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Review study on Local Space Heaters

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Final report

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I. Preface

This report concerns the review of Commission Regulation (EU) 2015/1188, of 28 April 2015, implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for local space heaters. The Ecodesign Directive[1] provides consistent EU-wide rules for improving the environmental performance of products placed on the EU market. This EU-wide approach ensures that Member States' national regulations are aligned so that potential barriers to intra-EU trade are removed.

The Directive's main aim is to provide a framework for reducing the environmental impacts of products throughout their entire life cycle. As many of the environmental impacts associated with products are determined during the design phase, the Ecodesign Directive aims to bring about improvements in environmental performance through mandating changes at the product design stage.

The Ecodesign Directive is a framework directive, meaning that it does not directly set minimum requirements rather the aims of the Directive are implemented through product-specific Regulations (implementing measures), which are directly applicable in all EU member states. For a product to be covered by under the Ecodesign Directive it needs to meet the following criteria:

- Have a volume of sales that exceeds 200.000 units per year throughout the internal European market
- Have a significant environmental impact within the internal market
- Present significant potential for improvement in environmental impact without incurring excessive costs

The objective of the product specific regulation for local space heaters is to ensure the placing on the market of technologies that reduce the life-cycle environmental impact of local space heaters, leading to estimated energy savings of around 240 PJ/year in 2030, corresponding to around 10% of the baseline[2] when combined with energy labelling. For liquid and gaseous fuel local space heaters the regulation also sets requirement for the emission NOx (Nitrogen oxides). However, the impact of the emission limits was not calculated in the 2015 Impact Assessment due to lack of data[3]. The Ecodesign Regulation was amended by the horizontal Regulation (EU) 2016/2282 with regard to the use of tolerances in verification procedures.

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0125&from=EN
[2] According to the 2015 Impact Assessment, page 7 {C(2015) 2643 final}, {SWD(2015) 90 final}, based on annual fuel consumption of 2404 PJ/year in 2030 and 10% savings.
[3] According to the 2015 Impact Assessment page 9

Article 7 of Regulation (EU) 2015/1188 requires a review of the regulation by 1 January 2019. The specific aspects to review according to article 7 of the Regulation are:

- Whether it is appropriate to set stricter ecodesign requirements for energy efficiency and for emissions of NOx
- Whether verification tolerances should be modified
- The validity of the correction factors used for assessing the seasonal space heating energy efficiency of local space heaters
- The appropriateness of introducing third party certification

Furthermore, the review study will include a technology roadmap as part of task 4, and assessment regarding the resource efficiency and an evaluation of the requirements in view of a possible new PEF (Primary Energy Factor).

The review study aims to update the 2012 preparatory study[4] with aspects relevant to the Ecodesign Regulation on local space heaters and thus focus mainly on changes compared to this study. Like the preparatory study, the review study follows the seven tasks of the MEErP (Methodology for Ecodesign of Energy-related Products[5]). The seven MEErP tasks are listed below:

- Task 1: Scope
- Task 2: Markets
- Task 3: Users
- Task 4: Technology
- Task 5: Environments and economics
- Task 6: Design options
- Task 7: Scenarios

This Final report is the third deliverable under the specific contract of review study of Regulation (EU) 2015/1188 and contains the results for all tasks (task 1 to 7).

[4] Preparatory study Lot 20, link: http://www.eup-network.de/fileadmin/user_upload/Produktgruppen/Lots/Final_Documents/BIO_EuP_Lot21_Task_5_09072012.pdf
[5] https://publications.europa.eu/en/publication-detail/-/publication/b7650397-32f1-436c-82c4-df39aef297a3/language-en

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i. Task 1

Task 1 outlines the scope of the regulation and of the review study as well as the relevant standards and legislations related to local space heaters. The section about standards includes also status on the ongoing standardisation processes.

Scope

Task 1 presents the product scope of the regulation and the current definitions, which will form the basis for the rest of the study. These are also compared to the scope and definitions of other regulations and PRODCOM (NACE rev. 2). The PRODCOM database contains seven different categories, which are generally less elaborate and do not match the 14 product categories in the regulation.

Based on communication with stakeholders and market surveillance authorities, a number of loopholes and other needs for scope clarification were identified. One of these recommendations is to change of overall definition and exemptions of local space heaters to simplify and make it clearer. This in turn requires changes in the exemptions, including specific exemptions of heaters not used in places where human stay or work and for cooking appliances. It is also recommended to change the definition of air heating appliances to match that of Regulation 2016/2281 [6] to avoid the possible misunderstandings of the current formulation in Regulation 2015/1188.

Further clarifications are recommended for the categories of portable and fixed heaters. For fixed heaters it should be added to the current definition "…<u>and is not a towel rail</u>" or a similar phrasing. For portable heaters it is suggested to change the definition so that it is not merely an exclusion of all other options but describes the products. Furthermore, it is suggested to add that if a portable appliance can be used as a fixed appliance, they should be considered a fixed heater and thus comply with the fixed heater requirements.

Towel rails were mentioned as a major loophole by stakeholders, since many are used also heat the room, even though they might be claimed not to be for space heating purposes. Towel rails should therefore be defined as a separate product group in the regulation and included with specific ecodesign requirements for two categories: Those above and those below 250 W.

[6] Commission Regulation (EU) 2016/2281 of 30 November 2016 implementing Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products, with regard to ecodesign requirements for air heating products, cooling products, high temperature process chillers and fan coil units

The category "electric radiant heaters", however, was reported by stakeholders to be empty due to the current definition, meaning that no such products are produced or sold. It is therefore suggested to delete this category from the Regulation.

The exemption of slave heaters has been identified as a major loophole, and it is therefore suggested to remove this exemption and consequently also the definition of slave heaters. Instead information requirements should be implemented for all heaters sold without controls, supplemented with detailed information requirements regarding which specific control functions are needed for the products. This suggestion also solves identified issues with underfloor heaters, as these are often sold without controls and has therefore been an important topic of discussion. The requirements should also cover self-regulating heating cables.

Stakeholders have suggested a range of other products to look into, for example mixed heaters, air curtains and outdoor heaters. According to one stakeholder mixed heaters are "a product intended to be used in a central heating hydronic system but that also has an electric heater inside and together can be used as an electric Local Space Heater or an electric slave heater when the central heating system is turned off". Since heating by the hydronic system is clearly not in scope of Regulation 2015/1188 (not being a locally generated heat source), the only product in question is the heating element itself. However, the heating element is dependent on the hydronic radiator and cannot heat the room by itself. It is therefore not considered, in itself, a local space heater. Furthermore, the information available regarding sales, stock, use patterns, and technical specification is very limited. It can further be assumed that the use of such products is very low, since they are only used when the hydronic system is not used and can only be installed in specific radiator types prepared for installation of such heating elements. The potential energy savings are thus also assumed to be negligible.

Neither the outdoor heaters nor the air curtains fit the definition of a local space heater, and for neither of the products the options for adjusting the heat emission are relevant. Neither of the products have the main purpose "to reach and maintain a certain level of human thermal comfort within an enclosed space in which the product is situated", which is a central part of the definition of a local space heater. Outdoor heaters are by definition not intended to heat and enclosed space, and air curtains are primarily used as a climate zone separator to keep warm air inside buildings and cold air outside, in situations where doors open often. Both products are intended for human comfort, but it is not recommended to include them in the scope of the Regulation, as this is based on efficiency through heat emission control option, while outdoor heater are more dependent on positioning (as they are often radiant) and air curtains are more dependent on the air flow in order to obtain high efficiency.

For gas and liquid fires local space heaters, a change of the categories has been suggested, because especially the current meaning of open and closed fronted is ambiguous, and it is not clear whether it is actually open and closed combustion that is meant, which makes it difficult for manufacturers to determine which category each appliance belongs to. The new categories should therefore be based on the following technical parameters:

- Primary air supply
- Need for flue duct
- Sealing to the flue duct
- Presence of glass/metal pane in front of fire bed

However, a specific definition of e.g. decorative heaters cannot be made, since this is not based on technical factors, but on appearance and purpose, and all types of heaters have some design or consideration for appearance, making such a category highly ambiguous.

It has been argued that some product types with low sales and stable technology without many changes in the last 10-20 years, should be excluded entirely form the regulation, as they are already disappearing. However, as long as they are still on the market and an alternative to the other heating technologies, it is recommended not to exclude them from the scope to avoid creating further loopholes or grey areas.

The current use of the terms 'commercial' and 'domestic' local space heaters has been criticized to not be consistent with how products are used and to create room for interpretation of the scope of the regulation. Many appliances currently categorised as domestic can also be used in commercial settings (e.g. offices). Since the term 'commercial' is currently covering only two specific technologies in this regulation, it is therefore recommended to remove these terms entirely and instead refer to the specific technologies in question. The idea to include commercial appliances down to 50 kW instead of the current 120 kW is not recommended, since the technologies in this size span are primarily air heating products, which are covered by Regulation (EU) 2016/2281[7].

A proposal to split the regulation into two separate regulations was considered: one for electric local space heaters and one for gas/liquid local space heaters due to the large difference in technologies. While this could make sense technically, it might easily make the law-making process less efficient since alignment between the two regulations would have to be maintained.

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[7] Commission Regulation (EU) 2016/2281 of 30 November 2016 implementing Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products, with regard to ecodesign requirements for air heating products, cooling products, high temperature process chillers and fan coil units

Legislation
In task 1 an overview is given of the legislations relevant for local space heaters and the Regulation (EU) 2015/1188 itself is described. A number of issues related to the Regulation is raised, especially in connection with the calculation methods and correction factors defined in the Regulation. These issues include:

- The use of input heat instead of output heat for calculating NOx emissions
- The fact that not all control types are available for all product types, and the specified bonuses are therefore not technically obtainable for some products (especially related to gas and liquid fuel local space heaters)
- How to deal with controls sold separately from the heaters (this is relevant for underfloor electric heating and for smart products)
- The value of the Conversion Coefficient (CC) related to primary energy conversion
- Confusion of whether calculations and correction factors are in percentages or percentage-points

Standards
The last part of task 1 is about the relevant test standards for local space heaters, especially those with relevance to the ecodesign measures. For electric local space heaters, the CENELEC technical committee TC59x, WG 12, is working on drafting harmonised standards for Regulation (EU) 2015/1188. For gas and liquid fuel local space heaters, however, the standardisation request was rejected by CEN and the further development is therefore uncertain.

ii. Task 2

Task 2 gives an overview of the local space heater market including sales, stock and base data on consumer costs.

Sales and stock
The stock of local space heaters in Europe is determined based on sales and the expected lifespan [8]. Sales are based primarily on the Impact Assessment and verified by stakeholders[9]. Sales are generally expected to be stable for electric heaters and decrease for gaseous and liquid heaters for over the coming years. The product group with the highest sales is electric local space heaters.

In the stock model, the average product life varies from 7 to 40 years for different product types, based on the impact assessment and discussion with stakeholders. In the current stock model, the statistical standard deviation of the lifetime is assumed to be 2 to 6 years.

[8] Based on the Impact Assessment and discussion with stakeholders
[9] Not all numbers have yet been verified, this is a topic of the first stakeholder meeting.

This is used to calculate the number of local space heaters in the stock, using a normal distribution for their lifetime of years +/- the standard deviation of years.

The sales and stock are presented in compiled graphs (Figure 1 for electric heaters, Figure 2 for gaseous heaters and Figure 3 for liquid heaters). It is seen that the sales (and thus the stock) reaches a plateau, resulting in a total stock just below 240 million electric local space heaters, approximately 6 million gaseous space heaters and approximately 0.6 million liquid heaters by 2030. The sales and stock figures will be used in subsequent tasks to estimate the annual energy consumption and the resource consumption.

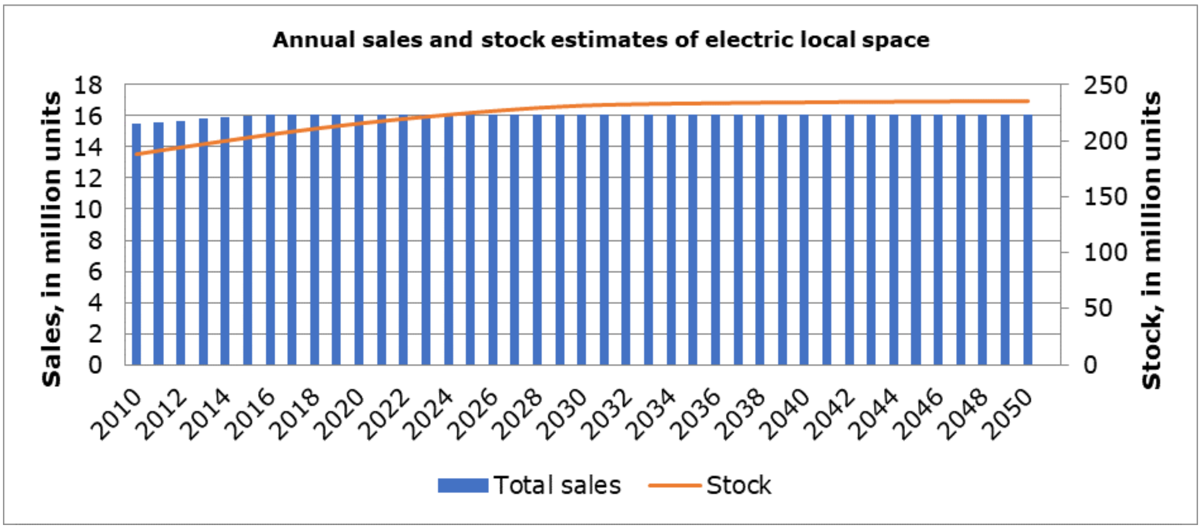


Figure 1: Total annual sales and stock of electric local space heaters. Source: Impact Assessment sales, information from stakeholders and Viegand Maagøe Stock model.

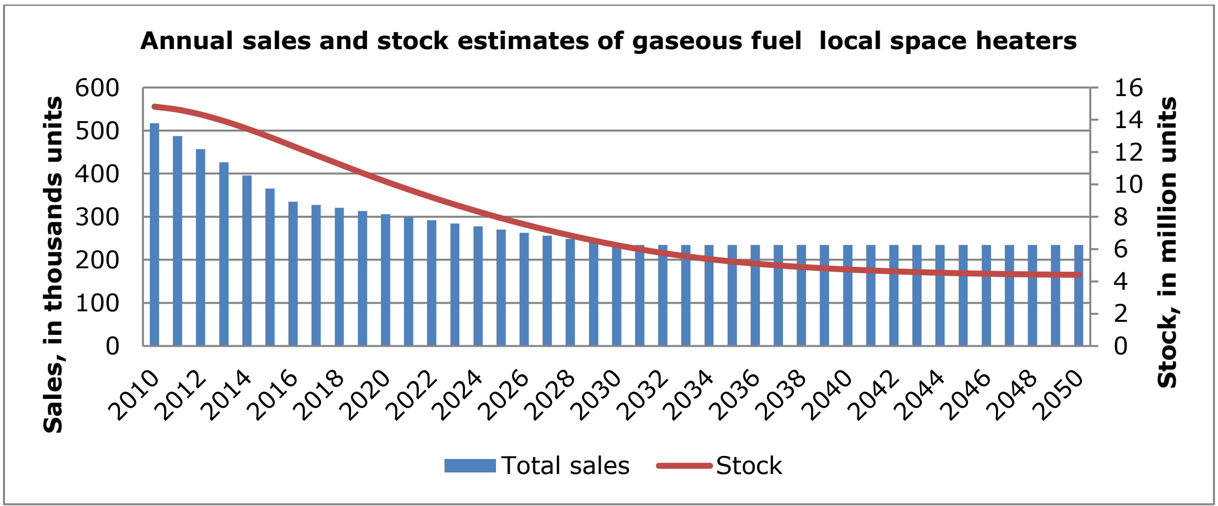


Figure 2: Total annual sales and stock of gaseous local space heaters. Source: Impact Assessment sales, information from stakeholders and Viegand Maagøe Stock model.

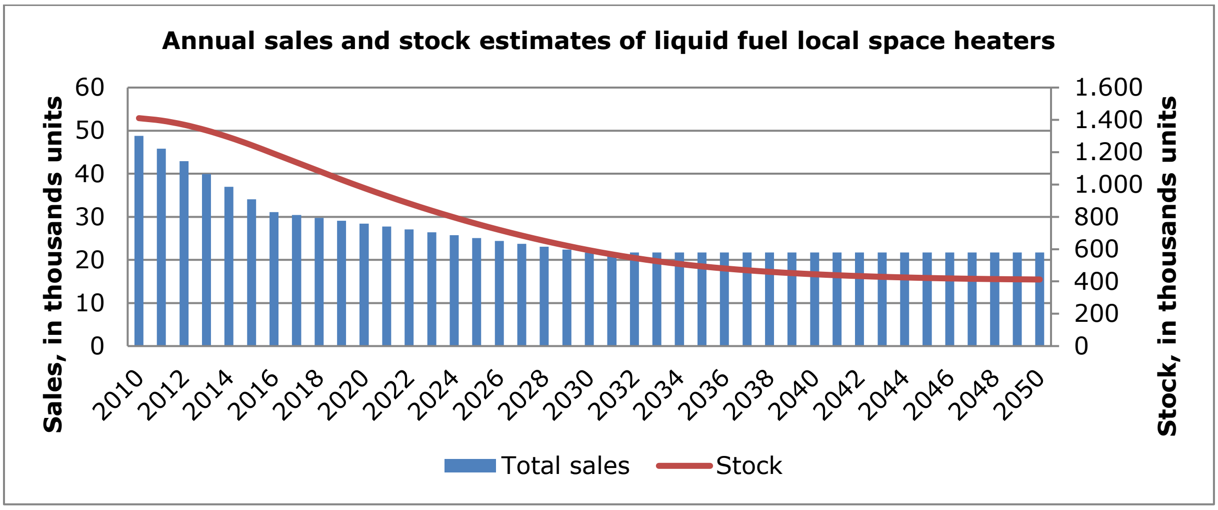


Figure 3: Total annual sales and stock of liquid local space heaters. Source: Impact Assessment sales, information from stakeholders and Viegand Maagøe Stock model.

Market trends

Generally, all electrical products are moving towards more refined controls and an increased number of control functions with more and more products being connected through Wi-Fi or other network connection types. For fixed electrical heaters a shift is also seen away from convector heaters towards radiators and towel rail heaters. For gas and liquid heaters, the sales are significantly lower than for electric, and the market shares of different product types fluctuates somewhat from year to year.

iii. Task 3

Climate (HDD)

The user heat demand for each product type is based on the heat demands defined in the preparatory study (and also used in the impact assessment), but updated for future years according to the development in Heating Degree Days (HDD) (Δ°C*days/year). HDDs are defined relative to a base temperature, meaning the outside temperature below which a building is assumed to need heating or cooling. The base temperature in EU is 15,5 °C[10]. This is the same for both domestic and commercial heating covered in Regulation (EU) 2015/1188, since they are all used for human comfort.

[10] European Environment Agency, Heating and cooling degree days, https://www.eea.europa.eu/data-and-maps/indicators/heating-degree-days , Created 19 Dec 2016 Published 20 Dec 2016 Last modified 21 Feb 2017. And https://ec.europa.eu/eurostat/cache/metadata/en/nrg_chdd_esms.htm

In order to use updated data and take into account the temperature development (especially with the consideration of changes due to climate change), the HDD data for 2000-2017 is used as baseline in this study[11]. Figure 15 shows the difference in HDDs between this average period and the period 1980-2004, which was used in the preparatory study, for the EU-28 countries and Norway. It is clear that the development towards warmer climate, which was taken into account in the preparatory study, continues.

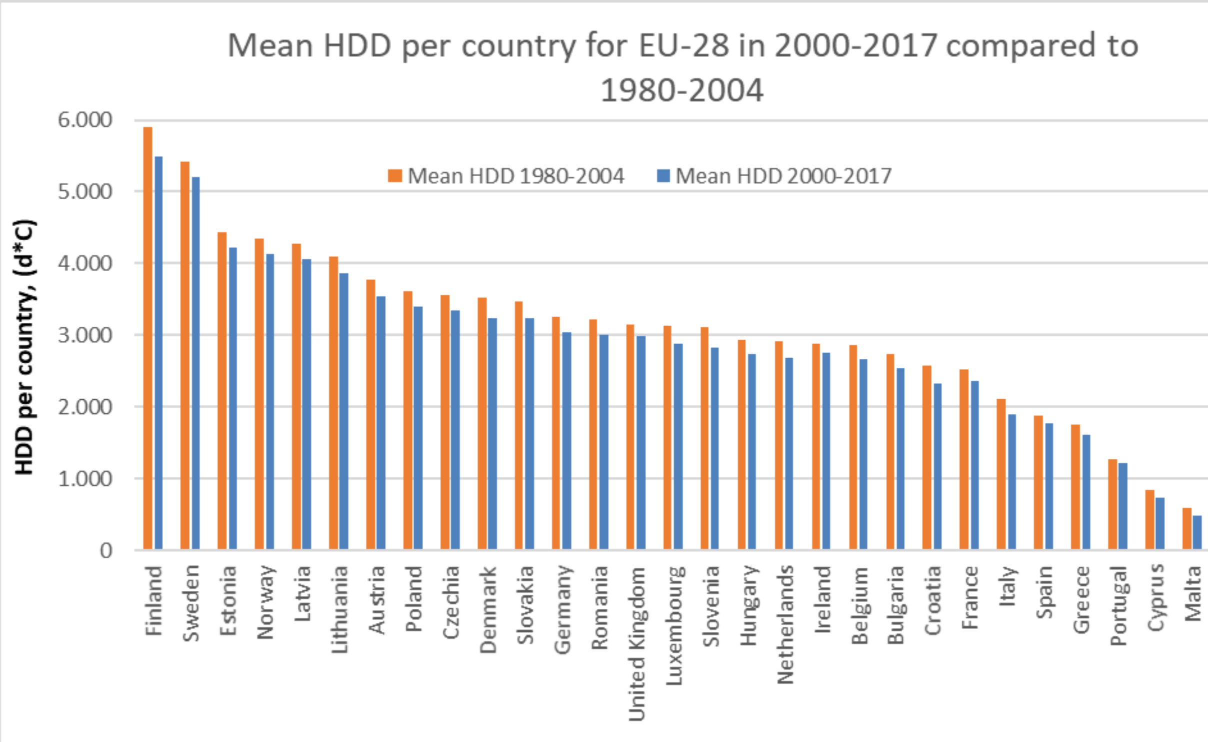


Figure 4: Average heating degree days for European countries in the period 1980-2004 (reference period in the preparatory study) and in the period 2000-2017 (reference period in this study).

