of boilers up to 10 (solo) or 30 kW (combi). As the preparatory study shows, this B1
exception is sold much more than market analysis indicates and thus already constitutes
a loophole. Now, as an initiative from Croatia, but probably also applicable to many more,
mostly Eastern European member states, there is the request for an exception also for
non-condensing C4 and C8 boilers that were installed 10-15 years ago in high-rise
(“Plattenbau”) apartment-buildings and that now need to be replaced. In the preparatory
study it is indicated that, depending on the situation, there are several technical solutions
without excessive costs. This is similar to the situation in several Western European
countries like the UK or the Netherlands that made the switch to individual condensing
boilers in apartment-buildings several years ago. The main difference is that these
countries had an active incentive programme (advise and subsidies) for chimney-
renovation to make the transition for their citizens.

Discussions at and after the final stakeholder meeting indicated that the boiler-industry
would have a problem with an exception for C4 and C8 boilers, because they don’t make
them anymore and would incur significant costs—and thus require a high product price—
to restart production. They may lose market share—and Ecodesign may lose credibility—to
illegal production of these C4 and C8 boilers. Western-European Member States see the
problem of not attaining policy goals through new exceptions. Eastern-European Member States see the economic problem for some of their citizens and seem reluctant to enter in an effective chimney renovation programme with technical support and incentives.

Questions

1. Do critical Member States want to make the effort and spend the money to realize the saving through condensing boilers?

2. If so, how can the expertise from installers in other countries that already went through the chimney renovation be used to help minimize the costs in Eastern European countries?

3. If so, how could additional European funds help to realize the chimney renovation?

4. If Member States asking for the exception do not want to make the effort and spend the money, are the other Member States prepared to accept the lower savings from the loophole that is created. Do the other Member States have alternative options to meet their policy goals—in the context of effort sharing—rather than the switch to condensing boilers?
Annex

News since the Task 6 report in the summer of 2019:

Hydrogen boilers

Sunday Times is reporting that "The government is considering a proposal from the heating industry to set a date by which all boilers on sale would be "hydrogen ready", meaning they burn natural gas but can be converted easily to burning hydrogen." 5

Worcester Bosch presented its hydrogen-ready boiler to the chancellor and MPs as a potential solution to the UK’s quest for net zero carbon by 2050. 6 ‘It can run on natural gas, but it’s capable of converting to 100% hydrogen following a one-hour visit by an engineer….. It says this would allow households to switch painlessly to clean boilers when existing boilers reach the end of their lives. The extra cost of the hydrogen-ready boiler would be about £50, it says.’ 7 Dutch subsidiary Nefit Bosch is working hard to support its British colleagues for the H21 Leeds project, which reportedly should connect 1000 homes to a 100% hydrogen feed. 8

First 100% hydrogen-fired boilers became operational June 2019 (4 Jan. 2020) in an apartment building in Rozenburg (near Rotterdam, NL). The hydrogen boiler prototypes are made by GasTerra, Bekaert and Remeha, the latter being a brand of the BDR Thermea boiler manufacturing group. 9 10 11 German BDR Thermea subsidiary Brötje was also involved. 12 In October 2019, the Italian subsidiary Baxi S.p.A. –also pertaining to the BDR Thermea group—presented its 100% hydrogen-fired premix boiler as its vision for the future. 13

There are advanced plans to equip all 600 homes in the Dutch village “Stad aan ‘t Haringvliet” with a hydrogen-boiler and connect them to a 100% hydrogen gas grid as soon as possible. 14

As regards safety aspects in general, and specifically in the context of the GAR (Gas Appliance Regulation) there are several CEN working groups working on the use of hydrogen, amongst others in heating boilers.

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5 https://www.thetimes.co.uk/article/hydrogen-boilers-may-be-only-choice-for-homes-by-2025-2rw5t3tpt
7 https://www.bbc.com › science-environment-50873047
9 https://www.installatie.nl/nieuws/eerste-ketels-branden-op-pure-waterstof/
11 https://remeha.be/fr/projet-pilote-avec-hydrogene-de-la-generation-au-chauffage/
12 https://www.broetje.de/de/broetje/presse/aktuelle-pressemitteilungen/wasserstoffbetriebener-heizkessel-als-zukunftsmodell
13 https://www.baxi.it/news-eventi/caldiaia-premiscelata-idrogeno
14 https://hy-gro.net/en/stad-aan-t-water-stof
Hydrogen production

As regards the technology (and costs) for producing ‘green’ and – for a transitional period – ‘blue’ hydrogen:

Green hydrogen

Apart from hydrogen production through alkali electrolysis and low-temperature PEM fuel cells, there are some new developments in the field of high-temperature (SOFC) fuel cells for the production of hydrogen from (renewable source) electricity.15

Blue hydrogen

In November 2019 the German Karlsruhe Institute of Technology (KIT), prize-winning for its methane pyrolysis to produce hydrogen and solid carbon, launched a collaboration with Wintershall Dea, leading European oil- and gas company (4000 employees), to develop climate-friendly hydrogen on an industrial-scale. 16 The technology is attractive for blue hydrogen because it requires no capture and storage of gaseous carbon-dioxide and thus no risk of leakage. Furthermore, there are several commercial applications for the solid carbon (‘carbon black’).