Buildings

The building characteristics have a large influence on how the local space heaters are used. The main differentiation is made between commercial and domestic (including tertiary) settings of use. Furthermore, whether the room heater is used as a primary or secondary heating source, determines the temperature settings and the duration local room heating products are used. Table 1 and Table 2 shows the annual use hours for commercial and domestic local space heaters in 2018, based on the type of use and the HHDs presented above. These use patterns are similar to those in the preparatory study.

[11] Eurostat Cooling and heating degree days by country, code: nrg_chdd_a, https://ec.europa.eu/eurostat/web/products-datasets/product?code=nrg_chdd_a , Last update: 18/10/18. Note that the base temperature is set to a constant value of 15°C in the HDD calculation in the Eurostat database.

Table 1: Annual use hours (full hour equivalents) in commercial settings

Fuel type	Full load hour equivalents	Type of use pattern	Heating hours per year, 2018
Electric	Air curtains	Commercial	352
Gas and liquid	Luminous	Commercial	1.408
	Tube	Commercial	1.408

Table 2: Annual use hours (full hour equivalents) in non-commercial settings for primary and secondary heating

Fuel type	Local space heater type	Type of use pattern	Heating hours per year, 2018
Electric	Portable Electric	Secondary	550
	Fixed electric >250	Primary	1.408
	Fixed electric <250	Primary	1.408
	Electric storage heaters	Primary	1.408
	Electric underfloor	Equal secondary and primary	836
	Radiant	Primary	1.408
	Visibly glowing >1,2	Equal secondary and primary	819
	Visibly glowing <1,2	Equal secondary and primary	836
	Towel heaters	Equal secondary and primary	836
Gas and liquid	Open fronted	Equal secondary and primary	836
	Closed fronted	Equal secondary and primary	836
	Flueless	Secondary	264
	Open to chimney	Secondary	264

Infrastructure

The local infrastructure is important for the choice and use of local space heaters. This is both for practical reasons (how easy it is to install different types of local space heaters, the security of supply etc.), but also for political reasons, for example the share of renewable energy in the grid and incentive schemes from Member States. The power sector in the EU is in a transitional state, moving from fossil fuels to renewable energy, which challenges the existing infrastructure, but also gives rise to new opportunities.

Some countries, for example France and Norway have high shares of low carbon electricity in their national grids, and thus promote electric heaters, while others Member States still rely on fossil fuels for electricity production.

For the gas grid some Member States have decided on a long term cut down of natural gas consumption due to increasing reliability of imported natural gas (mainly from Russia) and increased focus on climate change mitigation. For the same reason, an increasingly high pressure is expected to be put on gas and oil driven appliances such as local space heaters.

For example, the Netherlands has decided that all residential buildings should be off natural gas in 2050. Other gas types, however, such as biogas could potentially increase.

End of Life

Due to the long lifetime of local space heaters it is very difficult to quantify any impacts of resource requirements if from setting resource requirements in the Ecodesign Regulation. If the products are more durable, it is uncertain whether the actual lifetime will increase, or consumers will still exchange them at the same rate, for example when they renovate. Also, the material composition of most local space heaters consists of different types of metal, which means that the product is highly recyclable, and a high share is properly already made of recycled metals, which there are a lot of in circulation.

iv. Task 4

Calculation of seasonal efficiency

No change is proposed, but it is recommended to define "seasonal efficiency" better in the Regulation, to not confuse with other terms such as thermal efficiency.

Efficiency levels

As the useful efficiency is per default 100% for the electric appliances, the options for achieving better seasonal energy efficiency are all on the controls side. The controls of electric local space heaters are already at advanced level. BNAT-technology is mainly focusing on taking advantage of the connectivity, interoperability and introducing more intelligence into controls.

Oil-fired closed-fronted heaters may have a useful efficiency slightly above 80%, which allow them to comply with current minimum requirements. For gas-fired closed-fronted heaters, the useful efficiency may exceed 88% whereas for compliant open-fronted heaters the useful efficiency may be as low as 52%.

For commercial local heaters, the thermal efficiency with reference to gross calorific value (GCV) can be 80% up to and even exceeding 84% for tube heaters. In case of luminous local space heaters, Commission Regulation (EU) No 2015/1188 is using a fixed value of 85,6% due to the difficulties of measuring the thermal efficiency in practice. In both cases, the thermal efficiency is a weighted value based on the thermal efficiency of more loads.

$\eta_{S,RF}$ is the emission efficiency which is based on the radiant factor of the commercial local space heater. The radiant factor is a weighted value based on the radiant factor of more loads. The emission efficiency can be less than 100% but will for compliant products typical be larger and up to and even exceeding 110%.

NO_x-emissions are expected to be less than the minimum requirements: 200 mg/kWh_{input}. However, limited data are available yet. A typical tube local space heater can have NOx-emissions of 130 mg/kWh_{input}.

BAT and BNAT

Commission Regulation (EU) No 2015/1188, article 6, provides indicative best available technology levels of local space heaters on the market for seasonal space heating energy efficiency (Table 3) and nitrogen oxide emissions (Table 4). As these BAT-levels were applicable by entry into force of the Regulation (2015), they are considered to be the same three years after.

Table 3: Seasonal space heating energy efficiency minimum requirement and indicative BAT

Local space heater Type	Calorific value Reference	Seasonal space heating energy efficiency	
		Minimum requirement	Indicative BAT
		%	%
Electric	-	31-38,5	> 39
Gas/liquid open fronted	NCV	42	65
Gas/liquid closed fronted	NCV	72	88
Gas/Liquid luminous	GCV	85	92
Gas/Liquid tube	GCV	74	88

Table 4: Nitrogen oxide emissions minimum requirement and indicative BAT

Local space heater Type	Calorific value Reference	Nitrogen oxide emissions	
		Minimum requirement	Indicative BAT
		mg/kWh_{input}	mg/kWh_{input}
Gas/liquid open and closed fronted	GCV NCV	130	50
Gas/Liquid luminous and tube	GCV	200	50

PEF

In the current regulation a conversion coefficient, CC = 2,5 is used for electric heaters to convert the electricity consumption at the point of operation to primary energy, taking into account the efficiency of the electricity production processes and distribution losses. It has been decided to revise this CC to 2,1 based on the advances and efficiency improvements in electricity production[12], which affects the primary energy calculation for electric local space heaters.

The minimum requirements for electric heaters should be scaled according to the new CC. Table 5 shows the requirements for electric local space heaters with the revised CC.

Table 5: Revised requirements for electric local space heaters based on the revised PEF / CC factor

Product category	Existing regulation requirements with CC=2,5	Revised regulation requirements with CC=2,1
Portable	36%	43,6%
Fixed >250 W	38%	45,6%
Fixed <250 W	34%	41,6%
Storage	38,5%	46,1%
Underfloor	38%	45,6%
Visibly glowing >1,2 kW	35%	42,6%
Visibly glowing <1,2 kW	31%	38,6%

v. Task 5

For local space heaters the use phase is the most dominant phase of the entire life cycle in terms of energy consumption and CO_2 emissions. However, the distribution of the environmental impacts varies considerably across the analysed Base Cases. For example, more than 90% of impacts of indicators is due to the use phase for some Base Cases, while for other Base Cases, the use phase and the material acquisition phase have similar contributions (even if distributed differently on the impacts). This is due to the influence of the input parameters such as the weight of the appliance, its lifespan and its power/fuel consumption. It is difficult to quantify the importance of different impact categories, but recently the focus has mainly been on energy consumption and emission of CO_2. Hence, the EU-28 aggregated environmental impacts only considers the primary electricity consumption of space heaters. The combined energy consumption of space heaters is presented in Figure 5.

[12] https://ec.europa.eu/energy/en/studies/review-default-primary-energy-factor-pef-reflecting-estimated-average-eu-generation

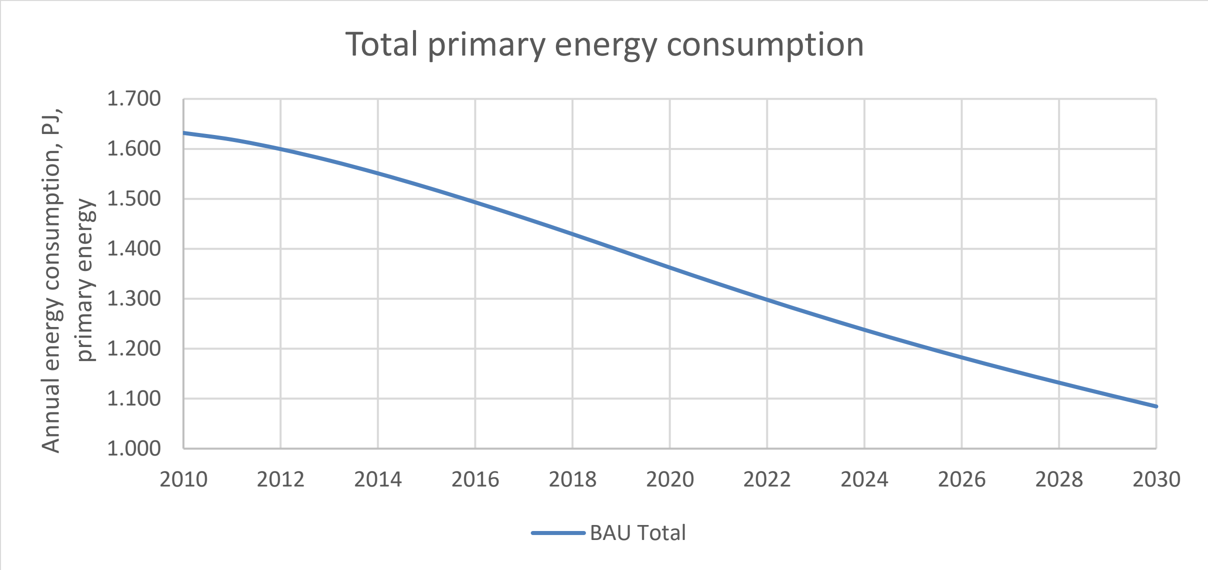


Figure 5: Combined energy consumption of the stock towards 2030

The combined energy consumption of all space heaters will account to above 1.500 PJ in 2018 resulting in 70 Mt CO2-eq emitted. The energy consumption is expected to decrease due to falling sales (gas and liquid), higher efficiency of space heaters and fewer heating degree days. The decrease in energy consumption it the use phase has also an impact on the total consumer expenditure which are expected to decrease towards 2030. The total consumer expenditure is presented in Figure 6.

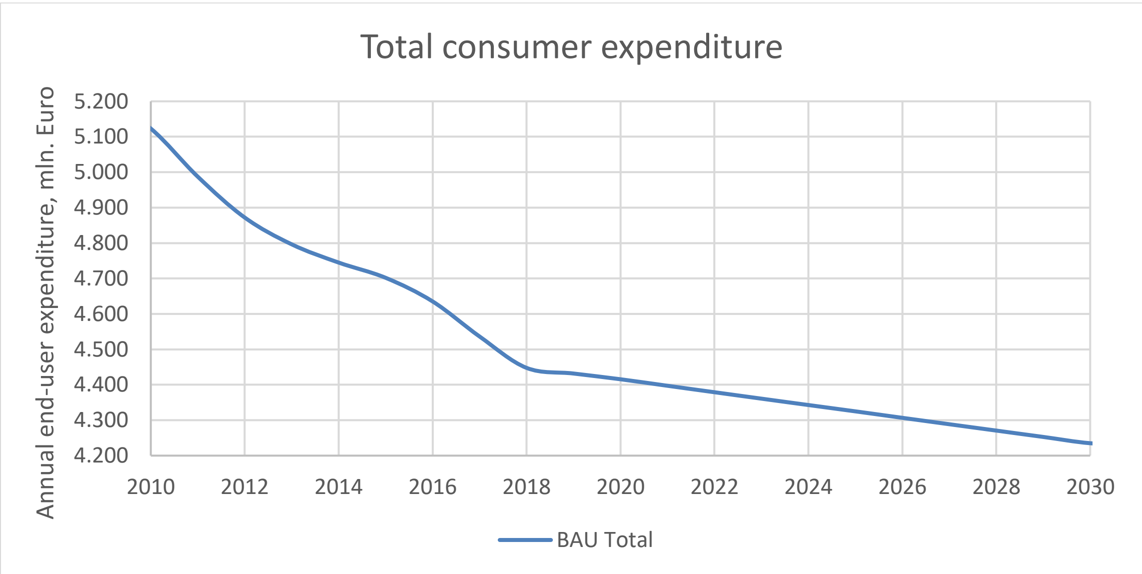


Figure 6: Annual consumer expenditure in EU28

Electric heaters have the greatest environmental and economic impacts as the sales and thus the stock is considerable higher for these appliances. The life cycle impacts and cost will serve as baselines or reference for the improvement options and policy scenarios assessment in Task 6 and 7.

vi. Task 6

Four possible design options were looked into in this task:

Auto programming

Automatic programming is one of the most advanced types of control options, in which the control reads the end-users' behaviour and use patterns and based on these inputs auto-programs periods of high and low temperatures. This type of control can be used with any device (gas/liquid/electricity) but requires electronic control.

The specific energy saving potential related to auto programming depends highly on user behaviour and especially the difference in end-user behaviour with this control option compared to without. Based on the size of the other correction factors and the fact that the auto programming build on top of other control functions and depends on these different sensors as well, it is suggested to add a maximum of 0,5% in bonus for this function. This could further be restricted only to devices that are connected to the internet, since these will inevitably have a better access to data on end-user behaviour.

Accuracy

Efficient temperature control could improve comfort and energy efficiency as users of dwellings tend to increase the temperature in case of uneven temperature distribution and draught the same goes for temperature fluctuations.

Lower energy consumption can be achieved with a more stable temperature and quicker response. This means the temperature set point can be lower since users do not need to add a "safety factor" to the setting. At the same time there would be fewer peaks with unintentional high temperatures and consequently higher heat loss. In general, high control accuracy requires electronic controls, which in itself gives a much higher accuracy than the mechanic thermostats, which has already been taken into account in the current Regulation (EU) 2015/1188. However, even between electronic thermostats the accuracy can vary.

A threshold could thus be set for the accuracy of the thermostat, where the good electronic thermostats with CA below 0,25 K could achieve an additional 0,5%-point in bonus through the correction factors.

Improved useful efficiency

There is quite large efficiency difference between different gas and liquid products on the market today. For example an open fronted heater with 52% useful efficiency (plus a two stage mechanical timer) can be compliant, whereas best types on market has combustion efficiencies around 71% or more (plus electronic controls). For the closed fronted local space heaters, the differences are smaller, with combustion efficiencies around 82% for the least efficient and 88% for the most efficient. However, the simple (and less efficient) gas appliances are often used in low income households, and are important in some member states to keep energy poverty rates from increasing and furthermore the domestic gas and liquid products are in scope of the Energy Labelling Regulation (EU) 2015/1186, which helps users make an informed choice and buy the most energy efficient products within their budget. The label will most likely pull the market towards higher efficiencies, but since both the regulations have been in force in less than one year, data of average energy levels for these products is still insufficient. Since the ecodesign is a market-entry threshold it is thus not recommended to set stricter ecodesign limits at this point.

For the commercial gas and liquid local space heaters, i.e. the tube and luminous heaters the efficiency range is smaller and the average level higher, with most products being above 90% combustion efficiency. An increase of for example 5%-points cause a decrease in fuel costs of around 5%. Due to the uncertainties in the calculations, especially due to uncertainties in the end-user behaviour and use pattern, as well the uncertainties regarding increases in purchase price, a lower LCC (Life Cycle cost) is not certain, and it is therefore not sufficient to recommend a stricter ecodesign requirement.

Furthermore, it is unlikely that the combustion efficiencies will increase any further since it is already very high, and BAT can therefore be expected to be the same as any BNAT in terms of energy efficiency, and the far majority of commercial local space heaters are already sold with advanced controls, making improvement potentials small for additional controls as well.

Resource efficiency options

Resource efficiency requirements are increasingly important as energy levels are decreasing across different ecodesign regulations. However, these requirements may become counterproductive for local space heaters as the lifetime already is quite long compared to other regulated products. If spare parts have to be available for 20 years or more, manufacturers need to store a considerable amount of spare parts which may never be used. In general, it is assumed that all local space heaters are durable products with few moving parts, which means that there is very limited wear and tear of these products.

Overall the design of local space heaters is fairly simple, and the material composition consists mostly of different types of metals. Metal are highly recyclable compared to other materials, which means that a high share of local space heaters is recycled at End-of-Life. Based on these considerations, no resource efficiency requirements are suggested for local space heaters.

vii. Task 7

Better regulation evaluation

The current regulation has been effective in reducing the electricity and fuel consumption, and GHG emission of local space heaters. The regulation has not led to the expected monetary savings for end-users, due to the highly discounted electricity price used in the review study and in this evaluation. However, it has been a monetary saving to end-users, though smaller than expected, and not resulted in extra costs. The effectiveness is set back by the scope exemptions.

The overall benefits of the Regulation seem to outweigh its costs, overall, but might not do so for each product type individually. The manufacturers have invested in improvements of the products, but it seems they have been able to pass the costs on to the end-users. In addition, the manufacturers would then have benefitted from an increased turnover compared to the situation without the regulations.

It is not possible to say clearly how much the increased performance has resulted in increased purchase prices for end-users and whether this is offset by the energy savings to result in lower total costs of ownership. This is due to the change in product categories and thus available data from the preparatory study over the impact assessment to the final regulation.

The regulation continues to be relevant for reducing the energy consumption and GHG emissions of local space heaters and contributes to achieve the targets in the EU 2030 Climate and Energy Policy Framework[13] and mitigate climate change and air pollution.

The Ecodesign Regulation prevents placing on the market of local space heaters with insufficient controls, making the products ineffective in use. Furthermore, it creates an increased incentive for manufacturers of gas and liquid fuel local space heaters to increase the combustion efficiency of the appliances.

[13] 2030 Climate and energy policy framework. Conclusion – 23/24 October 2014. EUCO 169/14. https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf

Policy option 1: Scope clarification

Based on the recommendations on scope suggested in section 1.5, this policy option suggest a range of changes, some of which affects the scope of the regulation, others are solely a question about wording, to make the regulation clearer. Those related solely to wording are:

- Re-phrasing the overall definition of local space heaters (section 1.5.1)
- Change the definition of air-heating appliances (section 1.5.1)
- Change the definition of "portable electric heaters" (section 1.5.2)
- Remove the "electric radiant heater" category (section 1.5.2)
- Change the definitions for commercial gas and liquid fuel heaters (section 1.5.3)

The changes that affects the scope and/or the requirements are the following:

- Include commercial gas and liquid heaters up to 300 kW according to reviewed standards (section 1.5.3)
- Remove the definition and exemption of slave heaters (section 1.5.1 and 1.5.2)
- Add information requirements to all heaters and controls sold unbundled (section 1.5.2)
- Include towel heaters in scope of the regulation (+/- 250 W) (section 1.5.2)
- Change the definitions for domestic gas and liquid fuel heaters (section 1.5.3)

Only the changes related to scope changes affect the energy consumption, and the energy levels are shown in Figure 7. With implementation of the scope changes in 2020, the total 2030 energy savings amount to 28 PJ/year in primary energy, corresponding to 1,3 MT CO_2/year, approximately 3%. The approximate user expenditure saving is 7,9 million € per year in 2030, or 0,2%.

While these energy savings are not very large, the most important aspect of this policy option is to clarify the scope of the Regulation and ensure a level playing field, by eliminating the loophole that the exemption of slave heaters constitute in the current Regulation.

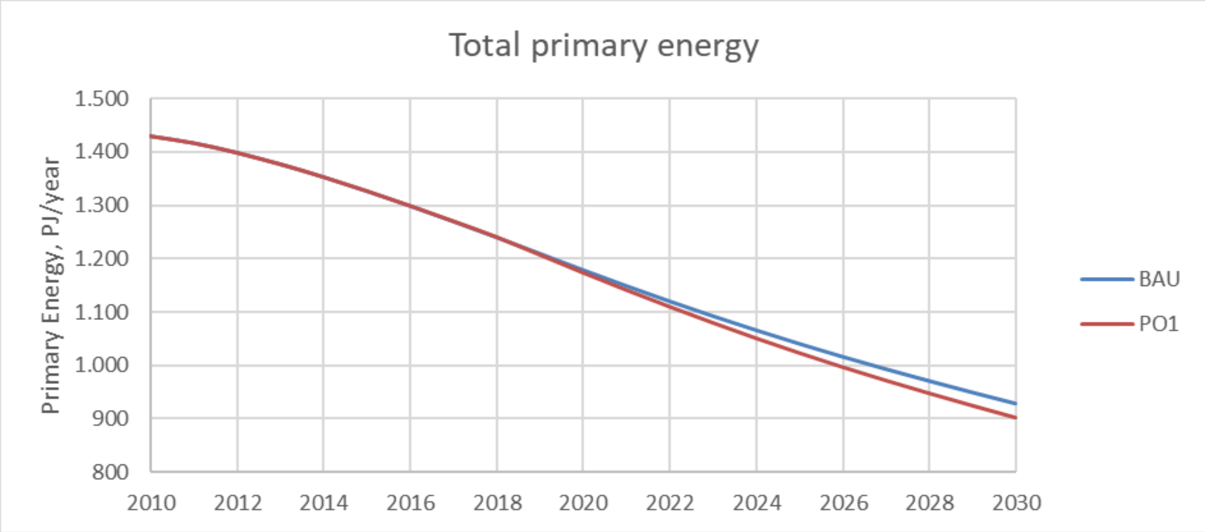


Figure 7: Primary energy consumption for all products in BAU and PO1 from 2010 to 2030 (with PEF 2.1)

Policy option 2: New correction factors

The correction factors could be extended to include the most recent advancement in controls, by including a bonus for high accuracy and for automatic programming.

In order to not surpass the 10%-point in the formula, the other correction factors would need to be adjusted as well. In this policy scenario it is assumed that the accuracy and auto programming will each account for an additional 0,5%-points, which will in turn mean a lesser bonus for the week timer. The existing and the suggested correction factors can be seen in Table 6 and Table 7.

Table 6: Current correction factors in the existing Regulation (EU) 2015/1188

F(2)	Portable	Fixed	Storage	Underfloor	Radiant	Gas/liquid
Single stage heat output, no room temperature control	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Two or more manual stages, no temperature control	1,0%	0,0%	0,0%	0,0%	2,0%	1,0%
With mechanic thermostat room temperature control	6,0%	1,0%	0,5%	1,0%	1,0%	2,0%
With electronic room temperature control	7,0%	3,0%	1,5%	3,0%	2,0%	4,0%
With electronic room temperature control plus day timer	8,0%	5,0%	2,5%	5,0%	3,0%	6,0%
With electronic room temperature control plus week timer	9,0%	7,0%	3,5%	7,0%	4,0%	7,0%
Contribution from F(1)			5%			

F(3)	Portable	Fixed	Storage	Underfloor	Radiant	Gas/liquid
With presence detection	1,0%	0,0%	0,0%	0,0%	2,0%	1,0%
With open window detection	0,0%	1,0%	0,5%	1,0%	1,0%	1,0%
With distance control option	0,0%	1,0%	0,5%	1,0%	1,0%	1,0%
With adaptive start control	0,0%	1,0%	0,5%	1,0%	0,0%	0,0%
With working time limitation	0,0%	0,0%	0,0%	0,0%	1,0%	0,0%
With black bulb sensor	0,0%	0,0%	0,0%	0,0%	1,0%	0,0%
Total	10,0%	10,0%	10,0%	10,0%	10,0%	10,0%

Table 7: Policy Option 2 Correction factors updated with accuracy and auto programming. New and changed factors are marked with light blue

F(2)	Portable	Fixed	Storage	Underfloor	Visibly glowing	Towel	Gas/ liquid
Single stage heat output, no room temperature control	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Two or more manual stages, no temperature control	1,0%	0,0%	0,0%	0,0%	2,0%	0,0%	1,0%
With mechanic thermostat room temperature control	6,0%	1,0%	0,5%	1,0%	1,0%	1,0%	2,0%
With electronic room temperature control	7,0%	3,0%	1,5%	3,0%	2,0%	3,0%	4,0%
With electronic room temperature control plus day timer	7,5%	4,5%	2,5%	4,5%	3,0%	4,5%	5,0%
With electronic room temperature control plus week timer	8,0%	6,0%	3,0%	6,0%	4,0%	6,0%	6,0%
Contribution from F(1)			5%				
F(3)	**Portable**	**Fixed**	**Storage**	**Underfloor**	**Visibly glowing**	**Towel**	**Gas/ liquid**
With presence detection	1,0%	0,0%	0,0%	0,0%	2,0%	0,0%	1,0%
With open window detection	0,0%	1,0%	0,5%	1,0%	1,0%	1,0%	1,0%
With distance control option	0,0%	1,0%	0,5%	1,0%	1,0%	1,0%	1,0%
With adaptive start control	0,0%	1,0%	0,5%	1,0%	0,0%	1,0%	0,0%
With working time limitation	0,0%	0,0%	0,0%	0,0%	1,0%	0,0%	0,0%
With black bulb sensor	0,0%	0,0%	0,0%	0,0%	1,0%	0,0%	0,0%
Automatic programming	0,5%	0,5%	0,5%	0,5%	0,0%	0,5%	0,5%
Accuracy	0,5%	0,5%	0,5%	0,5%	0,0%	0,5%	0,5%
Total	10,0%	10,0%	10,0%	10,0%	10,0%	10,0%	10,0%

The minimum requirements are expected to be kept unchanged, at the current levels. The suggested changes in correction factors are thus not expected to significantly change the average seasonal efficiencies on the market. However, it is assumed that the following products are run more efficiently with the automatic programming and better accuracy:

- Fixed heaters >250W (including the towel heaters sold as fixed heaters today)
- Electric storage heaters
- Electric underfloor heaters (those not sold as slave heaters)
- Electric visibly glowing radiant heaters >1,2 kW
- Gas and liquid closed fronted heaters

This assumption yields an annual energy saving of 1,6 PJ primary energy in 2030 (0,1 Mt CO2-eq/year), corresponding to a 0,2% saving. The energy savings alone are thus not large enough to justify this change in correction factors. However, the change ensures that the Regulation is brought up to date and incentivises the use of the most technologically advanced controls.

Policy option 3: Changes to formulas and expressions in the regulation

Policy option 3 includes the adjustments to formulas and expressions in the regulation that have been suggested by stakeholders in the study to clarify grey areas. These adjustments are primarily details that will make the regulation clearer, and none of them have any effect on the energy consumption or emissions. The changes investigated includes:

- Limits of factor F(1) for commercial heaters: Adding the following limits for the F(1) factor for commercial heaters: for two stage burners (2,5% ≤ F(1) ≤ 5,0%) and for modulating burners (0 % ≤ F(1) ≤ 5,0%)
- Change information requirements for commercial local space heaters from heat output to input. as this is more conventional
- Change the calculation of the F(4) correction factor for electric local space heaters
- Add information requirements on NOx for flueless heaters

The first change is solely a question of clarification and is recommended in order to not risk large negative values.

The second change is a matter of expressing efficiencies and emissions for commercial heaters based on heat output or heat input. The effort to change all expressions, formulas and correction factors in the regulation, however, is considered large compared to the benefit. It is thus not crucial to make this change, and it is not recommended now that calculation methods are in place to express efficiency and emissions based on heat output.

The last change is about the formula for calculating the F(4) correction factor for auxiliary electricity consumption for electric local space heaters. It is suggested to change it to the following:

$$F(4) = CC * \frac{\alpha * (el_{sb} + el_{idle} + el_{off})}{P_{nom}} * 100\%$$

Rather than being dependent on the compliance with the standby regulation, it is recommended to set limit values for each of the low power modes (idle, standby and off mode), and let the compliance with these values determine the α factor. If the consumption of the appliance is below all of these limits, α=0 and if not, α=1,3 (same values as today). This would mean that the fact that most heaters have no standby mode, would no longer mean that the idle and off modes are not considered.

Regarding flueless heaters it is it is recommended to consider product information of NO_x-emissions to be included in the regulation, in order to provide end users with health related information. The information should be displayed in the same places as the sentence 'This product is not suitable for primary heating purposes'.

viii. Conclusions

Based on the outcomes of the analyses in this report, it is recommended to follow Policy Option 1, as modelled in the above section, with the scope and definition changes described in task 1.

It is not recommended to follow Policy Option 2, because implementing the revised correction factors will have only limited contribution to energy savings and it is uncertain if it will have any impact at all. It is therefore not recommended to update any of the correction factors. It is recommended to follow Policy Option 3 with the exception of changing expression of efficiency and emissions for commercial local space heaters from heat output to heat input.

1. Scope and definitions

Task 1 follows the MEErP methodology and includes the following:

- Product scope: Identification and description of relevant product categories and definition of the product scope based on regulations and previous studies.
- Legislation: Update on relevant legislation on EU, Member State and third country level as well as relevant voluntary agreements.
- Test standards: Update on and description of relevant test and measurement standards on EU, Member State and third country level.
- Recommendations: Recommended changes to scope and definitions.

In each section the information from the preparatory study is updated to reflect the current situation.

1.1 Product scope

The review study builds on the scope of Regulation (EU) 2015/1188, which covers domestic local space heaters with a nominal heat output of 50 kW or less and commercial local space heaters with a nominal heat output of the product or of a single segment of 120 kW or less.

Exempted from the scope of the regulation are:

- Local space heaters using a vapour compression cycle or sorption cycle for the generation of heat driven by electric compressors or fuel
- Local space heaters specified for purposes other than indoor space heating to reach and maintain a certain thermal comfort of human beings by means of heat convection or heat radiation;
- Local space heaters that are specified for outdoor use only
- Local space heaters of which the direct heat output is less than 6 % of the combined direct and indirect heat output at nominal heat output
- Air heating products
- Sauna stoves
- Slave heaters

1.1.1 Categories and definitions in the Regulation

Regulation (EU) 2015/1188 establishes ecodesign requirements for local space heaters. The product definitions employed in the regulation are listed below, while more detailed explanations including pictures are given in Table 8.

Products and components that are within the scope of the Regulation are defined as:

Local space heater means a space heating device that emits heat by direct heat transfer or by direct heat transfer in combination with heat transfer to a fluid, in order to reach and maintain a certain level of human thermal comfort within an enclosed space in which the product is situated, possibly combined with a heat output to other spaces and is equipped with one or more heat generators that convert electricity or gaseous or liquid fuels directly into heat, through use of the Joule effect or combustion of fuels respectively.

Domestic local space heater means a local space heater other than a commercial one;

Commercial local space heater means either a luminous local space heater or tube local space heater;

Gaseous fuel local space heater means an open fronted local space heater or a closed fronted local space heater using gaseous fuel;

Liquid fuel local space heater means an open fronted local space heater or a closed fronted local space heater using liquid fuel;

Electric local space heater means a local space heater using the electric Joule effect to generate heat;

Open fronted local space heater means a local space heater, using gaseous or liquid fuels, of which the fire bed and combustion gases are not sealed from the space in which the product is fitted, and which is sealed to a chimney or fireplace opening or requires a flue duct for the evacuation of products of combustion;

Closed fronted local space heater means a local space heater, using gaseous or liquid fuels, of which the fire bed and combustion gases are sealed from the space in which the product is fitted, and which is sealed to a chimney or fireplace opening or requires a flue duct for the evacuation of products of combustion[14];

Electric portable local space heater means an electric local space heater, which is not an electric fixed local space heater, electric storage local space heater, electric underfloor local space heater, electric radiant local space heater, electric visibly glowing local space heater or slave heater;

[14] Note that in the Energy Label Regulation (2015/1186) the definition of closed fronted local space heater is formulated as ”… and combustion gases can be sealed from the space…”. However, the two definitions are de facto the same.

Electric fixed local space heater means an electric local space heater not intended to accumulate thermal energy and designed to be used while fastened or secured in a specific location or wall mounted and not incorporated in the building structure or building finishing;

Electric storage local space heater means an electric local space heater designed to store heat in an accumulating isolated core and to discharge it for several hours after the accumulation phase:

Electric underfloor local space heater means an electric local space heater designed to be used while incorporated in the building structure or building finishing;

Electric radiant local space heater means an electric local space heater in which the heat emitting element is to be directed towards the place of use so that its thermal radiation directly warms the subjects to be heated and which has a temperature rise of the grill covering the heat emitting element of at least 130 °C in normal use and/or a temperature rise of 100 °C for other surfaces;

Electric visibly glowing radiant local space heater means an electric local space heater in which the heating element is visible from outside the heater and has a temperature of at least 650 °C in normal use;

Sauna stove means a space heating product, incorporated in, or declared to be used in, dry or wet sauna's or similar environments;

Slave heater means an electric local space heater which is not capable of autonomous operation and needs to receive signals sent from an external master controller, not being part of the product but connected to it by pilot wire, wireless, power line communication or an equivalent technique, in order to regulate the emission of heat into the room in which the product is installed;

Luminous local space heater means a local space heater, using gaseous or liquid fuel[15] which is equipped with a burner; which is to be installed above head level, directed towards the place of use so that the heat emission of the burner, being predominantly infrared radiation, directly warms the subjects to be heated and which emits the products of combustion in the space where it is situated;

Tube local space heater means a local space heater, using gaseous or liquid fuel, which is equipped with a burner; which is to be installed above head level, near the subjects to be heated, which heats the space predominantly by infrared radiation from the tube or

[15] Stakeholders have informed the study team that no such thing as liquid fuel luminous heaters exists, however, this is the wording of the definition in the current regulation.

tubes heated by the internal passage of products of combustion and of which the products of combustion are to be evacuated through a flue duct;

Tube heater system means a tube local space heater comprising more than one single burner, of which the products of combustion of one burner may feed into a next burner, and of which the products of combustion of multiple burners are to be evacuated by a single exhaust fan;

Tube heater segment means a part of a tube heater system that comprises all the elements needed for standalone operation and as such can be tested independently of the other tube heating system parts;

Flueless heater means a local space heater using gaseous or liquid fuel emitting the products of combustion into the space where the product is situated, other than a luminous local space heater;

Open to chimney heater means a local space heater using gaseous or liquid fuels intended to sit under a chimney or in a fireplace without sealing between the product and the chimney or fireplace opening, and allowing the products of combustion pass unrestricted from the fire bed to the chimney or flue;

Air heating product means a product providing heat to an air-based heating system only that can be ducted and is designed to be used while fastened or secured in a specific location or wall mounted which distributes the air by means of an air moving device in order to reach and maintain a certain level of human thermal comfort within an enclosed space in which the product is situated;

Direct heat output means the heat output of the product by radiation and convection of heat, as emitted by or from the product itself to air, excluding the heat output of the product to a heat transfer fluid, expressed in kW;

Indirect heat output means the heat output of the product to a heat transfer fluid by the same heat generation process that provides the direct heat output of the product, expressed in kW;

Indirect heating functionality means the product is capable of transferring part of the total heat output to a heat transfer fluid, for use as space heating or domestic hot water generation;

Nominal heat output (P_{nom}) means the heat output of a local space heater comprising both direct heat output and indirect heat output (where applicable), when operating at the setting for the maximum heat output that can be maintained over an extended period, as declared by the manufacturer, expressed in kW;

Minimum heat output (P_{min}) means the heat output of a local space heater comprising both direct heat output and indirect heat output (where applicable), when operating at the setting for the lowest heat output, as declared by the manufacturer, expressed in kW;

Maximum continuous heat output ($P_{max,c}$) means the declared heat output of an electric local space heater when operating at the setting for the maximum heat output that can be maintained continuously over an extended period, as declared by the manufacturer, expressed in kW;

Intended for outdoor use means the product is suitable for safe operation outside enclosed spaces, including possible use in outdoor conditions;

Equivalent model means a model placed on the market with the same technical parameters set out in Table 1, Table 2 or Table 3 of point 3 of Annex II as another model placed on the market by the same manufacturer;

Nominal heat output limitations: the scope for local space heaters is limited to "domestic local space heaters with a nominal heat output of 50 kW or less and commercial local space heaters with a nominal heat output of the product or of a single segment of 120 kW or less";

Examples of Local Space Heaters

As seen from the product scope and definitions, regulation 1188/2015 encompasses a varied group of local space heating devices. Figure 8 gives a visual overview of the various local space heater types included in the regulation, as well as the solid fuel local space heaters, covered by Regulation 1189/2015. Furthermore, Table 8, gives examples of products belonging to each of the defined categories.

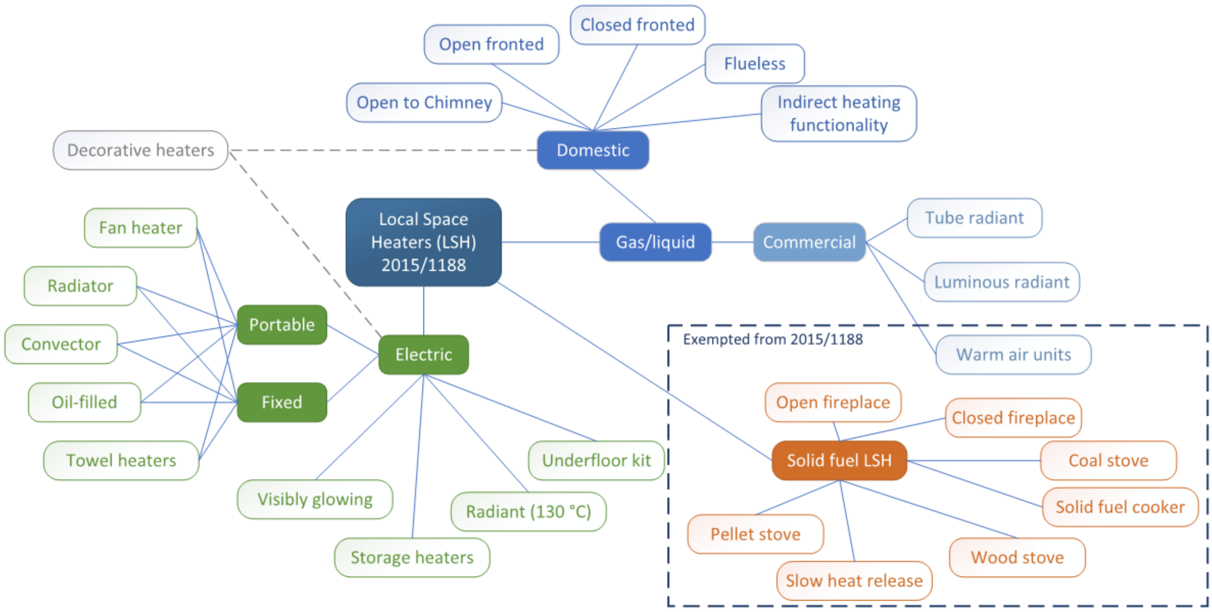
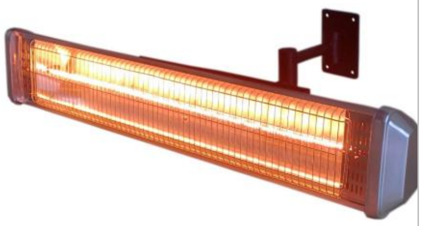


Figure 8: Graphical presentation of local space heaters (LSH) within the scope of Regulation EU 2015/1188.

Table 8. Overview of products in scope of or adjacent to the current scope of Regulation (EU) 2015/1188. Pictures are examples of products, but the appearance can vary significantly within each category.

Fuel	Product category	Definitions and explanations
Electric	Electric fixed local space heaters Two categories in the regulation: >250 W ≤250 W	Fixed heaters are attached to the wall and not capable of storing thermal energy. Fixed heaters can use different technologies to disseminate the heat to the room, the most common being oil-filled radiators, convectors and fan heaters which are briefly described below. Regardless of technology, electrical fixed heaters have ecodesign requirements based on their size.
	Portable electric heaters 	Portable heaters can be moved between rooms depending on heat requirements and are not fastened to any surface. Portable heaters can in principle use the same technologies as fixed heaters (oil-filled radiators, radiant heaters, convectors and fan heaters) to disseminate heat.

	Oil-filled radiator 	Oil-filled heaters have a similar look to water-based radiators. These types of heaters are filled with oil, which have excellent properties as a heat transferring medium from the heat element to the outer casing, as the oil can be heated a lot before it vaporises and due to the high heat capacity of the oil the radiator will continue to emit heat for a little while after the mains are switched off.
	Electric convector 	Electric convectors use the principle of natural convection to heat the ambient air. An electric resistive heating element inside the convector produces heat. The air in contact with the convector surface heats up and becomes lighter, rising up. The heat is diffused throughout the room and the ambient temperature can be controlled.
	Radiant heaters 	Radiant heaters emit infrared waves that pass through the air until they reach a surface at which point the energy is turned into heat. As the heating plates also warm up the external surfaces of the appliance, they also create convective heating. Even though many heating appliances emit radiant heat, the category Radiant heaters have a temperature rise of the grill covering the heat emitting element of at least 130 °C in normal use and/or a temperature rise of 100 °C for other surfaces. These heaters can e.g. be electric radiant cassettes which are mounted on the ceiling and are suitable for large rooms.
	Fan heater 	A fan heater induces forced convection using an electric fan to speed up the airflow. This reduces the thermal resistance between the heating element and the surroundings, allowing heat to be transferred more quickly. They draw in air and warm it over a resistive element, then blow it back into the space to be warmed.
	Towel and room heater 	Towel heaters used to also heat the room they are installed in, is a specific case of a special use of local space heaters, utilising one or more of the technologies for delivering heat that are described above. Towel heaters do not have their own category in the regulation, and are thus categorised as fixed/portable heaters, if they also deliver heat to the room. Towel heaters are normally not included in the scope because often their only purpose is to dry towels. According to the Regulation, if a towel heater is not capable of heating a room or if it is specified for purposes other than indoor space heating for human comfort, it is

		not covered by the Regulation, and cannot be marketed as a local space heater.
	Storage heater 	A storage heater is an electrical appliance which stores heat inside the heater. This may be useful if base load electricity is available at a low price, usually during the night, where it can heat up the storage and release the heat during the day. Heat is usually stored in clay bricks or other ceramic material because of its low cost and high specific heat capacity. Even though storage heaters are usually permanent, they do not fall under the “fixed” category in the regulation but have their own specific requirements.
	Electric visibly glowing radiant heaters 	Glowing radiant heaters are also known as strip or bar heaters that heat objects with infrared waves. These heaters use electric elements packed inside a quartz glass tube or a halogen lamp and radiates heat to warm people and objects and are therefore best at spot heating. Visibly glowing heaters have their own category in the regulation with their own specific ecodesign requirements.
	Under floor 	Electric thin film and cable heating systems are thin electric heating cables or mats that can be installed under floor surfaces, such as tiles, concrete, carpets, vinyl and hardwood, or less commonly also in the ceiling and in the wall. Underfloor heating systems have their own category in the regulation with their own specific ecodesign requirements.
	Electric space heaters with a decorative effect 	Electrical fires are decorative local heating devices that imitate the appearance of solid fuel fireplaces. The heat is provided in the same way as convector heaters whilst the flickering flame effect is created by electrical lights. Their heat output is typically in the range of 0,5-2,4 kW. The decorative characteristics of a heater are not a criterion to determine whether the product is in the scope of the Regulations or not: the decisive element is whether the heater is capable to reach and maintain a certain level of thermal comfort within an enclosed space in which the product is situated. If it is capable of doing so, it is covered by the Regulations, independent of its decorative aspects.

Gas/liquid	Gas/liquid heaters	Gas and liquid heaters are combustion type room heaters that burn either gaseous or liquid fuel to produce heat. The most common type of gas is natural gas although many types can be adapted to LPG or other types of gas. The liquid heaters are often bio ethanol, oil or paraffin. The produced heat is distributed by both radiation and natural convection or by forced convection when the heater it is fan-assisted.
	Open fronted 	Open fronted means heaters where the supply of air comes from the room and fire bed and combustion gases are not sealed from the room. They are sealed to a chimney, fireplace opening or a flue duct for the evacuation of combustion air. Note that the description is in line with the regulation and the preparatory study uses a slightly different definition. Open fronted gas/liquid fuel heaters have their own specific ecodesign requirements.
	Closed fronted 	Closed fronted heaters are also sealed to a chimney, fireplace opening or a flue duct for the evacuation of combustion air. Contrary to the open fire heaters, the front of the heater is sealed from the room and the fire bed and combustion gasses are sealed from the room. Note that the description is in line with the regulation and the preparatory study uses a slightly different definition. Closed fronted gas/liquid fuel heaters have their own specific ecodesign requirements.
	Flueless fire heaters 	Flueless fires are easier and cheaper to install than flued fires. These products emit their combustion directly in the room it is situated in because the fuels used results in cleaner burning. Due to safety there are some restrictions on the use of flueless heaters e.g. there must be an air opening in the room and flueless heaters must be equipped with an oxygen depletion sensor. Note that luminous heaters are not considered as flueless heaters. Flueless heaters only have information requirements in the regulation, but no efficiency or emission requirements.
	Open to Chimney heaters 	Open to Chimney heaters are often placed in old wood fire places or the like, where there is an open connection to the chimney, which is not sealed from the room. Open to Chimney local space heaters are therefore often decorative in appearance with open flames. For open to chimney heaters the only requirements are information requirements.