Likewise, Dutch research institute TNO is working on the EMBER project, which foresees speeding up commercial scale methane pyrolysis (Technology Readiness Level TRL 9) in 2030.17

The BASF/Linde/ThyssenKrupp industrial consortium working on methane pyrolysis announced that these technologies are available at level TRL 1-4.18 19

Hydrogen distribution

Hydrogen is the lightest element with the smallest atoms in the periodic system and thus more critical than natural gas as regards leakage from generation, distribution and end-use. Like any fuel it is flammable and -- under specific conditions -- is explosive. Having said that, there are technical and empirical arguments that in that respect it is not very different from natural gas. However, being zero-carbon and having no air-pollution impact, it is very different in terms of leakage-impact. Methane is a greenhouse gas (GHG), 28 to 36 times more potent than CO2 (GWP-10020) and has an impact on the formation of ground-level (tropospheric) ozone. Especially in the second half of 2019 there has been considerable negative publicity regarding ‘methane leakage’ from oil- and gas generation and distribution, i.e. at a level considerably higher than previously assumed. The IEA estimated 79 million tonnes (Mt) of oil- and gas related global methane leakages in 2018, equivalent to the global warming potential of at least 2.2 billion tonnes (Gt) of CO2.

18 https://www.ies.be/files/Breaking_Through_Industrial_Low-CO2_Technologies_on_the_Horizon_IES_13072018_0.pdf
20 GWP-100 is Global Warming Potential at a 100-year horizon. Short term, e.g. GWP-20 at 20 years, it is a much more potent GHG.
emissions.\textsuperscript{21} For comparison: this amounts half of the total EU greenhouse gas emissions.\textsuperscript{22} The 79 Mt are divided equally between gas and oil, according to the IEA, and there is little progress in reducing those emissions. There are also several incidents and anecdotes firming up the IEA estimates.\textsuperscript{23} \textsuperscript{24} \textsuperscript{25}

\textit{Policy}

Approximately half of all EU households rely on gas for their space heating.\textsuperscript{26} For the non-residential sector a similar share can be expected.\textsuperscript{27} Largest EU gas boiler buyers are UK, Italy, France, Germany, the Netherlands, Spain, Belgium, Poland and Romania (representing 95% of EU unit sales of individual boilers in 2014)\textsuperscript{28}. Even without the UK, which is the largest gas boiler buyer in the EU28, still at least 44% of the EU27 households will be connected to the gas grid for their space heating.\textsuperscript{29}

The use of hydrogen was on the agenda of the G20 in Japan in the summer of 2019, as reported in the Task 6 report. At the European Gas Regulatory Forum (a.k.a. the Madrid Forum), hydrogen was the number one subject of the presentations.\textsuperscript{30} Several EU Member States give hydrogen a high policy priority in the transition to a carbon-neutral society. The Netherlands wants to play a leading role, explicitly including hydrogen boilers. The UK seems to be thinking along the same lines. In Germany the discussion on hydrogen seems to focus on transport and heavy industry, but recently some large boiler-manufacturers are promoting the concept of hydrogen for boiler as a welcome additional road to carbon neutrality. Poland is preparing to move away from coal to gas and is considering not just the short-term option of natural gas but also the longer-term hydrogen option.\textsuperscript{31}

\textsuperscript{21} https://www.iea.org/reports/methane-tracker/methane-from-oil-and-gas#abstract
\textsuperscript{23} The Tropomi-instrument in the Sentinel-5P-satellite detected a major gas-leak in Ohio, emitting as much as 60 kt methane in 20 days. recently detected a major gas leak in Ohio, emitting as much as 153 kt methane leakage at a gas compressor installation in Turkmenistan, now shut down. This is the equivalent to the Global Warming Potential (GWP) of 4,3 Mt of annual CO2 emissions. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019GL083798
\textsuperscript{25} https://www.sciencemag.org/news/2019/07/major-us-cities-are-leaking-methane-twice-rate-previously-believed
\textsuperscript{26} Primary dwellings are those occupied most of the year by households. Secondary dwellings are holiday homes and empty housing, which are assumed to have a relatively large share of no or only local heating.
\textsuperscript{27} Note that in the non-residential sector the gas-fired boilers are not only used in hydronic emitter systems. Gas-fired boilers are also used for the heating part of central air conditioning, in combination with an AHU (Air Handling Unit). Furthermore, they are the core of most industrial air heaters, i.e. blowing hot air in industry halls and warehouses for space heating purposes. Gas-fired radiation heaters are used in various non-residential formats such as agriculture (stables), restaurants (outdoors), churches (fast-acting, temporary heating of ill-insulated ambients), etc..
\textsuperscript{28} VHK in coll. with BRG, Ecodesign preparatory review study on space and combination heaters – Task 2 on Market Analysis, for the European Commission, Jan. 2019.
\textsuperscript{29} In 2017 the EU-28 had around 220 million households, of which the UK made up 27 million. After Brexit this leaves a EU27 with 193 million households. Assuming that almost all UK households (say 25 million) had a gas boiler and half the EU28-households (110 million) had a gas boiler, 85 million EU27-households with gas boilers remain for 193 million households, which is 44%. This is not counting the local gas heaters and an unknown fraction of non-residential buildings using gas for space heating. Source: VHK in coll. with BRG Building Solutions, Space- and combination heaters - Review study, TASK 2 REPORT, July 2019
\textsuperscript{30} https://ec.europa.eu/info/events/32nd-madrid-forum-2019-jun-05_en
A recent CEPS report gives an overview/comparison of recent studies on the future of gas by various policy makers, oil & gas companies, think tanks, etc..\textsuperscript{32}