	Cookers 	Cookers are local space heaters with an indirect heating functionality, but with cooking (hob/oven) as the primary function. They are sealed to a chimney, fireplace opening or a flue duct for the evacuation of combustion air. Though most common in connection with solid fuels, some might use gas or liquid fuels. These products are not covered by Regulation 2015/1188.
	LSH with indirect heating functionality 	Local space heaters with indirect heating functionality are products capable of transferring part of the total heat output to water, for use as space heating or domestic hot water generation. Note that if is less than 6% of the total heat output is used for room heating at nominal load, these products are exempted from the regulation. Furthermore, these appliances are mostly used with solid fuels.
	Decorative fires 	Decorative fires are not a specific group of products in the regulation, but can be either open or closed fires and might have ceramic or other materials to mimic burning wood. Decorative fires shall comply with the requirements for either open fronted or closed fronted heaters.
Gas/liquid Commercial heaters	Commercial heaters	In the regulation, commercial heaters are defined very precisely as gas or liquid fuel heaters that are either luminous heaters or tube heaters, as described below. All other types consequently fall under the definition "domestic".
	Luminous heaters 	Luminous heaters are a type of radiant gas heaters predominantly used at industrial premises. Radiant heaters work by heating e.g. a ceramic material by burning gas or liquid fuel and emitting the heat rays towards people and objects in the room form the heated material.
	Tube heaters 	Tube heaters are a type of radiant gas heaters predominantly used at industrial premises. Radiant heaters work by heating a material by burning gas, thus emitting heat rays towards people and objects in the room. The tube heater is equipped with a single burner, placed in a tubular enclosure, which heats up due to the combustion taking place; which is to be placed near the place of use.

1.1.1 PRODCOM categories

The official source of market and stock data is the Eurostat PRODCOM database[16], which is based on data collected from Member States in pre-defined manufactured goods categories that are standardised across the EU thus allowing comparability across borders. According to the MEErP methodology PRODCOM is the official data source to be used in ecodesign studies. A number of PRODCOM codes are related to local space heaters and associated products. However, there is a mismatch between categories in PRODCOM in the Regulation. This makes it unclear exactly which products are covered under the different categories, shown in Table 9. Furthermore, the PRODCOM data encompasses more products than the scope of the regulations[17], which makes it unsuitable as data source for the markets of the local space heater product categories defined in the Regulation.

Table 9: PRODCOM codes and nomenclature

Code	PRODCOM Nomenclature – (NACE Rev 2, from 2007)
27.51.26.30	Electric storage heating radiators
27.51.26.50	Electric radiators, convection heaters and heaters or fires with built-in fans
27.51.26.90	Other electric space heaters
27.52.12.33	Iron/steel gas domestic appliances with an exhaust outlet (including heaters, grates, fires and braziers, for both gas and other fuels; excluding cooking appliances
27.52.12.35	Iron/steel gas domestic appliances (including heaters, grates, fires and braziers, for both gas and other fuels radiators; excluding cooking appliances and plate warmers, those with an exhaust outlet)
27.52.12.50	Iron or steel liquid fuel domestic appliances, including heaters, grates, fires and braziers (excluding cooking appliances and plate warmers)
27.52.13.00	Air heaters/hot air distributors n.e.c.18, of iron or steel, non- electric

1.2 Legislation

There are several pieces of environmental legislation which either directly or indirectly address products within the scope of this review project. This section will present the relevant legislation both inside and outside of EU that has been updated since the preparatory study (2012), whereas relevant legislation from before 2012 are mentioned in Annex A.

[16] http://ec.europa.eu/eurostat/web/prodcom/data/database
[17] DG Energy and Eurostat are cooperating to adapt the categories PRODCOM to the Regulation. First results are due in 2019.
[18] Not elsewhere classified

1.2.1 EU legislation

EU Regulation 2015/1188/EU - Ecodesign Requirements for local space heaters[19]

The Ecodesign Directive (2009/125/EC) [20] is the framework directive under which a number of product specific ecodesign regulations are implemented, including the Regulation (EU) 2015/1188 implementing ecodesign requirements for local space heaters.

Regulation (EU) 2015/1188 are presented in detail below to give an overview of the requirements. The Regulation includes requirements on the following aspects:

- Requirements on the seasonal space heating energy efficiency
- Requirements on emission of NOx from liquid and gaseous fuel local space heaters
- Information requirements

The efficiency and NOx emission requirements are summarised in Table 10.

Table 10: Overview of requirements for different product types in regulation 2015/1188

Fuel	Type	Seasonal space heating energy efficiency requirement	Emissions of NOX requirement
Electric	Fixed > 250 W	> 38 %	Not applicable
	Fixed ≤ 250 W	> 34 %	
	Storage	> 38,5 %	
	Portable	> 36 %	
	Underfloor	> 38 %	
	Radiant	> 35 %	
	Visible glowing > 1,2 kW	> 35 %	
	Visible glowing ≤ 1,2 kW	> 31 %	
Gas/liquid	Open fronted	42 %	≤ 130 mg/kWhinput
	Closed fronted	72%	≤ 130 mg/kWhinput
	Luminous (gas only)	85 %	≤ 200 mg/kWhinput
	Tube	74 %	≤ 200 mg/kWhinput

When calculating the seasonal space heating energy efficiency (η_S) for domestic local space heaters, the measured values (expressed as efficiency in active mode, $\eta_{S,on}$) are subtracted 10%-points in the calculation shown below. The 10%-points can then be achieved via the correction factors in Table 11. No subtraction is made when calculating efficiency of commercial space heaters, as seen in the formula below, but for these products the correction factors all contribute negatively.

[19] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02015R1188-20170109&from=EN s
[20] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0125&from=EN

For domestic: $$\eta_S = \eta_{S,on} - 10\% + F(1) + F(2) + F(3) - F(4) - F(5)$$

For commercial: $$\eta_S = \eta_{S,on} - F(1) - F(4) - F(5)$$

Table 11: Overview of correction factors in the current Regulation[21]

Factor	Description	Possible values		
		Control type	Electric storage	Gas/liquid commercial
F(1)	Attribution to efficiency due to options for adjusting heat output (positive contribution for electric storage heaters, negative contribution for commercial heaters)	Single stage Two-stage Modulating	0,0% 2,0% 3,5%	5% ≥2,5% ≥5%
			Electric	Gas/liquid
F(2)	Attribution to efficiency due to controls of indoor heating comfort. Mutually exclusive: cannot be added (For domestic only)	1 stage manual	0%	0%
		≥2 stages manual	0-2%	1%
		Mechanic control	0,5-6%	2%
		Electronic control	1,5-7%	4%
		Electronic control+ day timer	2,5-8%	6%
		Electronic control+ week timer	3,5-9%	7%
			Electric	Gas/liquid
F(3)	Attribution to efficiency due to controls of indoor heating comfort. Can be added. (For domestic only)	Presence detection	0-2%	1%
		Open window detection	0-1%	1%
		Distance control option	0-1%	1%
		Adaptive start control	0-1%	0%
		Working time limitation	0-1%	0%
		Black bulb sensor	0-1%	0%
		Electric	Gas/liquid	
F(4)	Negative contribution due to auxiliary electricity use in on- and standby-mode	Based only on standby electric power	Based on electric power in standby, at nominal and at lowest load	
F(5)	Negative contribution due to permanent pilot flame power requirement	Not applicable	Based on pilot flame power	

[21] This is a simplified overview of the factors. Detailed formulas etc. can be seen in Regulation 2015/1188 Annex III

EU Regulation (EU) 2015/1186 - Energy labelling of local space heaters[22]

Local space heaters with a nominal heat output of 50 kW or less will be sold with energy labels from 2018. The rating scale ranges from A++ (most efficient, only applicable to solid fuel local space heaters that use pellets) to G (least efficient). Note that regulation have the following exemptions:

(a) Electric local space heaters;

(b) Local space heaters using a vapour compression cycle or sorption cycle for the generation of heat driven by electric compressors or fuel;

(c) Solid fuel local space heaters that are specified for the combustion of non-woody biomass only;

(d) Local space heaters specified for purposes other than indoor space heating to reach and maintain a certain thermal comfort of human beings by means of heat convection or heat radiation;

(e) Local space heaters that are specified for outdoor use only;

(f) Local space heaters of which the direct heat output is less than 6 % of the combined direct and indirect heat output at nominal heat output;

(g) Solid fuel local space heaters that are not factory assembled, or are not provided as prefabricated components or parts by a single manufacturer which are to be assembled on site;

(h) Luminous local space heaters and tube local space heaters;

(i) Air heating products;

(j) Sauna stoves.

Electric local space heaters are not part of the labelling scheme.

EU Directive 2014/35/EU - Low Voltage Directive[23]

The Low Voltage Directive (LVD) ensures that electrical equipment (including electric local space heaters) that operates within certain voltage limits, provides a high level of protection. The LVD Directive covers all health and safety risks of electrical equipment operating with a voltage of between 50 and 1000 volts for alternating current and between 75 and 1500 volts for direct current. Consumer goods with a voltage below 50 for alternating current or 75 for direct current are covered by the General Product Safety Directive (GPSD) (2001/95/EC).

[22] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02015R1186-20170307&from=EN
[23] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:374:0010:0019:en:PDF and http://ec.europa.eu/growth/sectors/electrical-engineering/lvd-directive_en

EU Directive 2014/30/EU - Electromagnetic Compatibility Directive[24]

The Electromagnetic Compatibility Directive (EMC) Directive has the primary aim of protecting the electromagnetic spectrum. The Directive requires that products must not emit unwanted electromagnetic interference and must be protected against a normal level of interference. The vast majority of complete electrical products must comply independent of whether they are mains or battery powered. The EMC Directive does contain exemptions for a range of components with no intrinsic function and some products that are already covered by other directives such as medical, military and communications equipment.

Directive 2014/53/EU – Radio Equipment Directive[25]

The Radio Equipment Directive (RED) covers products that emit or receive radio wares in order to communicate or for radiodetermination (i.e. determination of positions and/or velocity). This also includes when radio signals are used to remotely control a device, and therefore electric heaters equipped with radio controls are covered. It ensures equivalence of the covered radio interfaces and their conditions of use to reduce barriers for the access of radio equipment to the internal market.

EU Directive 2018/844 - amending the existing Directive 2010/31/EU on Energy Performance of Buildings[26]

The EU Directive 2018/844 entered into force in 2018, amending the existing Directive 2010/31 on Energy Performance of Buildings. The new Directive introduced targeted amendments to EU Directive 2010/31. The aim of the directive is to accelerate the cost-effective renovation of existing buildings, with the vision of a decarbonised building stock by 2050 and the mobilisation of investments. The revision also supports electromobility infrastructure deployment in buildings' car parks and introduces new provisions to enhance smart technologies and technical building systems, including automation. Directive 2010/31 on Energy Performance of Buildings is described in Annex A.

EU Directive 2018/2001 – The revised Renewable Energy EU Directive[27]

The revised Renewable Energy EU Directive 2018/2001 establishes a binding EU target of at least 32% for 2030 with a review for increasing this figure in 2023. The rules serve also to create an enabling environment to accelerate public and private investment in innovation and modernisation in all key sectors. It aims to provide guiding principles on financial support schemes for RES, renewable energy self-consumption, energy communities and

[24] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0030 and http://ec.europa.eu/growth/sectors/electrical-engineering/emc-directive_en
[25] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0053
[26] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0844&from=EN
[27] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

district heating. It seeks to enhance mechanisms for cross-border cooperation, simplify administrative processes, strengthen the sustainability and greenhouse gas emissions-savings criteria for biofuels, and mainstream the use of RES in the transport sector and in the heating and cooling sector.

EU Directive 2018/2002[28] amending EU Directive 2012/27 on energy efficiency

The revised Energy Efficiency Directive (EU) 2018/2002 sets a 2030 target of 32.5%, with a possible upward revision in 2023. This means that EU countries must put measures in place to save on average 4.4% of their annual energy consumption between now and 2030. The aim of the revised directive will ensure more efficient use of energy and lead to:

- reduced energy consumption for households and businesses
- lower consumption, making Europe less reliance on energy imports
- incentives for producers/manufacturers to use new technologies and innovate
- more investment, for example in the building sector, thereby creating jobs
- clearer information in household bills

Regulation (EU) 2018/1999 – The new Governance Regulation[29]

The new Governance Regulation (EU) 2018/1999 includes the requirement for Member States to draw up integrated National Energy and Climate Plans for 2021 to 2030 outlining how to achieve the targets and submit the draft to the European Commission by the end of 2018. The overall goals of the new regulation are:

- to implement strategies and measures which ensure that the objectives of the energy union, in particular the EU's 2030 energy and climate targets, and the long-term EU greenhouse gas emissions commitments are consistent with the Paris agreement.
- to stimulate cooperation between Member States in order to achieve the objectives and targets of the energy union
- to promote long-term certainty and predictability for investors across the EU and foster jobs, growth and social cohesion
- to reduce administrative burdens, in line with the principle of better regulation. This was done by integrating and streamlining most of the current energy and climate planning and reporting requirements of EU countries as well as the Commission's monitoring obligations
- to ensure consistent reporting by the EU and its Member States under the UN Framework Convention on Climate Change and the Paris agreement, replacing the existing monitoring and reporting system from 2021 onwards.

[28] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2002&from=EN
[29] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R1999&from=EN

Regulation (EU) 2016/426 – Gas Appliance Regulation[30]

The Gas Appliance Regulation (GAR) is a framework regulation placing on the market and putting into service of gas appliances and their fittings. The definition of "gaseous fuel" in the GAR is "any fuel which is in a gaseous state at a temperature of 15°C under an absolute pressure of 1 bar". That means that LPG is a gaseous fuel and radiant tube and luminous heaters are thus covered under the GAR. It became fully applicable as of 21 April 2018, replacing the previous Directive 2009/142/EC. The GAR clarifies the requirements that different types of gas appliance and fitting has to fulfil and sets requirements to safety of gas fired products and deals with energy efficiency when no ecodesign regulation applies to a product. However, for gas local space heaters, the energy efficiency is handled in Regulation 2015/1188.

1.2.2 Alignment with other space heating product regulations

There are several types of equipment available on the market which all are categorised as products for "space heating". These space heating products and corresponding regulations are presented in Figure 9. For simplicity, the figure categorises the different products into:

- central heating or local (non-central) heating products;
- hydronic systems or dry systems products;
- heating or cooling.

Local space heaters have the heat generator in the same room as the room that needs heating, while central space heaters are split so that the heat generator is located in another room.

[30] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016R0426

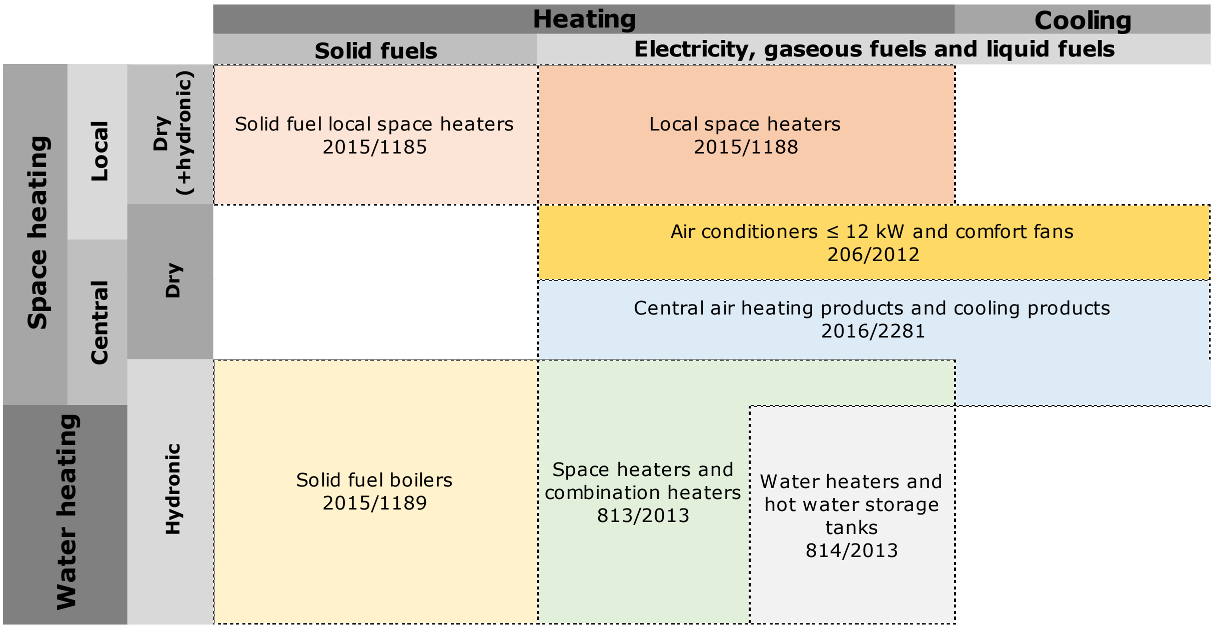


Figure 9: Division of the different products for space heating into sub-categories with reference to the relevant Regulation number[31].

As Figure 9 shows, there are multiple EU Regulations dealing with different types of space heating devices and local space heaters are just one type of technology used for room heating. The Regulations that cover products with the largest resemblance in service provision to products covered by Regulation (EU) 2015/1888 are Regulation (EU) 2015/1185, Regulation (EU) 206/2012, Regulation (EU) 2016/2281 and Regulation (EU) 813/2013.

Many of the products presented in the different regulations are all suitable for room heating. Their scopes are described below and generally align well with the scope of Regulation 2015/1188 in order to avoid overlaps and gaps. However, some specific product types are not covered by any of the Regulations. The different products and the Regulations they are covered by are listed in Table 12.

Table 12: Overview of different products suited for local space heating and of their inclusion in existing Ecodesign and Energy Labelling Regulations

Products in scope			
Usual product names	Capacity threshold	Ecodesign Regulation	Labelling regulation
Local space heaters, except commercial – See Table 8	≤50 kW (domestic) ≤120 kW (commercial)	2015/1188	2015/1186 (electric and commercial exempted)
Solid fuel local space heaters	≤ 50 kW	2015/1185	2015/1186

[31] http://www.eceee.org/static/media/uploads/site-2/Ecodesign/products/lot-20-local-room-heating-products/bio-eup-lot20-task-1-final-report.pdf

Products in scope			
Usual product names	Capacity threshold	Ecodesign Regulation	Labelling regulation
Air conditioners - Split, multi-split, window, through-the-wall, double duct, single ducts, Ventilation exhaust air-to-air	≤ 12 kW	206/2012	626/2011
Air conditioners - Split, multi-split, VRF, Rooftop, water cooled heat pumps, Ventilation exhaust air-to-air	> 12 kW	2281/2016	None
Heat pumps and air conditioners - Ventilation exhaust air-to-air	> 12 kW	2281/2016	None
Chillers – (heating function only), Reversible chillers Water/brine-to-water (heating function only)	≤ 400 kW (ecodesign) / ≤ 70 kW (Label)	813/2013	811/ 2013
Towel rails	≤ 50 kW	2015/1188	None
Air curtains	None	None	None
Slave heaters	None	None	None
Outdoor heaters	None	None	None
Mixed heaters	None	None	None

Commission Regulation (EU) 2015/1185 with regard to ecodesign requirements for solid fuel local space heaters

Solid fuel space heaters are also local space heaters but are fired by solid fuels (wood or pellets) with a nominal heat output of 50 kW or less. Products within this scope are e.g. stoves and fireplaces and are clearly out of the scope of Regulation (EU) 2015/1188.

Commission Regulation (EU) 2016/2281 with regard to ecodesign requirements for air heating products, cooling products, high temperature process chillers and fan coil units

Before this regulation a number of products was not within any scope e.g. warm air unit heaters. Regulation (EU) 2016/2281 exempts products that are already covered by other ecodesign regulations: local space heaters within the scope of Regulation (EU) 2015/1188 are clearly out of the scope by the exemption item a) of Regulation (EU) 2016/2281. Regulation (EU) 2015/1188 aimed to do the same, by exempting air heating products, but did not make an explicit cross reference to Regulation (EU) 2016/2281 as this did not exist yet. As a result, the two Regulations describe air heating products slightly differently[32], even though the intention is that these products are in scope of one (and only one) of the two regulations.

[32] This is also mentioned in the 2017 guidelines for the regulation: "**21**. Are air heating products in scope of Regulation (EU) 2016/2281 excluded from the scope of the Ecodesign Regulation (EU) 2015/1188? *Air heating products, as defined in Regulation (EU) 2015/1188 (Art.2 point 23) are excluded from the Regulation by Article 1(e). Please note that this definition is not completely identical to the definition in Regulation (EU) 2016/2281."*

Air conditioners > 12 kW are not within the scope of Regulation (EU) 2015/1188. This was a potential loophole until the adoption of regulation (EU) No 2016/2281 with regard to ecodesign requirements for air heating products, cooling products, high temperature process chillers and fan coil units. This regulation covers all air conditioners above 12 kW and up to a rated heating capacity not exceeding 1 MW.

Commission Regulation (EU) 206/2012 with regard to ecodesign requirements for air conditioners and comfort fans

All air conditioners – defined as devices capable of cooling or heating, or both, indoor air, using a vapour compression cycle driven by an electric compressor - are clearly out of the scope of Regulation (EU) 2015/1188, as local space heaters using a vapour compression cycle or sorption cycle for the generation of heat driven by electric compressors or fuel, are exempted.

Comfort fans are defined as *"appliance[s] primarily designed for creating air movement around or on part of a human body for personal cooling comfort"* and are within the scope of Regulation (EU) 206/2012. Fan heaters are not within the scope of Regulating (EU) 206/2012 as their primary function is heating, and they are therefore included in the scope of Regulation (EU) 2015/1188. However, since their secondary services (air movement) can compete with comfort fans, it would have an added value for end-users to have comparable information for the secondary function as is required for comfort fans.

Air conditioners ≤ 12 kW are not within the scope of Regulation (EU) 2015/1188. Regulation (EU) 206/2012 covers all air conditioners below 12 kW. Ventilation exhaust air-to-air heat pumps are not clearly within the scope of Regulation (EU) 206/2012 but are included in the ongoing revision study of the regulation.

Commission Regulation (EU) 813/2013 with regard to ecodesign requirements for space heaters and combination heaters.

Central heating products are clearly out of the scope of Regulation (EU) 2015/1188, since these products supplies heat for multiple rooms from one central unit such as a boiler. These products do not fit the definition of local space heaters which can reach and maintain a certain level of human thermal comfort within an enclosed space in which the product is situated.

Air-to-water and Water/brine-to-water reversible chillers are a possible heating competitor in residential or service premises. Regulation (EU) 2016/2281 covers in general chillers and Regulation (EU) 813/2013 covers the chiller heating function. Both types are usually central installations and thus not associated with local space heaters.

Commission Regulation (EU) 814/2013 with regard to ecodesign requirements for water heaters and hot water storage tanks

Water heaters and hot water storage tanks are clearly out of the scope of Regulation (EU) 2015/1188, since these products are intended for heating water and connected to the supply of drinking or sanitary water. Some products work both as a water heater and boiler for room heating. These products are covered by Regulation (EU) 813/2013.

Commission Regulation (EU) 2015/1189 with regard to ecodesign requirements for solid fuel boilers

Solid fuel space boilers are central heaters and fired by solid fuels (wood or pellets) with a nominal heat output of 500 kW or less. Products within this scope are clearly out of the scope of Regulation (EU) 2015/1188.

Products not included in any Ecodesign or Energy Labelling Regulation

The products in the bottom of Table 12 as well as many towel heaters are not included in the scope of any Ecodesign or Energy Label Regulation. These products and whether they would fit the scope of Regulation (EU) 2015/1188 will be further elaborated in chapter 1.5 along with the recommendations for the scope of this Regulation.

Towel rails are included in Regulation (EU) 2015/1188 only if they are capable to reach and maintain a certain level of human thermal comfort within an enclosed space in it is situated, unless it is 'specified for purposes other than indoor space heating to reach and maintain a certain thermal comfort of human beings by means of heat convection or heat radiation' as specified in Article 1(b) of the Regulation (EU) 2015/1188. In that case the appliance is not a local space heater.

Air curtains was considered to be included in Regulation (EU) 2015/1188 (included in the preparatory study[33] as Base Case 9), but only a small portion of these appliances are equipped with an electric internal heat generator. Most air curtains are fed by heaters that are considered to be covered by other regulations e.g. Regulation (EU) 2016/2281 and Regulation (EU) 813/2013.

Slave heaters are exempted in Regulation (EU) 2015/1188 and are defined as an electric local space heater which is not capable of autonomous operation and needs to receive signals sent from an external master controller, not being part of the product but connected to it by pilot wire, wireless, power line communication or an equivalent technique, in order to regulate the emission of heat into the room in which the product is installed.

[33] Preparatory study Lot 20, task 5, link: http://www.eup-network.de/fileadmin/user_upload/Produktgruppen/Lots/Final_Documents/BIO_EuP_Lot21_Task_5_09072012.pdf

Outdoor heaters are not covered by Regulation (EU) 2015/1188, since they fall outside the definition of a local space heaters, and the fact that they are not intended to "reach and maintain a certain level of human thermal comfort within an enclosed space in which the product is situated", and are explicitly exempted from the regulation by two of the exemptions in Article 1, which state that the Regulation does not apply to: (b) local space heaters specified for purposes other than indoor space heating to reach and maintain a certain thermal comfort of human beings by means of heat convection or heat radiation; (c) local space heaters that are specified for outdoor use only.

Mixed heaters are heating systems that have a central heat source (e.g. a boiler) which provides heat to a hydronic circuit, combined with electric heating elements, located inside the individual radiators, which can be turned on when the central boiler is off, in order to provide heat only for specific rooms. The central part of such mixed heaters is covered by other regulations such as Regulation (EU) 813/2013 depending on the type of central heating unit. The local part (the radiator) of these will be discussed further in section 1.5.2.

1.2.3 Member State legislation

Since the EU Member States follow the European Directives, Ecodesign and Energy Labelling Regulations are directly imposed in the Member States, and there appears to be no other particularly outstanding legislation at Member State level with relevance for the scope which have not been presented in the preparatory study[34]. An analysis of the Clasp online database [35] on measures shows that a series of regulation are under development/review in the Member States, but no relevant changes are found compared to the preparatory study.

Some countries have different Building Regulations, which have an effect on local space heaters. In countries such as France[36] fixed local space heaters are in practice not allowed to install in new buildings due to the building regulation requirements. It is possible to install a fixed local space heater, but then is the requirements for insulation stricter which often is an uneconomical solution. In Denmark it is not allowed to install fixed electric local space heaters in new buildings situated in areas with district heating or natural gas.

1.3 Voluntary agreements

There are no voluntary agreements on EU level regarding the energy efficiency of local space heaters. However, on national level some Member States have voluntary labelling of local space heaters, which are presented here.

[34] Preparatory study Lot 20, task 5, link: http://www.eup-network.de/fileadmin/user_upload/Produktgruppen/Lots/Final_Documents/BIO_EuP_Lot21_Task_5_09072012.pdf
[35] https://clasp.ngo/policies
[36] Based on inputs from stakeholders

1.3.1 NF label – France

The French NF label covers electrical heaters including radiators, convectors and towel rails. The products can be certified with one to three starts and three stars plus an eye, when products have presence/absence detection. The certification scheme includes many of the same performance parameters as the Ecodesign regulation, but with some additions such as presence/absence detection and accuracy of the temperature control (amplitude and drift maximums). The NF mark is owned by AFNOR[37] and managed by LCIE[38].

1.4 Review of relevant standards

The review of relevant standards will focus mainly on the development of European standards that has taken place since the first preparatory study on local room heating products of 2012 (ENER lot 20) and as a result of the entry into force of Commission Regulation (EU) 2015/1188 and Delegated Commission Regulation (EU) 2015/1186 (not included in this review study). The standards that have been updated or are in the process of being updated since 2012 are mentioned in this chapter, whereas relevant standards that has not been updated are mentioned in Annex B.

1.4.1 Mandate M/550 – Standardisation request

The European Commission published on 30 November 2016 the final standardisation request to European Standardisation Organisations (ESOs) for local space heaters and solid fuel local space heaters, M/550[39]. In the subsequent acceptance process CEN rejected the request whereas CENELEC accepted it. This means that drafting of harmonised standards related to Commission Regulation (EU) 2015/1188 continues for electric local space heaters by the CENELEC technical committee TC59x, work group WG 12 as planned.

For gas and liquid heaters, TC59/WG12 has been amending existing European performance standards to include methods for checking compliance with the Ecodesign Regulations, which are going through final editing and are planned to be published in 2019.

For the tube and luminous gas fired heaters, CEN TC 180 have elaborated new draft standards prEN 416:2017, prEN 419:2017 and prEN 17175:2017. Each draft standard includes all issues of energy efficiency and combustion emission including NOx. The new draft standards have just passed the CEN Enquiry and Voting process and will be finally overworked for editorial issues in the next months by CEN TC 180. The 3 draft standards also incorporated the terms, requirements and calculations of Ecodesign Regulation 2015/1188.

[37] https://www.afnor.org/en/
[38] http://www.lcie.com/en/868-certification/certification-rules.html
[39] http://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=572

1.4.2 Commission communication (2017/C 076/02) – Transitional methods

The European Commission published on 10 March 2017 transitional methods of measurements and calculations for the implementation of Regulation (EU) 2015/1188 and Regulation (EU) 2015/1186 regarding local space heaters[40]. The document also includes transitional methods for measurements and calculations for the implementation of Regulation (EU) 2015/1185 regarding solid fuel local space heaters. However, these products are out of scope of the present review study.

The transitional methods are divided into the following relevant product groups:

- Gaseous fuel fired local space heaters, except luminous heater and tube heaters
- Liquid fuel fired local space heaters
- Electric local space heaters
- Luminous and tube heaters

These transitional methods will ultimately be replaced by harmonised standards. The transitional methods cover measurement and calculation methods necessary to prove compliance with Regulation 2015/1188 In case of compliance with 2015/1186, for flueless heaters, potentially, the determination of heat output may be clarified[41].

1.4.3 Overview of European and international standards

Local space heaters are, as many other appliances, getting smarter. Therefore, standards for connected appliances recently published on e.g. networked standby (EN 50643:2018) and on general requirements for interoperability and data models are also considered relevant (EN 50631-1:2017). As result of the general update of standards supporting the Energy Performance of Buildings Directive (EPBD), the recently published standard EN 15316-4-8:2017 is also found interesting. This standard is specifying calculation methods for local heating systems and is extended to cover local room heating products subject to Ecodesign Regulation.

A general overview of relevant European standards related to local space heaters is shown in Table 13. The table presents for each product group the standard references and their CEN/CENELEC status for revision/amendment. Standards marked with an asterix (*), are referenced in the transitional methods (2017/C 076/02). The type indicates the main

[40] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2017.076.01.0004.01.ENG&toc=OJ:C:2017:076:TOC

[41] The general challenge with flueless heaters is to specify the heat output, since you can wither assume 100% efficiency (no heat leaves the room through flue gas exhaustion), or you can assume that because these heaters often require high ventilation rates, which means heat output is less that heat inputs, and efficiency is less than 100%. If the first is assumed (100% efficiency) heat input (and thus output) can be determined with the transitional methods, but if not e.g. the French NF D35-300 standard could be used to determine the flue gas losses.

products in scope of the standard. Important measurands relevant for ecodesign are indicated as well in the table. The standards are further explained below the table.

Table 13 Overview of standards related to local space heaters

Product group	Standard reference	CEN/CENELEC Status for revision/ amendment (per March 2019)	Type	Measurand
Gaseous fuel fired local space heaters, except luminous heater and tube heaters	*EN 613:2000	prEN 613 under approval	Closed-fronted	Efficiency, NO_x
	*EN 13278:2013		Open-fronted	Efficiency, NO_x
	*EN 1266: 2002		Fan-assisted	Efficiency, NO_x, Pilot flame
	EN 14829:2007		Flueless	
	*EN 449:2002		Flueless (LPG)	
	*EN 1319:2009	To be replaced by prEN 17078 under approval	Air-heater	Efficiency, NO_x
Liquid fuel fired local space heaters	*EN 1:1998	prEN 1 under drafting	Flued	Efficiency, NO_x
	*EN 13842:2000		Air-heater	Efficiency
Electric local space heaters	*IEC/EN 60675:1998	Enquiry	Direct acting	
	*IEC/EN 60531:1999	Enquiry	Thermal storage	
	EN 50559:2013		Underfloor heating	
	EN 15316-2		Underfloor heating	
Luminous and tube heaters	*EN 419-1:2009	passed the CEN enquiry without negative vote	Luminous	
	*EN 419-2:2006		Luminous	Efficiency
	*EN 416-1:2009	passed the CEN enquiry without negative vote	Radiant tube	
	*EN 416-2:2006		Radiant tube	Efficiency
	EN 777-4: To be replaced by prEN 17175:2017	prEN 17175:2017 passed the CEN enquiry without negative vote	Tube heating system	
	EN 1886:2007		Envelope losses	
Auxiliary, standby and	*EN 15456:2008		Auxiliary consumption	el_{min}, el_{max}, el_{sb}

Product group	Standard reference	CEN/CENELEC Status for revision/ amendment (per March 2019)	Type	Measurand
networked standby electricity consumption	EN 50643:2018		Networked standby	
	EN 50564:2011		Other standby	
	*IEC 62301:2011			el_{sb}
Smart capabilities of smart appliances	EN 50631-1:2017		Interoperability, model	
Energy performance of buildings	EN 15316-4-8:2017		Calculation of energy performance	
Energy performance of buildings	12831-1:2017		Calculation of the design heat load	

1.4.4 Gaseous fuel fired local space heaters (domestic heaters)

Since 2012, updates for gas fired local space heaters have mainly been due to safety and the differences in requirements for the Gas Appliance Regulation (GAR) compared to those of the Gas Appliance Directive (GAD). Below the standards that have been updated since 2012 or are in the process of being updated are mentioned. Standards that have not been or are not being updated are listed in Annex B.

PrEN 613 (to replace EN 613:2000) Independent gas-fired convection heaters

This standard covers independent gas-fired convection heating appliances that incorporate a natural draught burner, that are connected directly to an open flue or to a device to evacuate the products of combustion (open-flued appliances, balanced-flued appliances), that are wall mounted, free-standing or built in and that have a nominal heat input not exceeding 20 kW (based on the net calorific value). The requirements and test methods relate to the construction, safety, marking and rational use of energy.

The standard PrEN 613 *Independent closed-fronted gas-fired type B11, type C11, type C31 and type C91 heaters* is under approval and to replace EN 613:2000. The updated standard uses the term *closed-fronted* as do the Regulation (EU) 2015/1188. The prEN 613 definition of *closed-fronted appliance* is: *appliance which does not have exposed flames or exposed incandescent areas.*

EN 13278:2013 Open fronted gas-fired independent space heaters

This standard covers open fronted gas-fired independent space heaters with and without a fan to assist with the transportation of flue gases that incorporate an atmospheric burner, that are connected directly to an open flue or to a device to evacuate the products of combustion (open-flued appliances), that have a nominal heat input not exceeding 20 kW (based on the net calorific value) and that are delivered with the gas-carrying components, burner(s), combustion chamber and heat exchanger fully assembled.

prEN 17082 (to replace EN 1319:2009 and others) for Domestic gas-fired forced convection air heaters for space heating, with fan-assisted burners not exceeding a net heat input of 70 kW

prEN 17082 is under approval and will supersede EN 1319:2009 and a number of other air heater standards: EN 778:2009, EN 621:2009, EN 525:2009, EN 1196:2011 and EN 1020:2009. The final standard expects to provide technical additions related to Regulation (EU) 2016/2282 setting ecodesign requirements for air heating products.

The standard covers domestic gas-fired air heaters with a fan to assist the transportation of combustion air and/or combustion products with an input not exceeding 70 kW (net cv basis), intended primarily for use in single unit residential dwellings. Provision of the heated air may be by means of ducting.

1.4.5 Liquid fuel fired local space heaters (domestic heaters)

prEN 1 (to replace EN 1:1998) Flued oil stoves with vaporizing burners

This standard applies to flued oil stoves with one or more vaporizing burners as used for individual heating in the domestic field and having either a draught regulator or a combustion air limiter and a nominal heating capacity of not more than 15 kW. It is not applicable for built-in equipment. Requirements and test method related to the constructional and operating requirements, conditions for functional testing and marking and instruction. The standard is currently under revision.

1.4.6 Electric local space heaters (domestic heaters)

Following the acceptance of the standardisation request (M/550) by CENELEC, adaptions of standards for electric local space heaters have started. These includes for example test methods for the controller options that were introduced with Regulation No. 2015/1188.

Adaption of EN 60675:1995 Household electric direct-acting room heaters - Methods for measuring performance

This standard applies to electric direct-acting room heaters. They may be portable, stationary, fixed, or built-in. The standard defines the main performance characteristics of direct-acting room heaters and specifies methods for measuring these characteristics, for the information of users. This standard does not specify values for performance characteristics.

A draft standard is under development according to Mandate M/550, which includes updated terminology in line with Regulation (EU) 1188/2015 e.g. the definition of a slave heater and methods to verify the control types used and their functionality.

Adaption of EN 60531:2000 Household electric thermal storage room heaters - Methods for measuring performance

This standard applies to electric storage heaters having a daily operating cycle and intended to heat room in which they are located. The standard defines the main performance characteristics of storage heaters and specifies methods for measuring these characteristics, for the information of users

A draft standard is under development according to Mandate M/550, which includes updated terminology in line with Regulation (EU) 1188/2015 and methods to verify the control types used and their functionality.

EN 50559:2013 Electric room heating, underfloor heating, characteristics of performance. Definitions, method of testing, sizing and formula symbols

This standard applies to electrical underfloor heating of dwellings and all other buildings whose use corresponds to dwellings or is at least similar, having a maximum load bearing in use of 4 kN/m^2. The standard defines the main characteristics of electrical underfloor heating and establishes the method of testing of these characteristics as information for the user.

Air curtains (Commercial heaters)

Air curtains are not part of the current Regulation, but will be looked into in this review study. Standards specific for air curtains includes the following:

- ISO 27327-1: Fans - Air curtain units - Part 1: Laboratory methods of testing for aerodynamic performance rating
- ISO 27327-2: Fans - Air curtain units - Part 2: Laboratory methods of testing for sound power

Neither of these standards can be used to measure the heating efficiency of the air curtains, which is relevant in the perspective of the review study. However, the European Industry Association, Eurovent, has developed a recommendation for testing of air curtains 'Air curtain unit - Classification, test conditions and energy performance calculations', from 2016, which includes methods to calculate air curtain climate separation efficiency and heat losses from buildings as well as the heating capacity as a function of the air flow and temperature.

1.4.7 Luminous and tube heaters (commercial heaters)

PrEN 416 (to replace EN 416-1:2009 & EN 416-2:2006) Single burner gas-fired overhead radiant tube heaters for non-domestic use - Part 1: Safety & Part 2: Rational use of energy
The two standards apply to non-domestic gas fired overhead radiant tube heaters incorporating a single burner system under the control of an automatic burner control system. These standards are applicable to Type A2, A3, B12, B13, B22, B23, B42, B43, B52, B53, C12, C13, C32 and C33 appliances intended for use in other than domestic dwellings, in which the supply of combustion air and/or the evacuation of the products of combustion is achieved by mechanical means located upstream of the draught diverter, if provided. The standards are not applicable to appliances of heat input in excess of 120 kW (based on the net calorific value of the appropriate reference test gas) and other specific exemptions. Combined, the two standards specify the requirements and test methods for the construction, safety, classification, the rational use of energy and marking. prEN 416 (Gas-fired overhead radiant tube heaters and radiant tube heater systems for non-domestic use - Part 1: Safety & Part 2: energy efficiency), which has passed the CEN enquiry without negative vote, is planned to supersede EN 416-1:2009 and EN 416-2:2006

prEN 419 (to replace EN 419-1:2009 & EN 419-2:2006) Non-domestic gas-fired overhead luminous radiant heaters - Part 1: Safety & Part 2: Rational use of energy
The two standards apply to non-domestic gas-fired overhead luminous radiant heaters for environmental comfort, incorporating an atmospheric burner system. These Standards are applicable to Type A1 appliances only and are not applicable to appliances of heat input in excess of 120 kW (based on the net calorific value of the appropriate reference gas) and other specific exemptions. Combined, the two standards specify the requirements and test methods for the construction, safety, classification, the rational use of energy and marking. prEN 419 (Gas-fired overhead luminous radiant heaters for non-domestic use - Part 1: Safety & Part 2: energy efficiency), which has passed the CEN enquiry without negative vote, is planned to supersede EN 419-1:2009 and EN 419-2:2006.

prEN 17175 (to replace EN 777-4:2009) Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use - Part 4: System H – Safety
This standard non-domestic gas-fired overhead radiant tube systems incorporating two or more burner units with each burner under the control of an automatic burner control system, and operated by a single fan providing a single flue outlet, called system H. This standard is applicable to Type B52 systems intended for use in other than domestic dwellings, in which the supply of combustion air and the evacuation of the products of combustion is achieved by mechanical means. This standard is applicable only to such systems that have fully pre-mixed gas/air burners. This standard is not applicable to systems of heat input in excess of 120 kW (based on the net calorific value of the

appropriate reference test gas) and other specific exemptions. The standard specifies the requirements and test methods for the construction, safety, classification and marking.

prEN 17175 Gas-fired overhead radiant strip heaters and multi-burner continuous radiant tube heater systems for non-domestic use – Safety and energy efficiency, which has passed the CEN enquiry without negative vote, is planned to supersede EN 416-1:2009, EN 416-2:2006 and EN 777-4:2009 and is bringing aspects of safety and energy efficiency of appliances together in one document.

1.4.8 Auxiliary, standby and networked standby electricity consumption

EN 50643:2018: Electrical and electronic household and office equipment - Measurement of networked standby power consumption of edge equipment

This European Standard specifies methods of measurement of electrical power consumption in networked standby and the reporting of the results for edge equipment. Power consumption in standby (other than networked standby) is covered by EN 50564:2011, including the input voltage range.

EN 50643:2018 also provides a method to test power management and whether it is possible to deactivate wireless network connection(s). This standard has been written in particular to support Commission Regulation (EU) 801/2013 for the measurement of energy consumption in networked standby. It applies to electrical products with a rated input voltage of 230 V ac for single phase products and 400 V ac for three phase products.

The measurement of energy consumption and performance of products during intended use are generally specified in product standards and are not covered by this standard.

The term "products" in this standard includes household appliances or information technology products, consumer electronics, audio, video and multimedia systems; however, the measurement methodology could be applied to other products. Where this standard is referenced by more specific standards or procedures, these should define and name the relevant conditions to which this test procedure is applied.

More and more products are getting connected to a network why the above standard may be relevant. Measurement of electrical power consumption in networked standby for interconnecting equipment is the subject of ETSI standard EN 303 423 *Environmental Engineering (EE) - Electrical and electronic household and office equipment; Measurement of networked standby power consumption for interconnecting equipment*.

1.4.9 Smart capabilities of smart appliances

EN 50631-1:2017: Household appliances network and grid connectivity - Part 1: General Requirements, Generic Data Modelling and Neutral Messages

This standard focuses on interoperability of household appliances and describes the necessary control and monitoring. It defines a set of functions of household and similar electrical appliances. The functions in this standard cover next to energy-management main remote-control and – monitoring use cases. Energy management systems will more and more become necessary due to change from fossil and nuclear to renewable production and the associated decentralisation. Since an appropriate standard for a home & building management is in preparation this European Standard specifies how sets of products from multiple manufacturers are able to interoperate with Home & Building / Customer Energy Management Systems, located in a home network or in the cloud, in the most interoperable manner.

1.4.10 Energy performance of buildings

EN 15316-4-8:2017 Energy performance of buildings. Method for calculation of system energy requirements and system efficiencies. Space heating generation systems, air heating and overhead radiant heating systems, including stoves (local)

This standard concern solely the heat generation in buildings as part of the approach of total efficiency buildings. It standardises the required inputs, the calculation method and the resulting outputs for space heating generation by air heating systems and overhead radiant heating systems for non-domestic use, both including control and for stoves and local heaters for residential use.

Compared to EN 15316-4-8:2011 the scope of the 2017-issue is extended to stoves and local heaters included in the lot 20 of ecodesign studies.

Energy performance of buildings. Method for calculation of the design heat load. Space heating load, Module M3-3

This standard covers methods for the calculation of the design heat load for single rooms, building entities and buildings, where the design heat load is defined as the heat supply (power) needed to maintain the required internal design temperature under design external conditions.

EN 12831 Energy performance of buildings. Method for calculation of the design heat load. Space heating load, Module M3-3

Another standard for estimating the energy performance of buildings is EN 12831-1:2017, which is focused on the space heating, and thus includes parameters such as Thermal design of buildings and heat losses as well as heating equipment and space heating systems.

1.4.11 Relevant standards and voluntary agreements on resource efficiency

Within the past 10 years the awareness of resource depletion has increased, and the ideas of circular economy have been widely accepted as a solution that can improve the resource efficiency. The European commission published in 2015 a circular economy package that included an action plan to promote circular economy[42]. The areas of actions that are most relevant in connection with ecodesign is the general measures on product design.

Product design is key to facilitating recycling, repair and refurbishment, but also more durable products. All measures hold the potential to reduce the consumption of virgin materials (including critical raw materials) and reduce the environmental burden of products.

To reach better design of products the Commission will[43]:

- "Support reparability, durability, and recyclability of products in product requirements under the Ecodesign Directive, taking into account specific requirements of different products. The Ecodesign working plan 2015–2017 will identify product groups that will be examined to propose possible eco-design and/or energy labelling requirements. It will set out how ecodesign can contribute to the objectives of the circular economy. As a first step, the Commission will propose requirements for electronic displays, including requirements related to material efficiency."
- "Propose the differentiation of financial contributions paid by producers under the Extended Producer Responsibility scheme on the basis of the end-of-life management costs of their products. This provision under the revised legislative proposal on waste creates economic incentives for the design of products that can be more easily recycled or reused."
- "Examine options and actions for a more coherent policy framework for the different strands of work on EU product policy in their contribution to the circular economy."

Besides the economy work package there is also a number of standards and voluntary agreements on resource efficiency, which are briefly described below.

M/543 – Material Efficiency

In December 2015, the European Commission published a standardisation request to the ESOs covering ecodesign requirements on material efficiency aspects for energy-related

[42] https://ec.europa.eu/growth/industry/sustainability/circular-economy_en
[43] https://ec.europa.eu/growth/industry/sustainability/circular-economy

products in support of the implementation of Directive 2009/125/EC.[44] It was noted in the mandate that the absence of adequate metrics is one of the reasons for the relative lack of ecodesign requirements related to material efficiency in previous ecodesign implementing measures. The mandate therefore requests that the ESOs[45] draft new European standards and European standardisation deliverables on material efficiency aspects for energy-related products in support of the Ecodesign Directive 2009/125/EC. This standardisation request clarifies that the following material efficiency aspects should be covered:

- Extending product lifetime
- Ability to re-use components or recycle materials from products at end-of-life
- Use of re-used components and/or recycled materials in products

All the below preliminary standards (PrEN) are currently under development in accordance with standardisation request M/543.

<u>prEN 45553</u>

This standard deals with the assessment regarding the ability to remanufacture energy related products. The aim is to ensure a general method for assessing the ability to remanufacture energy related products. The aspects considered are among others:

- Assessment of accessibility (Including a formula that can evaluate the accessibility)
- Assessment of the ability to re-/disassemble (Including disassembly sequence, disassembly index, time for disassembly and different formulas)

This standard may allow requirements regarding disassembly in ecodesign as this standard creates a common framework for documenting the disassembly. Without any standard it is difficult for the market surveillance authorities to control such measures.

<u>prEN 45554</u>

This standard deals with methods for the assessment of the ability to repair, reuse and upgrade energy related products. This standard suggests a horizontal approach for all energy related products. The standard is described as generic and general in nature which means that it is not intended to be applied directly but may be cited in relation with product specific or product group harmonised standards.

The standard provides a general methodology for:

- the ability to repair products

[44] http://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=564

[45] http://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=564

- the ability to reuse products, or parts thereof,
- the ability to upgrade products, excluding remanufacturing.

Furthermore, it provides a common framework for future vertical/product specific standards.

prEN 45555

This standard deals with methods for assessing the recyclability and recoverability of energy-related products. This standard suggests a horizontal approach for all energy related products. However, the standard also states that a correct assessment can only be done in a product-specific way, taking into account specific parameters of a specific product group. This standard defines a series of parameters which may be considered to calculate product specific recycling and recoverability rates.

The standard provides a general methodology for:

- Assessing the recyclability of energy related products
- Assessing the recoverability of energy related products
- Assessing the ability to access or remove certain components of interest to facilitate better recycling and recovery operations.
- Assessing the recyclability of critical raw materials from energy related

prEN 45556

The aim of this standard is to ensure a general method for assessing the proportion of reused components in energy related products. The aspects considered are among others:

- Calculation of reused component index
- Quality assurance (maintain records of previous quality control)
- Marking and Instructions (e.g. ensure traceability of the reused component)

prEN 45557

The aim of this standard is to develop a general method for assessing the proportion of recycled material content in energy related products. This standard relates to the physical characteristic of the materials and manufacturing history of all the parts in the product. The standard includes:

- Methods for calculating the recycled material content
- Specific guidelines per material type
- Traceability
- Reporting

Guidelines for accounting and reporting recycled content will contribute to avoid potentially unsubstantiated and misleading claims on recycled content for which it is not clear how they are determined. This standard enables requirements of recycled content in products as these claims can be controlled by market surveillance authorities

prEN 45558

The aim of the standard is to develop a method so information on critical raw materials can be exchanged up and down in the supply chain of energy related products. Though, it does not provide any specific method to capture this information. How organisations will capture the data is individually which allow more flexibility.

The standard e.g. allows organisations to

- Assess the use of critical raw materials in energy related products
- Support collection and recycling processes, so the critical raw materials can be extracted End-of-Life
- Use information on critical raw materials in life-cycle management

Furthermore, this standard will be able to support policy makers regarding policy around the import of critical raw materials. It can also prove to be valuable in connection with ecodesign studies as more information about the materials will be available, which can lead to more precise estimates of both the value and impact of critical raw materials in energy related products, but also measures that can improve the recycling of critical raw materials.

prEN 50614 (M/518)

This European Standard is currently under development within the standardisation request M/518. The purpose of the standard is to facilitate the preparation for re-use of equipment and support the WEEE Directive. The standards include measures on how to check, clean or perform repair recovery operations, so components of discarded products (waste) are prepared so they can be reused without any other pre-processing. The standard also provides relevant description of quality, safety and environmental requirements that a reuse operator should adopt to ensure safe products for the consumer and also to protect the brand of the product (avoid faulty and dangerous remanufactured products) as consumers still may connect a remanufactured product with the brand of the appliances which not necessarily is the case.

National standards related to material efficiency

BS 8887-211 (UK)

This standard focus on design for Manufacture, Assembly, Disassembly and End-of-life processing (MADE) of computing hardware. It is thus not related to household appliances directly, but some of the requirements could be used across all electronic products. The standard describes the different types of products that potentially could re-enter the production. Examples of products that can re-enters the production are:

- Non-working products (out-of-the-box)
- Products that needs repair within the warranty period (returned to the OEM)
- Unsold products (factory overstock, demonstration models, "try before buy – offer"
- Return of used products (e.g. lease or "trade-in-offers" – relevant in connection with circular economy)

VDI 2343 (Germany)

This standard provides a common framework for the different definitions on reuse which is crucial to reach a common understanding on the different definitions. Definitions are also crucial in connection with interpretation of Regulation and without any clear definitions any requirements towards reuse/remanufacturing/refurbishment will be invalidated. In general, refurbishment is not clearly defined in most EU Regulation (e.g. fully refurbishment is defined in the Regulation on medical devices46). The standard defines different levels of reuse such as:

- Repair – restores defective product
- Refurbishing – restores used product to a certain quality
- Remanufacturing – restores used product to 'as good as new' through new and reconditioned components and parts;
- Upgrading – improving the functions/properties of the original product
- Definitions are very important in connection with the liability of the product. At which level of repair/reuse is the original manufacturer (brand on the appliance) responsible for the product.

ONR 192102 (Austria)

Standard ONR 192102 is an Austrian standard that establishes a label for electronic products designed for easy repair.

[46] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2017:117:FULL&from=EN

The standard/label established both mandatory requirements that should be followed by anyone claiming the label and a set of voluntary requirements. If the manufacturers also follow the voluntary criteria, they are awarded with a score. The score is dependent on the number of criteria the product complies with and an overall reparability score is awarded which are either 'good', 'very good' or 'excellent'.

- Examples of the requirements and criteria are:
- Information relevant for disassembly (e.g. instructions, break down plan)
- Requirements on information for repair (e.g. instructions and exploded views)
- Easiness of disassemble (e.g. possibility of breaking down the product and accessibility to inner parts (cable lengths, space for mounting, welding, screw orientation and size, scale of design)

Such standards and labels are very important for both manufactures designing products for the circular economy, but also regarding requirements. European standard can be developed in line with ONR 192102, which makes any requirements towards improvement resource efficiency (design for easy disassemble etc.) more robust.

1.5 Recommendations

While the above sections all describe the situation as it currently is, with the current terms and scope of Regulation 1188/2015 as well as other legislation and relevant standards, this chapter focus on the changes to Regulation 1188/2015 that are suggested to improve the regulation.

1.5.1 Overall definition and exemptions

The current definition of a local space heater in the Regulation (EU) 2015/1188 includes the following: "a space heating device that emits heat […] in order to reach and maintain a certain level of human thermal comfort […]". A similar formulation is used in the second exemption (b) in Article 1 of the Regulation that states that a local space heater is exempt from the requirements if it is "specified for purposes other than indoor space heating to reach and maintain a certain thermal comfort of human beings".

According to several stakeholders, the definition is vague for various reasons and together with the exemption it gives rise to a loophole through specification of products to be other than local space heating devices. For example, the Ecodesign Regulation has triggered a trend in the market, where an increasing number of gas fired products are specified as decorative[47] (or according to other secondary attributes) rather than for heating. Others claim to be unable to reach and/or maintain a certain temperature in a given room, and thus be out of scope. This means that the products can be exempted from the scope of the regulation and the ecodesign requirements can be avoided, even though the product delivers a significant amount of heat to the room and it might be purchased by the consumer for heating purposes.

The Danish Secretariat for Ecodesign and Energy labelling of Products conducted market surveillance of the ecodesign product information requirement related to local space heaters (EU 2015/1188) in 2018. The specific surveillance activity was related to whether or not the manufacturer's public available websites showed the required information[48]. The surveillance showed that there were issues related to the scope of the regulation with several manufacturers claiming that the regulation did not apply to their products due to a number of reasons related to the term "reach and maintain a certain level of thermal comfort":

- When using products without an exhaust (flueless heaters) there is a need for opening a window. Consequently, the product is not capable to "reach and maintain a certain level of thermal comfort within the enclosed space in which the product is situated".

[47] especially open to chimney gas heaters.
[48] Regulation 2015/1188, OJ L 193, 21.7.2015, p. 76–99, Annex II, paragraph 3 regarding ecodesign requirements for product information,

- Products using bioethanol are capable of reaching a certain level of thermal comfort, but the products cannot maintain this level. When the bioethanol fuel is used up, the end user is not allowed to refill the product with new bioethanol until the burner is cooled off due to safety reasons. This can take as long as 30-60 minutes.
- As long as the manufacturers' do not claim on their website, that the purpose of the local space heater is to maintain a certain level of thermal comfort, the regulation does not apply to their products

The way the local space heater definition and scope exemption (b) are formulated thus poses a loophole for those who intentionally wants to avoid the ecodesign requirements, since it is up to the manufacturer how to define their products. The same has been observed for e.g. decorative light bulbs in the regulation for luminaires (Regulation 874/2012)[49]. The products specified as e.g. "decorative" heaters will still have information requirements, which includes stating on the product packaging and user manuals that "This product is not suitable for primary heating purposes". This is, however, not the intention of the regulation, and the guidelines for the regulation clearly states that:

"The decorative characteristics of a heater are not a criterion to determine whether the product is in the scope of the Regulations or not: the decisive element is whether the heater is capable to reach and maintain a certain level of thermal comfort within an enclosed space in which the product is situated. If it is capable of doing so, it is covered by the Regulations, independent of its decorative aspects. Please refer to Article 1(b) of Regulation (EU) 2015/1185, Article 1(d) of Regulation (EU) 2015/1186 and Article 2(1) of Regulation (EU) 2015/1188"[50].

This could pose a number of problems for end-users and market surveillance authorities (MSAs) since the specified sentence is no guarantee for how retailers may promote the product to end users and it could be understood as the products being suitable for secondary / auxiliary heating purposes. Furthermore, a scope exception like this, when based on manufacturer declaration makes it very difficult for market surveillance authorities to disprove that the product is for decoration (or other purposes) only, and not for heating.

Changes to definitions

Multiple stakeholders argue that the local space heater definition itself (Article 2.1) and/or the formulation of exemption (b), should be changed in order to avoid the loophole. Most stakeholders agree that the term "human thermal comfort" and the fact that only heaters specified for this purpose are included in the scope, creates the loophole. There is a general

[49] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012R0874
[50] Answer to point 25 in the guidelines: "25. Are decorative local space heaters excluded from Regulation (EU) 2015/1185, Regulation (EU) 2015/1186 and Regulation (EU) 2015/1188?"

agreement that secondary functions (being decorative, dry towels etc.) to that of room heating, should not exempt heaters from the scope if they are capable of heating the room.

The idea of changing the formulation of is to avoid that suppliers can sell heating products without complying with the Ecodesign Regulation by claiming and additional feature for an appliance (such as towel heater, decorative heater, auxiliary heater etc.). Hence, the regulation should also apply to auxiliary heaters. On the other hand, the definition should ensure that not all products that emit any kind of 'waste' heat to a room is defined as a local space heater (e.g. ovens, hobs, and almost any type of electrical devices).

Changes for the local space heater definition

The stakeholders have suggested the following changes for the local space heater definition, each of which are elaborated with their pros and cons below:

- Replacing "a certain level of human thermal comfort" with "a certain temperature level"
- Change "reach and maintain a certain level of human thermal comfort" to "maintain or contribute to a certain level of human thermal comfort"
- Add in the first part: "that emits, as a primary or secondary function, heat by direct heat transfer to an enclosed space which is useful for the residence of humans and in which the product is situated"
- Change the last part from "that convert electricity or gaseous or liquid fuels directly into heat, through use of the Joule effect or combustion of fuels respectively;" to "that convert electricity or gaseous or liquid fuels into heat"
- Delete the phrase "or by direct heat transfer in combination with heat transfer to a fluid" and replace it with the following "possibly combined with a heat output to other spaces or with heat transfer to a fluid"
- Add "and is equipped with electronics/control with a room temperature probe"

The first three suggestions all aim to settle the ambiguity of the term "human thermal comfort" by indicating that products cannot be claimed to be exempted from the Regulation by their secondary functions, when they are similar in technology to local space heaters. However, they also entail drawbacks.

Removing the term "human thermal comfort" from the local space heater definition (Suggestion 1) will result in a widening of the scope to all heaters used in agricultural, industrial or other settings for heating of products, storage facilities, or livestock. This could be a problem because the correction factors determined in the Regulation does not fit with how these products are used. This change would therefore require such products to be identified, defined and mentioned as specific exemptions, which in turn could create further loopholes. Furthermore, the meaning of "temperature level" would need to be defined, as e.g. radiant heaters do not heat the room (air) as much as the people in it.

Suggestion 2 alone would result in all products emitting any type of heat indoors to be included in the scope. However, if it is combined with a re-formulation stating that the purpose of the appliance is the heat generation itself, all appliances emitting waste heat (e.g. power supplies or other electric devices) could be excluded. Furthermore, the part about "maintaining" should be removed, since this is use as a loophole for some appliances on the market[51].

Suggestion 3 has the same drawback as the second, regarding including all heat emitting products in scope. Furthermore, adding "for the residence of humans" would exclude products used in public or buildings such as schools, hospitals, offices etc., where the heat is also needed for human thermal comfort, but which cannot be defined as residential. However, "residence of humans" could be further defined in article 2 to also include such other buildings where humans stay and/or work.

Suggestion 4 indicates that the technology by which heat is generated is not important, and that the definition can be simplified by deleting this part. This simplification makes sense if the exemptions in article 2 are enough to ensure that no type of product is covered by more than one Ecodesign Regulation (e.g. heat pumps which also produce heat from electricity but not with joule effect).

Suggestion 5 is also a simplification of the wording, which in this case do not change the meaning or the scope of the local space heater definition.

Suggestion 6 would risk creating further loopholes, since the electronics/controls with the temperature probe could be sold separately to avoid the requirements. Furthermore, it would then not be possible to set requirements for any product sold without the control (see below section on slave heaters).

Recommended changes in definitions and exemptions

Based on the above considerations, it is suggested to change the definition of local space heaters from the current one:

'local space heater' means a space heating device that emits heat by direct heat transfer or by direct heat transfer in combination with heat transfer to a fluid, in order to reach and maintain a certain level of human thermal comfort within an enclosed space in which the product is situated, possibly combined with a heat output to other spaces and is equipped

[51] For example if the appliance does not have a control function, or if it can only be manually batch-fed and has to cool down in between, it can be argued that it cannot "maintain" the same level of comfort.

with one or more heat generators that convert electricity or gaseous or liquid fuels directly into heat, through use of the Joule effect or combustion of fuels respectively;

To the following:

'local space heater' means a device that is equipped with one or more heat generators with the purpose of converting electricity or gaseous or liquid fuels directly into heat to contribute to a certain level of human thermal comfort in the enclosed space in which it is situated by direct heat transfer, possibly combined with a heat output to other spaces or with heat transfer to a fluid.

By specifying that the products' purpose is to produce and provide heat, there is no doubt that other appliances which emits waste heat are not included. Other appliances for which the main purpose is also heat generation, but not for heating a room for humans to stay, should be specifically excluded from the scope. Furthermore, by removing that the heater should be "able to reach and maintain" a certain temperature, (level of human thermal comfort), it is ensured that:

- Heaters sold without controls are included in scope of the regulation, since the lack of controls can otherwise be used as an argument that the heater cannot maintain a certain temperature
- Products cannot be argued to be out of scope, if they cannot maintain a continuous heat output for any technical reason (see examples from the Danish market surveillance above)
- It is still only heaters intended for providing human comfort that are included in the scope, hence heaters used for animals or for ensuring product quality are not included.

Changes to exemption b

The suggestions for changes in exceptions are listed below. Those not mentioned are kept unchanged. It is recommended to add 'cooking appliances' as an exemption, and define them, for example as ovens, hobs and stoves where the heat is generated solely for the purpose of preparing food.

Furthermore, the idea that secondary functions should not exclude heaters from the scope could instead be solved by changing exemption (b), which is currently:

- Local space heaters specified for purposes other than indoor space heating to reach and maintain a certain thermal comfort of human beings by means of heat convection or heat radiation

The following suggestions for changes have been made by stakeholders:

a) Change it to "Heaters specified to be used for other purposes than local space heaters"

b) The producer shall declare the technical performance that exclude the product from being able to perform heating to reach and maintain a certain thermal comfort of human beings by means of heat convection or heat radiation; E.g. A heater for freeze protection could state that the temperature controller has a maximum setting of e.g. 7 °C.

c) Set a lower power limit instead (e.g. 100 W) to avoid regulation for very low power products, which cannot "reach and maintain" a room temperature

d) Rephrase completely to: Local space heaters used in rooms not intended for humans to stay and/or work

Suggestion a) would not solve this issue, as it would still exclude products based on "specified use" and thus maintain the current loophole.

Suggestion b) takes a more technical approach and would require a definition of temperatures or heat emissions to define when a product can be exempted, or even a temperature rise in a standardised test room within a given time. More specific definitions of when the technical performance is not sufficient to be used for human thermal comfort would be necessary for both producers and market surveillance authorities, and producers would need to test products which are not in the scope to prove that they are not.

Suggestion c) could be used to eliminate most electric products that emits waste heat, but some might have much higher power ratings (e.g. electric ovens, external power supplies, electric motors etc.). Furthermore, the ability to "reach and maintain" any temperature or level of human thermal comfort depends not only on the device, but also on the building insulation and how it is used.

Suggestion d) has some of the same drawbacks as suggestion a) because it is based on intended use, however, in order to clarify it could instead be replaced or elaborated with specific exemptions such as agricultural purposes, or spaces for commercial process and/or storage purposes, which might be able to reach and maintain a certain level of human thermal comforts, but since this is not their purpose the calculations and correction factors in the regulation are not relevant.

Since the exemption is in principle an inversion of the local space heater definition itself, underlining that if an appliance does not fit the local space heater definition, it is not covered by the regulation, it is seen as redundant, and it is recommended to remove it from the regulation entirely. Instead specific exemptions can be added, for example it is recommended to add the exemption for cooking appliances.

Exemptions related to secondary features

While the change of the local space heater definition and the removal of scope exemption b eliminates a large part of the current loopholes in the regulation, it should be further specified that any secondary function of the product does not exclude them from the scope. This means that as long as the main aspect of the product is direct energy conversion of fuels (electricity/gas/liquid) into heat, any additional aspects such as being decorative, being an auxiliary heater, or being capable of providing freeze protection, should not exempt the products form the scope of the regulation.

Towel rails would be a case of doubt, but these are handled specifically in section 1.5.2.

Another product type that are not included in the regulation, which could be specifically exempted if necessary is personal heating devices, that can be used by only one person at a time. This is for example heating blankets or small infrared lamps located right next to a single person or similar. Such personal heating appliances are not included in the regulation today and should not be so in the future, as the regulation handles space heating devices, not personal heating devices.

This should be clear with the overall definition of local space heaters, and it is not considered necessary to add a specific exemption for personal heating devices. It should be included in the regulation, however, that secondary functions do not exempt any local space heater from the regulation.

Air heating appliance

It is suggested to change the definition to match that of Regulation (EU) 2016/2281 to avoid the possible misunderstandings of the current formulation in Regulation 2015/1188 (see Table 14). Below are the two definitions compared:

Table 14: Difference in definition of air heating products in Regulation 2015/1188 and 2016/2281

Regulation 2016/2281	Regulation 2015/1188
Air heating product means a device that: incorporates or provides heat to an air-based heating system; is equipped with one or more heat generators; and may include an air-based heating system for supplying heated air directly into the heated space by means of an air-moving device. A heat generator designed for an air heating product and an air heating product housing designed to be equipped with such a heat generator shall, together, be considered as an air heating product;	Air heating product means a product providing heat to an air-based heating system only that can be ducted and is designed to be used while fastened or secured in a specific location or wall mounted which distributes the air by means of an air moving device in order to reach and maintain a certain level of human thermal comfort within an enclosed space in which the product is situated;

These definitions have many similarities but also differences e.g. the number of heat generators. Though the greatest difference is related to the wording in the definition in the regulation for local space heaters. The word 'only' in the definition can be understood in two different ways:

- Only to an air-based heating system; or
- that can only be ducted

Especially when the regulation is translated to other languages, the wording can create confusion. Therefore, the definition in the local space heater regulation needs to be clarified and it is recommended to align the definition with Regulation (EU) No 2016/2281.

1.5.2 Scope recommendations for electric local space heaters

The following sections describe the specific changes that are recommended for the definitions and scope of electric local space heaters.

Portable and fixed heaters

It is suggested to clarify and strengthen the definitions of portable and fixed heaters. For fixed heaters it is suggested to add to the definition that they do not include towel heaters (see section on towel heaters below), i.e. adding to the current definition "…and is not a towel rail" or a similar phrasing.

For portable heaters it is suggested to change the definition so that it is not merely a list of what it is not, but a more technical description of what a portable heater is. This could for example be based on definition 3.5.1 from the standard EN 60335-1:2013 "*appliance that is intended to be moved while in operation or an appliance, other than a fixed appliance*". In order to not have intended use as part of the definition it could also be phrased as "...which can be moved while in operation...".

Another important parameter to include, is that if a portable appliance can be used as a fixed appliance (i.e. can be wall mounted or secured in place) they should be considered a fixed heater and thus comply with the fixed heater requirements.

One stakeholder proposed the following specific definition for portable heaters:

"Electric portable local space heaters are electric local space heaters provided with a cord supply and plug by the manufacturer which are designed to be portable in order to be operated on different rooms or locations. Portable appliances with features which can be used to fix them to a wall and/or floor shall comply with the requirements of fixed electric local space heaters."[52]

This definition ensures that the portable heater definition is limited to heaters which can be used only in a portable mode, and which have no option to be used as fixed heaters. Hence, if any accessories are made available for fixing the heater, which are either sold together or separately from the heater, the heater has to comply with the requirements for fixed heaters. The issue of competitors developing such accessories was brought up by one stakeholder. However, this could be avoided by defining that the accessories should be provided by the company itself or related companies.

In order to avoid any loopholes, one stakeholder suggested to add a fallback definition for fixed heaters to include any kind of combination of portable and fixed heaters. For example the current definition:

'electric fixed local space heater' means an electric local space heater not intended to accumulate thermal energy and designed to be used while fastened or secured in a specific location or wall mounted and not incorporated in the building structure or building finishing;

Could be amended with a sentence such as "Any kind of heater for which accessories are available for fastening it in a specific location are to be considered fixed heaters".

This is, however, also included in the definition suggested above, and it is therefore recommended to change the portable electric local space heater definition to that or something similar, i.e.:

"Electric portable local space heaters are electric local space heaters provided with a cord supply and plug by the manufacturer which are designed to be portable in order to be operated on different rooms or locations. Portable appliances with features which can be used to fix them to a wall and/or floor shall comply with the requirements of fixed electric local space heaters."[53]

Electric radiant heaters

The term "radiant heaters" used in the Regulation has given rise to some confusion, since most electric heaters emits radiant heat, even though they do not belong to this category

[52] Suggestion provided by APPLiA this complies with FAQ 39 in the guidelines: 39. Should portable appliances sold with features which can be used to fix it on a wall have to comply with ecodesign requirements applicable to fixed room heaters? Should a fixed appliance sold with a kit of castors be considered as a portable? The classification of the local space heater is dependent on its intended use and how it is marketed (in the catalogues, leaflets, etc.). If the product is marketed as a local space heater that can be used either as a portable or as a fixed local space heater, then it has to comply with both requirements. In practice, this means that the product has to comply with the most stringent requirements, i.e. those of the fixed local space heaters.

[53] Suggestion provided by APPLiA this complies with FAQ 39 in the guidelines: 39. Should portable appliances sold with features which can be used to fix it on a wall have to comply with ecodesign requirements applicable to fixed room heaters? Should a fixed appliance sold with a kit of castors be considered as a portable? The classification of the local space heater is dependent on its intended use and how it is marketed (in the catalogues, leaflets, etc.). If the product is marketed as a local space heater that can be used either as a portable or as a fixed local space heater, then it has to comply with both requirements. In practice, this means that the product has to comply with the most stringent requirements, i.e. those of the fixed local space heaters.

in the Regulation. It has therefore been suggested to re-name this specific category. The current definition is:

'electric radiant local space heater' means an electric local space heater in which the heat emitting element is to be directed towards the place of use so that its thermal radiation directly warms the subjects to be heated and which has a temperature rise of the grill covering the heat emitting element of at least 130 °C in normal use and/or a temperature rise of 100 °C for other surfaces;

According to the preparatory study, electric radiant heaters resembles other electric heaters (fixed and portable), which emit a combination of radiant and convection heat. The difference is that radiant heaters emits the majority of the heat as radiance, while other heaters often emits 20-30% of the heat as radiance. This share is also referred to as radiant efficiency.

Some stakeholders have argued that the definition based on surface temperature is not accurate, because radiant panels, which emits most of the heat as radiance, can have very different surface temperatures. For example, there are low-temperature large-area radiant systems with a surface temperature of 27-34 °C, which includes for example under floor heating and ceiling radiant heaters.

Because almost all appliances emit some fraction of radiant heat, and other technologies such as underfloor heating are primarily radiant, but are categorised specifically in the Regulation, the 'radiant heater' category is a bit misleading. It was never the intention that the radiant heaters category should encompass all heaters that are primarily radiant, but only a specific segment. However, according to multiple stakeholders the current definition means that the category is empty, because appliances with this definition are not produced.

Some stakeholders have suggested using the same definition as in the French NF electricity performance mark, which define panel radiant heaters as:

Heaters in which the temperature rise of at least 80% of the visible surface of the heat unit exceeds 75K in normal use and for which the ratio of the visible surface of the heat unit to that of the total surface area of the front face is higher or equal to 40%. A metal grille with a perforation rate of at least 50% shall be considered as transparent to radiant heat[54].

[54] NB: The surface of the heat unit seen without the grille shall be considered the visible surface. The visible surface may be seen through a solid material which is transparent to heat radiation. Materials such as quartz are considered to be transparent to this radiation, but not ordinary glass. NB: "Non-visible part" means that a part which cannot be seen from 2m away from the front of the heater and 1.2 m above ground level when the heater is installed.

However, since these heaters are today covered in the fixed heater category, which have stricter ecodesign requirements, it would de facto be a relaxation of requirements for these specific heater types.

Instead it is recommended to completely remove the specific category for radiant electric heaters with surface temperature rise of 130 degrees, since the category today is empty, and all heaters are covered by other categories, which result in this category being obsolete and only causing confusion among producers.

Towel rails

Electric heaters to dry towels and heat the room are not defined in the current Regulation. According to the 2017 guidelines, electric towel rails are covered by the Regulation if they are capable of reaching and maintaining a certain level of human thermal comfort, and are not specified for purposes other than room heating.

According to a majority of the stakeholders, this creates ambiguity and opposes a level playing field, since many high wattage products are sold as specified for heating and drying towels only, and can thus be sold without requirements of compliance to the Ecodesign Regulation, even though the high wattage means they are capable of reaching and maintaining a certain temperature in the room in which they are situated.

There is therefore a broad consensus to include electric towel rails in the scope of the Regulation. Only few stakeholders argue that towel heaters should be kept out of the ecodesign regulation for local space heaters. The argument is that they are designed to maintain a certain surface temperature, one that is enough to dry the towel, and low enough to be safe and thus cannot at the same time maintain a certain level of human comfort. However, due to the often large surface area towel heaters still contribute significantly to the indoor heating.

Despite the general agreement to include towel heater in scope of the regulation, several different viewpoints as to how this should be done have been raised, and the four main options are:

- Option 1: Including towel rails in the scope of the Regulation on the same terms as other electric heaters.
- Option 2: Including towel rails in the scope of the Regulation as a separate category.
- Option 3: Including towel rails above a certain wattage in the scope of the Regulation as a separate category
- Option 4: Including towel rails above a certain wattage in the scope of the Regulation as a separate category, and all above a certain, higher, wattage as fixed heaters

The first option would result in most towel rails being categorised as fixed heaters with the same correction factors and requirements. However, according to stakeholders, towel rails are used differently and have some other features than other fixed heaters, primarily because they are often used in bathrooms.

The second option takes into account these differences in use patterns by creating a specific category for towel rails, which allows for setting requirements and defining correction factors that are relevant for these specific heater types. However, some towel rails are too small (in terms of wattage) to be able to reach and maintain a certain temperature in the room in which they are situated, and are thus not considered to be local space heaters.

The third option is preferred by most stakeholders, since it includes only towel rails that are capable of heating the room in the scope of the regulation, while appliances with small wattages, which are only good for drying/heating towels, are not included. However, some stakeholders argue that towel rails above a certain wattage are not limited to use in bathrooms due to the flexibility of design and therefore suggest that above a certain wattage, towel rails should be regulated as fixed heaters.

The study team recommends following a combination of option 4, but with one modification: including all towel heater (disregarding wattage) in the regulation as a separate category, but with differentiate the requirements for towel heaters above and below a certain wattage. In this way loopholes for heaters (towel heaters and those sold as such) below the threshold wattage are avoided. In order to do this, the towel rail product group needs to be defined.

Towel rail definition

Following the above recommendations of including towel rails in scope, the category needs to be properly defined. Stakeholders have proposed a number of definitions and names for the category as well as different minimum wattage thresholds.

Some argue that the definitions of towel rails should be aligned with the harmonised safety standards they comply with. Towel rails comply with EN 60335-2-30 (safety standard for room heaters) as well as EN 60335-2-43 (safety standard for clothes dryers and towel rails). However, the standards cannot be specifically mentioned in the legal definition, even though the wording can be used, in order to ensure alignment between the standards and the Regulation. In the standard the products are referred to as towel rails, and is recommended to adopt this name in the ecodesign regulation as well.

According to EN 60335-2-43 towel rails are defined as "*appliance to hold, warm and dry towels. These appliances may also be suitable to dry swimwear, bath robes or the like*", however this definition is not specific enough to be used as a regulatory definition, as this could also apply to other products, e.g. a heating cupboard.

Since the technology of towel rails is very similar to that of electric fixed heaters, it is difficult to distinguish them as a separate category based of technical features. The main difference is that towel rails are dedicated to being covered in order to dry or warm linen, which should be included in the definition. However, wordings such as "intended to be used in the bathroom" or "designed for drying/heating towels" should be avoided in order to prevent loopholes. The recommended wording of the definition is:

'towel rail' means a fixed local space heater which is equipped with additional features so that to hold and dry or warm towels.

Furthermore, a specific wattage threshold could be added to the definition for towel rails, as discussed below.

Towel rail wattage threshold

According to the third and fourth option for including towel rails in the scope, there is a general consensus that ability to heat a room (and thus be classified as a space heater) depends on the wattage of the towel rails. Hence, in order to determine which towel rails should be in scope, and which should not, a wattage threshold should be set. The following suggestions have been made by stakeholders:

- Include towel rails of ≥150 Watt nominal power
- Include towel rails of ≥250 Watt nominal power
- Include towel rails of ≥300 Watt nominal power
- Include towel rails of ≥150 Watt to 300 Watt as towel rails, and those >300 Watt as fixed heaters

The threshold of ≥150 W is suggested in light of the capability to reach and maintain a temperature in smaller bathroom (up to $10m^2$) in a well-insulated building, based on the German building standard, which requires down to 15 W/m2 in passive houses[55]. However, with an appliance this size, the time needed to heat a $10m^2$ bathroom e.g. 3 degrees would be substantial. Even though heating the air alone (around 25 m^3) might take only 10 minutes, heating the walls, ceiling, furniture etc. would take much longer, most likely hours, since their thermal mass is much higher. It can therefore be argued that 150 W is too low a threshold.

[55] Higher German building standards like KFW 55 requires just 15 to 25 W/m² heating capacity for KFW 40 buildings (passive houses)

250 W was suggested as a threshold as this is also used for fixed heaters, where different requirements apply for those above and below 250 W.

The suggestion of a ≥300 W threshold is based on the same arguments as the first: that below 300 W the products do not guarantee an adequate level of thermal comfort in average bathrooms and therefore do not allow them to be considered as local space heaters. Furthermore, some national quality labels in other European countries (NF in France, for example) have already adopted a similar discriminating criterion, with the same threshold.

For the fourth option (150-300 W and above 300 W rated as fixed) it is argued that to avoid creating a loophole where the heaters can be sold as towel rails, but due to flexibility in design be used in any room as fixed heater, the requirements need to be the same over a certain threshold. This can also be avoided by setting similar requirements to the towel heaters as to the fixed heaters, to make such a loophole unattractive to use.

Based on the findings of this study and dialogue with stakeholders, it is recommended to include towel heaters in the regulation as their own, specific category, but differentiate between two size ranges: those above and below 250 W (as for fixed heaters), with different requirements for the two ranges. Products below 250 W will not be enough to heat most bathrooms, and it is therefore suggested that requirements for these heaters are less demanding than for those above 250 W. The specific requirements and control factors are determined in section 7.11. It is suggested to have a specific category for towel heaters, since they are used in a different way than fixed heaters (see task 3, section 3.3.3).

This threshold is chosen, even though towel rails below 250 watts are not sold on all markets, in order to avoid loopholes. Even some of the heater below 250 are according to some stakeholders sold with room thermostats, which indicates that they are sold and used for heating purposes as well as for drying towels. However, requirements should be adapted for each of the size ranges, as mentioned above.

Hence, towel rails below 250 watts would have one energy efficiency requirement, while those above 250 watts would have another, stricter requirement, but all towel rails should have the same correction factors. Efficiency requirements of towel heaters should be based on relevant correction factors. For small towel heaters, only simple controls are considered relevant while for large towel heaters more advanced controls are relevant. This will be elaborated in sections 4.4.1 and 7.1.2. Slave heaters

Regulation 2018/1188 currently exempts slave heaters from any requirements. There is a broad consensus among stakeholders that the definition and exemption of slave heaters[56] creates ambiguity and doubt about which products are included, and therefore creates a loophole in the regulation. The far majority of stakeholders have thus called for deleting the definition and exemption of slave heaters entirely form the regulation.

Clarification of the slave heater definition

The 2017 guidelines further elaborate the slave heater definition[57], by stating that to be a slave heater, an appliance need to comply with the following conditions:

- No built-in control of any kind (including a simple on/off switch)
- Have a component that can receive a signal from an external master controller
- Cannot emit heat without a signal form the external master controller (i.e. not capable of autonomous operation)
- The electric mains power connection does not count as a control signal

These elaborations should leave no doubt that electric heating products, which can emit heat simply by being plugged into the mains power supply (no matter if this is with a power plug, relay or other connection type), without the use of any control, are not exempted from this regulation by the slave heater definition. This includes also simple resistors (such as cables) which will emit heat if any type of power supply is added. This is one of the reasons why the definition is so highly disputed.

Controls for slave heaters

The reason for exempting slave heaters from the regulation is the assumption that these heaters will be connected to advanced controls, e.g. central control systems that adjust heating requirements in entire buildings and which have the necessary functions for the system (slave heater + control) to comply with the Ecodesign Regulation. In these cases, there is no good option to integrate controllers in the heating product, since all regulation of heat output is managed by the external controller, and the controller sold with the heater would be superfluous.

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[56] "an electric local space heater which is not capable of autonomous operation and needs to receive signals sent from an external master controller, not being part of the product but connected to it by pilot wire, wireless, power line communication or an equivalent technique, in order to regulate the emission of heat into the room in which the product is installed"

[57] The 2017 guidelines for the regulation deals with slave heater configurations in point 14, 15 and 16: "**14.** Are 'slave' heaters in the following configurations considered slave heaters for Regulation (EU) 2015/1188?", which is answered with a drawing of different configurations that are considered slave heaters. "**15.** Is an electric space heater considered to be a slave heater for Regulation (EU) 2015/1188 if it consists of an electric space heater but lacks an electric plug? *The existence of an electric plug is not decisive. What is decisive is whether the product has a component that receives a signal from the master controller and that regulates the emission of heat accordingly. When a product has such a component it is considered to be a slave heater. The product cannot emit heat without that signal.*" And "**16**. What does 'not capable of autonomous operation' mean? *'Capable of autonomous operation' can be derived from the definition of a slave heater (Article 2(16) of Regulation (EU) 2015/1188): 'needs to receive signals sent from an external master controller, not being part of autonomous operation the product but connected to it by pilot wire, wireless, power line communication or an equivalent technique, in order to regulate the emission of heat into the room in which the product is installed'. The signal to be provided is a control signal; this does not include the power connection and the option of just switching power ON and OFF. Therefore, a heater without control that will start heating when switching power ON and OFF is not a slave heater according to the definition of Regulation (EU) 2015/1188.*"

However, it is reported by stakeholders that many controls exist, which can be combined with the slave heaters, which does not ensure that the system (heater + control) lives up to the ecodesign requirements, and the slave heater exemption therefore poses a loophole. Several solutions have been suggested by stakeholders to close this loophole:

1. Require all heaters to be sold with adequate controls to ensure compliance with ecodesign requirements
2. Include all controls in the regulation with the same minimum requirements and correction factors as the corresponding local space heaters
3. Include slave heaters in the scope of the regulation and impose relevant information requirements
4. Delete the slave heater category entirely and impose relevant information requirements on all local space heaters sold separately from the control

The first option would ensure that all products live up to the ecodesign requirements, at least on paper, but it would also result in numerous controls being placed on the market which are never used, because the product is instead connected to a control bought separately or a building automation control system (BACS). Hence, this solution is neither environmentally nor economically feasible.

The second option would ensure that it is not possible to purchase a control that does not have adequate functions to make the system (heater + control) compliant with the ecodesign requirements. However, this solution gives rise to a number of difficulties. Firstly, in order to include controls in the scope of the regulation, they would need to be defined in a concise way, that leaves no doubt about which controls are regulated, and especially ensures that controls for products outside the scope of the Regulation are not regulated. However, controls outside scope might still be able to function with the slave heaters, again resulting in non-compliant systems.

Furthermore, the different categories of local space heaters all have different requirements and applicable correction factors, making it necessary to define exactly which controls fit each type of local space heater. While this might be possible, it is highly likely to cause further room for interpretation and simply replace one problem with another and make the market very difficult to navigate for consumers. Furthermore, it would still be possible to use controllers designated for specific product categories for other types of local space heaters.

Another issue with the second option is that the definition of controls should not overlap or interfere with the definition and regulation of BACS, for which an ecodesign preparatory study is currently being carried out[58]. However, the time frame for a (potential) implementation of a BACS Regulation is long, and the need for a more short-term solution for the local space heaters is recognised.

The third option entails including slave heaters in scope of the regulation and define information requirements, which specifies exactly which controls or BACS each slave heater needs to be combined with. A further simplification would be to expand such information requirements to all local space heaters that are not placed on the market with the control, as per option 4. This would eliminate the need for defining slave heaters, but in turn require a definition of what is meant by "placed on the market with the control".

In order to simplify the regulation and prevent further loopholes or grey areas, it is recommended to implement option four and define requirements for any local space heater sold without the control that makes them compliant with the ecodesign requirements. This could possibly be combined with option 2, at least on the short term, to make it clear which controls are intended to be used with which local space heaters. This will allow for inclusion of heaters currently defined as slave heaters in a concise and consistent way. Furthermore, it will bring more flexibility to a market moving towards digital and customisable technology.

There are opposing views among stakeholders as to whether controls (not including BACS) for local space heaters should be covered by the regulation or not. Some state that it is not necessary to include them, if precise information is given on the heater as to which specific control (with product number) it should be installed with. Such specific definition of applicable controls, however, will hinder small independent control manufacturers to sell controls separately, since most manufacturers would choose to specify their own controls. Other stakeholders therefore support option 2 to include all control in the regulation with the same minimum requirements and correction factors as the corresponding local space heaters. Hence, if a control is sold for an underfloor heating system, the installation as a whole should live up to the ecodesign requirements for underfloor heaters, which is solely dependent on the control functions. This then means, that the control itself should always have the functions that make it ecodesign compliant when combined with a simple resistor cable.

Some of the problems that have been raised with the current exemption of slave heaters and the slave heaters definition, which would be solved by removing the category all together are related to underfloor heating and to products sold specifically to be used with BACS systems. Underfloor heating products are elaborated in the next section.

[58] https://Ecodesignbacs.eu/welcome

Heating products used with BACS might not have integrated sensors or thermostats, since these can be located elsewhere, e.g. in the ceiling, from where they feed information to the BACS, which then regulates the connected heaters. However, this is often done with a Pulse Width Modulating (PWM) thermostat and a relay that connects 230V (or 400V) directly to the radiator, thus not using any of the control communication options defined in the current slave heater definition[59]. Hence these products would be not exempted from the regulation, but should not be banned from the market either.

Following option 4 would require that these products are sold with adequate information about which control system they should be used with, to avoid that they are installed without adequate functions by mistake. Following option 2 would ensure that controls put on the market for local space heaters live up to the requirements for that specific type of local space heater, and they are easy for end users and installers to identify.

Requirements for heaters sold separately from the control

In order to follow the suggestion above of removing the slave heater definition and thus the exemption from the regulation, requirements should be made for all local space heaters sold without a control and/or other electronic needed to improve their energy efficiency.

These requirements should be elaborated at a later stage, but at the conceptual level they should contain:

- A statement that if a product is put on the market with any type of control, the ecodesign energy efficiency determination shall be based on this control

This is to ensure that a product cannot be sold with a simple, non-ecodesign compliant control, even if the information specified below is provided. This includes on/off switches. The applicable minimum requirements for the heater + control should be those for the product category which the heater fits into (portable, fixed, underfloor etc.). This also entails that any heater that cannot be regulated with an external signal and that can be connected directly to the grid (i.e. are equipped with a plug) should be declared without any additional control factors, since the plug would make it up for an on/off switch. However, if the heater can be regulated by an external signal the following information should be provided and the heater should eb declared with the matching control:

- The minimum requirements for the controls to be used with the product, based on correction factors claimed for the product

This requirement should make it possible for users to pair the heater with BACS or controllers in a way that makes the system ecodesign compliant. The information should make them aware of which functions the controls must have for the appliance to work

[59] EHI, European Heating Industry

properly in accordance with ecodesign. This could also include type of communication technology the controller needs to have. This is to accommodate that there is no one-to-one relationship between controllers and heaters, and one heater can be used with multiple controls. The term "control" should also cover BACS, and the information should include specific functions that the controls or BACS need to have to be used with the product.

An additional requirement could be put on the controls sold for local space heaters (not including BACS), in accordance with option 2. If this is chosen, the following information should be provided:

- For which type of local space heater the control is suitable (based on the categories in the regulation) and which specific functions the control has (based on the correction factors in the regulation.

This would ensure that end users and installer can always find the controls with the functions that are necessary for fulfilling the ecodesign requirements. This means that if it is stated on a heater (sold without control) that the heater should be installed with a control with e.g. "automatic room temperature control", the function "automatic room temperature control" should be mentioned on the control itself. Then the information on the heater could also include a statement in the lines of "this heater must only be connected to an Ecodesign thermostat with high enough seasonal energy factor, required for the product concerned".

For all of the above the following should be included in the regulation:

- Definition of where all of the above information should be shown and made available for end-users

This requirement shall ensure that the information will always be available and easy for end-users to find.

According to stakeholders it is not possible to require that electric local space heaters are not able to emit heat unless it is connected with a control or BACS, because all that is needed is an electric current. However, it should be informed very clearly that the appliance cannot be installed or operated without a separately purchased control.

Hence, it is recommended that the information requirements and ecodesign requirements should cover all local space heaters and their controls, also those sold separately, and information requirements should be developed to easily identify and install together matching heaters and controls.

Underfloor heaters

Electric underfloor heaters are included in the scope of the Regulation when they are sold with controls. Underfloor cables sold without controls have been considered slave heaters by some. Some stakeholders clearly indicate that they perceive the slave heater principle to be applicable for underfloor heaters, while others state that a signal receiving component needs to be present for the slave heater definition to apply[60]. While it is not the task in this review study to conclude or interpret any definitions of the current regulation, it is clear that the slave heater definition brings a lot of ambiguity, also for underfloor heaters. This means that many of the same issues have been raised for underfloor heaters as are mentioned for slave heaters above, including the risk of end users not using the underfloor heating cables with the adequate controls.

For underfloor heaters sold without controls, the same options exist as for the slave heaters:

1. Require all underfloor heaters to be sold with adequate controls to ensure compliance with ecodesign requirements
2. Include all controls in the regulation with the same minimum requirements and correction factors as the corresponding local space heaters
3. Include all underfloor heaters in the scope of the regulation and impose relevant information requirements

For the first two options the same issues also arise: to equip all heaters with controls causes excessive use of resources and higher costs for end-users, who might choose not to use the included control. This solution is therefore not in line with the resource efficiency and circular economy policies of the European Commission. To include all controls in the regulation could add to the complexity of definitions, as explained above, and the risk that other control types could be used for the underfloor products, even though they were not designed for it.

Seen in light of the above recommendation to remove the slave heater definition, it is recommended to include underfloor heaters sold without controls on equal terms as other heaters sold without controls by imposing the same information requirements. That means that if not sold within one physical package, the product must have clear information on the necessary functions of external controls. The system (i.e. heater + control) should live up to the ecodesign requirements for underfloor heaters and employ the correction factors for underfloor heaters.

[60] It has been pointed out by some stakeholders that underfloor heaters are not slave heaters according to the current Regulation as they are capable of autonomous operation in the sense that they are sold without a relay and will start to heat if it is connected directly to the mains supply.

This would also solve the issue that heating cables today do not fit the slave heater definition, because they can be operated autonomously, i.e. they are able to emit heat without receiving a control signal by simply being connected to the mains grid.

<u>Definition of underfloor heaters</u>

One stakeholder has suggested to re-name the underfloor heaters in the regulation, to “embedded” heaters, since it can be embedded in all areas of the room, such as wall and ceilings. However, the definition in the regulation does not leave out heaters embedded in other areas, since it is defined as “an electric local space heater designed to be used while incorporated in the building structure or building finishing”. While changing the name would not change the coverage of the category in practice, “underfloor heaters” seems more easily understandable and it is recommended to keep this wording.

Self-regulating heating cables

A type of heating cable that is sometimes seen used as a local space heater, e.g. for underfloor heating is self-regulating heating cables also called self-limiting heating cables, heating tape, or heat trace cables. These heaters automatically adjust their heat output based on surface temperature.

These self-regulating heating cables is another area of dispute among stakeholders. On one hand, one stakeholder claims that these heating cables are always used without controls, and thus cannot live up to ecodesign regulations, and should be banned entirely. According to these stakeholders, the primary use for such cables is freeze protection and low temperature process maintenance such as water pipe heating and roof and gutter freeze protection.

Other stakeholders, including producers of these cables, however, state that they are never used without controls, since these are still necessary to control heat output. The cables are often used for temperature sensitive floors, since they can prevent cold or hot spots, but the overall control can still be performed by a controller and these cables has the same efficiency as other types of cable.

Based on the information collected through this study it is recommended to include the self-regulating cables in the regulation in the same way as other heating cables, and they should thus live up to the underfloor heating requirements. If they are sold without, the same information requirements are recommended as for all other heaters sold without controls.

Mixed heaters

Mixed heaters are systems that combine local heating (as electric heating) with external heating (as connection to a water-based heating system). These are not considered in Regulation 2015/1188, even though it is argued that an electric heating element combined with the individual radiator in the system can function as a local space heater.

The following definition of mixed heaters has been suggested by stakeholders: "'Mixed heater' refers to a product intended to be used in a central heating hydronic system but that also has an electric heater inside and together can be used as an electric Local Space Heater or an electric slave heater when the central heating system is turned off".

Since the central heater of such a system is already covered by Regulation (EU) 813/2013, the question is which technical parts should be included in scope of Regulation 2015/1188, if any.

Including the heat element itself is a possible solution, however it will not be able to heat the room by itself, without being installed in a water-filled radiator. Another option is thus to include the heat element + radiator as a system, but the problem is that these units might often not be purchased together as a kit, but rather as separate items which are then installed together. Another important aspect is how the heat output is controlled, whether it is a central control (maybe even installed with the central heater) or individual for each heat element.

Since the heating element is dependent on the hydronic radiator and cannot heat the room by itself it cannot be considered a local space heater. Furthermore, the information available regarding sales, stock, use patterns, and technical specification is very limited. It can further be assumed that the use of such products is very low, since they are only used when the hydronic system is not used, and can only be installed in specific radiator types prepared for installation of such heating elements. The potential energy savings are thus also assumed to be negligible.

Some stakeholders argue that mixed heaters constitute a loophole in the regulation, since they could be sold as mixed heaters (i.e. a hydronic heater with an additional heat element), but never be installed and connected with the central hydronic system. However, if the consumer wish to install a heater with no connected to a central system, any electric local space heater would be a better choice both regarding efficiency and purchase price. Furthermore, the heater would need to be filled with water in order to work, even with the heating element, so the situation of end users buying and using mixed heaters solely as a local space heater seems unlikely. It is therefore not recommended to include them in the regulation.

Air curtains

One stakeholder has requested that the product group for air curtains should be investigated further in order to determine how these would fit in the scope of regulation. Air curtains are appliances that are placed over doors and discharge a controlled flow of air across the door opening to create an air seal that separates different climatic zones, while allowing unhindered passage through the door. Air curtains thus helps maintaining the indoor temperature by decreasing the infiltration of cold outside air.

A suggested definition for air curtains is:

"A product which creates a uniform stream of directed air, whether heated or unheated, across an opening to create a barrier inhibiting the transfer of heat and particulate matter from one zone to the other. An appropriately designed system will create this barrier across the entire height and width of the opening"[61]

In order to fit the scope of this study and Regulation 2015/1188, only the heated air curtains are considered here, and only those with a local heat source that generate heat in the same place as it is delivered. This limits the considerations to air curtains with direct electric heating[62] (Joule effect heating elements).

As seen from the suggested definition, air curtains serve a different purpose than other local space heaters and the primary function is to act as a thermal replacement for a door in order to:

- Keep flying insects out by creating forceful turbulence
- Prevent outside air entering by reducing infiltration though the opening.
- Avoid cold draughts by mixing in warm air heated by the air curtain.
- Separate different climatic zones

However, they do also contribute to the heating of the indoor space and to "reach and maintain a certain level of human thermal comfort" – though they do not directly heat the space. Whether they can reach a comfortable indoor temperature autonomously, however, depends on the room in which they are installed. For small shops and receptions, the heat output from the air curtain can be a significant contribution to reaching the indoor comfort level, according to Eurovent.

[61] Suggested by Eurovent, representing the biggest European Group of Air Curtains manufacturers https://eurovent.eu/sites/default/files/media/Eurovent%20-%20Air%20Curtains%20Guidebook%20-%20First%20Edition.pdf
[62] Other types of air curtains include those heated by heat pumps or the buildings' central heating system.

However, for most rooms (except very small ones), especially in colder climates, air curtains are not primarily used for heating as it was also noted in the preparatory study: "Air curtains are not used for heating spaces directly, but are used to contain climatic zones within a space (typically to block cold air entering a building)"[63]. Based on all of the above it is therefore not recommended to include air curtains in the regulation.

Outdoor heaters

It has been requested by stakeholders that outdoor heaters should also be investigated with the aim of including them in scope of the Regulation.

While the study team recognizes that there might be potential energy savings related to this product group, the work to include them in the regulation supersedes what is possible to consider in the current review study, seeing that there is no data immediately available. This include data and information regarding:

- Sales volumes
- Consumer prices
- Test methods
- Current efficiency levels and control options
- User behaviour and whether controls can help reduce energy consumption

Furthermore, the scope of the regulation would need to be changed entirely (i.e. the current definition of a local space heater does not apply to outdoor heaters, due to the wording "in an enclosed space").

However, if any of the above-mentioned data is available to substantiate that there is indeed a major environmental issue, the product group should be considered specifically in the next revision.

[63] Preparatory study, task 2, p 26.

1.5.3 Scope recommendations for gas and liquid local space heaters

Changes in product groups of domestic gas and liquid fuel heaters

It has been mentioned by stakeholders that the terms used to define the gas and liquid heater product groups are not in accordance with the market. The current Regulation defines four (domestic) types of gas and liquid heaters with the following characteristics:

Open fronted:

- Fire bed and combustion gases are not sealed from the room
- Sealed to a chimney or fireplace opening or requires a flue duct

Closed fronted:

- Fire bed and combustion gases are sealed from the room
- Sealed to a chimney or fireplace opening or requires a flue duct

Open to Chimney:

- Fire bed and combustion gases are not sealed from the room
- Placed under a chimney or fireplace opening, but not sealed to it

Flueless:

- Not sealed nor fitted under chimney or fireplace opening
- Emits flue gas directly into the room
- Not luminous heaters

The open and closed fronted have specific requirements for energy efficiency and emissions, while flueless and open to chimney heaters only have information requirements.

However, according to stakeholders closed fronted and closed combustion is not the same, even tough, according to the definitions, it seems that what is meant is open and closed combustion rather than open and closed fronted. A close fronted unit can be also open combustion, and the current categories therefore create some doubt of how to classify different types of technology, especially those that are closed fronted, but where the fire bed and combustion gasses are not sealed from the room. The stakeholders suggest changing the categories to the following:

Open fronted/Open combustion[64]:

- Combustion chamber is directly accessible
- Combustion not sealed from room (primary air supply from the room)
- Requires a flue system
- With or without restricted exhaust gas

Open fronted/open combustion without exhaust restriction is what is called "open to chimney" in the current regulation. The open fronted / open combustion appliances with exhaust restriction have a decorative effect, but are also used for heating, even though the "closed fronted/open combustion" appliances (see directly below) are usually more efficient (Table 15), but the greatest selling point of these units are the low price compared (see Table 27).

Closed fronted/open combustion[65]:

- Combustion chamber is closed by a glass or metal pane
- Combustion not sealed entirely from room (primary air supply from the room), but only open through an adjustable air valve/throttle
- Requires a flue system

Balanced flue/closed combustion[66]:

- Combustion chamber is closed by a glass or metal pane
- Combustion is sealed from room (primary air supply from the outside)
- Requires a flue system

As seen from the list of characteristics, the existing open fronted category is actually open combustion, as it is based on whether the fire bed is open, not the presence of a plate. However, there is a fundamental disagreement among stakeholders of whether closed fronted/open combustion appliances, (i.e. where the combustion is not entirely sealed from the room, but air intake is controlled with a valve/throttle) belong to the open fronted or closed fronted category in the current regulation. Both sides of the disagreement claim

[64] "Open fronted/open combustion local space heater": means a local space heater, using gaseous fuel, of which the combustion chamber is directly accessible and not sealed from the space in which the product is fitted, and which requires a flue system for the evacuation of the products of combustion.
[65] "Closed fronted/open combustion local space heaters": means a local space heater, using gaseous fuel, of which the combustion chamber is closed by a glass or metal pane but not sealed from the space in which the product is fitted, and which requires a flue system for the evacuation of the products of combustion
[66] "Balanced flue/closed combustion local space heaters": means a local space heater, using gaseous fuel, of which the combustion chamber is closed by a glass or metal pane and is sealed from the space in which the product is fitted, and which requires a flue system for the evacuation of the products of combustion

that there is no doubt about where these appliances belong, but there is no general agreement.

The relation between the existing and the proposed categories are shown in Table 15. As seen from the table, the flueless heater, open to chimney and balanced flue categories would not change the scope of the products in these categories, but updated definitions (and names) would make it clearer where different products belong.

Table 15: Relation between existing and proposed categories for gas/liquid fuel domestic local space heaters

Existing categories	Proposed categories	Average efficiencies[67]	Current efficiency requirement
Closed fronted	Balanced flue	65-85%	72%
Open fronted or Closed fronted[68]	Open combustion/closed fronted (with controlled air intake)	50-80%	Uncertain (42% or 72%)
Open fronted	Open combustion/open fronted with exhaust restriction	40-65%	42%
Open to Chimney	Open combustion/open fronted no exhaust restriction	15-20%	None
Flueless	Flueless (unchanged)	15-20%[69]	None

As seen from the table, the open combustion/closed fronted appliances have efficiencies significantly higher than the open combustion/open fronted appliances, but lower than the balanced flue devices. For this reason, and due to the disagreement of where these appliances belong, it is suggested to define a separate category for these appliances (open combustion/closed fronted - with controlled air intake), with a specific efficiency requirement. This specific efficiency is further discussed in section 4.5.4.

Decorative domestic heaters

Some stakeholders argue that some gas and liquid fuel heaters are used primarily for decoration and only secondary for heating. The main differences between the two product types are the price and the flame temperature/colour. The wall heaters, used for primary heating, are low-priced and have relatively high flame temperatures with low excess air, which makes the flames blue and results in relatively high NO_X emissions. Decorative heaters are used only for secondary heating, are usually higher priced and have lower flame temperatures with high excess primary air in order to produce orange flames, which results in lower NO_X emissions.

[67] Based on stakeholder inputs
[68] It is an ongoing dispute among stakeholders, where these appliances belong today.
[69] There has been discussion whether the efficiency of flueless heaters is 0% or 100%, since all heat is given to the room, but it is required to have a window open during operation dur to indoor climate and exhaust gasses. A range of 15-20% was based on stakeholder input that flueless heaters will give off some heat to the room, but it is limited due to the opening of windows.

Other stakeholders oppose this view argue that all products have some type of design or at least consideration for appearance and decorative fires are as such not a special group within gas/liquid heaters.

The regulation does not distinguish explicitly between decorative heaters and those used purely for the heating function. This distinction has not been made, because it might lead to loopholes in the regulation, which could be exploited by specifying any product for "decorative purposes". This is in line with the discussion in section 1.5.3 of the overall definition of local space heaters and the current exemption (b), which should not exempt products based on intended use besides the heating function.

In order to avoid any grey areas or loopholes, it is not possible to define and distinguish product groups in the regulation based on specified purposes or appearance such as "intended for…" as such a definition would be highly ambiguous.

If any type of heater is to be defined specifically this should instead be based on technological differences. This is what has already been attempted in the current regulation, by exempting open to chimney (often decorative) from efficiency and emission requirements in return of a statement that they are not suited for heating.

Exclude some domestic product types

It has been suggested by a stakeholder to exclude oil fired local space heaters and closed fronted gas heaters from the scope of the regulation. This exclusion is suggested for the non-decorative, primary heating gas devices only. The reasons for this suggestion are that sales of these heater types are slowly decreasing every year and sales are primarily for replacement of existing appliances in social housing. Furthermore, it is argued that there is no or only very little technical development of these appliances, and that they will be phased out automatically eventually.

Furthermore, it is argued that these appliances are very simple, which makes many of the correction factors redundant for this product group, because they simply do not have the type of controls listed. Therefore, it is argued that they cannot earn all 10% points, which are subtracted in the formula for seasonal efficiency. However, as noted by other stakeholders, additional controls are offered for some products, which makes it possible to earn all 10% bonus points, however such additional controls come at high cost compared to the product price, and thus not all manufacturers offer these options, especially not for the cheap products.

Even though the sales are decreasing for these products, exempting them from the regulation would result in an uneven playing field, as all the types of local space heaters are in principle exchangeable for each other. Furthermore, the fact that they are primarily used in social housing makes it important that the life cycle costs are kept as low as possible, which is ensured by requiring a higher efficiency[70].

It is important to maintain not only the energy efficiency requirements, but also the NO_X requirements for these products because of the higher flame temperature which result in higher NOx emissions. Furthermore, since these products are used for primary heating, they are used more often and for longer periods of time than e.g. decorative/secondary heating appliances, which makes both energy efficiency and emission requirements essential.

Commercial and domestic definitions

The Regulation specifies commercial local space heaters as either luminous or tube heaters, and domestic local space heaters as all other than these types. Based on these definitions, all local space heaters that falls within the product categories defined in the regulation will thus be covered by the requirements, disregarding where they are used.

However, multiple stakeholders have pointed out the problematic use of the term "domestic", since local space heaters of types other than luminous and tube heaters could be used in offices, service sector, health care, education and other building areas that are neither residential or commercial.

The intention of the Regulation is clear, since the terms 'commercial' and 'domestic' are solely based on technology and neither mention anything about where the heater is installed/used. Hence, if an electric heater is used in e.g. a shop (a commercial space), it would still be covered by the regulation and defined as a "domestic" appliance and the calculation of energy efficiency would have to be made based on the formula for domestic appliances.

In order to make this even clearer, several stakeholders suggested removing the "domestic" definition, and one suggested removing both terms and instead focus on the technologies. Neither would change the intent, scope or requirements of the Regulation, but the wording would have to be changed everywhere the terms are used today. However, it would complicate some formulations in the Regulation, even though it would not change the meaning of any statements or requirements.

[70] Commission Staff Working Document, Impact Assessment accompanying the document "Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for local space heaters" and "Commission Delegated Regulation implementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling for local space heaters"
Brussels, 28.4.2015, SWD (2015) 90 final. (p 38, table 15)

Since the commercial and domestic heaters are defined by technology rather than actual place of installation, and the commercial heater types cannot be used in private homes, there would be no ambiguity in adding the word "commercial" to their definition.

The replacement would be:

- Tube local space heater → tube commercial local space heater
- Luminous local space heater → luminous commercial local space heater

Furthermore it has been suggested to add "radiant" to the tube heater definition, i.e. "radiant tube commercial local space heater". However, this does not seem to bring significant clarification to the category, as it is by nature primarily radiant, and it could create confusion of what "radiant" implies. It is therefore not suggested to make this addition.

In order to make the domestic definition clearer, it could be changed from "a local space heater other than a commercial one" to "a local space heater other than a tube commercial local space heater or a luminous commercial local space heater". However, this would not change the intention or the scope of the regulation or the domestic category.

Furthermore, while for example "gaseous fuel local space heater" could also cover commercial types, it is clear in the regulation that this expression covers only "open fronted local space heater or a closed fronted local space heater using gaseous fuel". Hence, there should be no doubt that commercial heaters are not included in this expression.

Some stakeholders argue that this poses a loophole for appliances other than tube and luminous heaters sold for use in commercial settings, however, since neither are exempted from the regulation, this cannot technically be used as a loophole. Furthermore, all requirements are expressed as "all local space heaters except commercial local space heaters" or by stating the product type directly (e.g. "all electric local space heaters"), so it is never implied in the Regulation that the place of installation has any influence on which requirements apply or whether the products are in scope or not.

Appliances between 50 and 120 kW

Another aspect that has been mentioned to be missing from the scope is heaters (of types other than luminous and tube heaters) of sizes between 50 and 120 kW, since the regulation covers only domestic appliances up to 50 kW (and commercial up to 120 kW). However, as mentioned in the preparatory study[71], the heaters used in the residential sector are usually in the range below 12 kW, those often used in commercial and larger non-residential and institutional buildings are in the range 12-20 kW, while appliances from

[71] Task 1 study report, page 33

20-100 kW and above are defined as industrial unit heaters by the preparatory study, which are often air handing units that are exempt from Regulation (EU) 1188/2015.

Hence, even though heaters (of types other than luminous and tube heaters) of sizes between 50 and 120 kW might exist in the market, the number is very low, and the feasibility of including these products in the scope is very difficult to prove. The low market share (if any) of such products might also be the reason for setting the limits at 50 kW and 120 kW in the regulation, and there is no indication at this point of the review study that such products are gaining market shares. It is therefore not recommended to change the scope for these sizes.

Commercial tube heaters above 120 kW

Based on changes in standards related to the tube local space heaters, it has been suggested to include commercial appliances up to 300 kW instead of the current 120 W. The way the tube heater category is formulated in the regulation, it includes both what is called radiant strips, which are tested according to prEN 17175:2017[72] what is called radiant tube heaters, tested according to prEN 416:2017. While the current limit of 120 kW was based on the EN 416 test, the new draft standard prEN 17175 titled defines a limit of 300 kW (heat input) of the radiant strips.

It is therefore recommended to change the limit for the scope of the regulation to go up to 300 W for commercial heaters. Technically, the strip heaters are often supplied with gas from outside the building/room it is heating, in order to avoid gas piping running indoors. Otherwise, the heat generation takes place in the room itself.

Split the Regulation into two

It has been noted by a stakeholder that there are significant technical differences between the electric and gas/liquid fuelled local space heaters in the domestic segment, and it has therefore been suggested to split the Regulation into two new Regulations: one for electric local space heaters and one for gas/liquid local space heaters, the latter also comprising the commercial heaters.

The proposal is based on the differences in emissions and efficiency, which is argued to not allow a common policy approach, and that a distinction between these specific product groups would allow a more detailed look into the particular specificities of each. Especially the discussion on smart appliances and advanced controls are argued to be much less relevant for room heating products fired by gas/liquid, as it is unlikely that these will be linked to a smart home, in particular gas and oil stoves which are typically a pure replacement market in cheap dwellings. However, the area of room heating in general is

[72] prEN 17175 *"Gas-fired overhead radiant strip heaters and multi-burner continuous radiant tube heater systems for non-domestic use – Safety and Energy Efficiency"*

characterised by a very large technological variety and splitting up all heating appliances regulations for each technology would create a much larger administrative burden and induce a risk that they would develop in different directions. Keeping the products bundled in fewer regulations makes the overall regulatory picture more consistent. If the local space heater regulation was split, it would therefore only make sense to merge the product groups with those in other regulations, for example electric heaters with air conditioners/heat pumps and gas and liquid heaters with solid fuel heaters. In that case it would still be simpler to keep the regulatory scope as it is.

Technically, there is no reason not to split the Regulation into two separate Regulations, however, it should be kept in mind that the two product groups are still possible replacements for each other. Even though the cheap gas/liquid appliances are primarily sold as replacements, the end-user could choose to buy an electric heater instead. It is therefore important that the requirements set for the product groups are aligned, even in case of two separate Regulations. Separating the product groups into their own Regulations might complicate the policy processes, since dates for reviews, entering into force and application of requirements would need to be aligned.

1.5.4 Possible 3rd party conformity assessment

In accordance with the review clause of the regulation (Article 7), the appropriateness of introducing third party certification should be assessed on this study. This is also mentioned in the review clause of regulation 2015/1189 for solid fuel space heaters, for which a special review study focusing only on the assessment of appropriateness of third party testing is ongoing.

Article 8 of the Ecodesign Directive[73] specifies that the conformity assessment procedure shall be the internal design control set out in Annex IV and the management system set out in Annex V of that Directive. Only when duly justified and proportionate to the risk, a conformity assessment according to the relevant modules as described in Annex II to Decision No 768/2008/EC74 will be proposed. A summary of these modules can be seen in Annex C.

The relevance is determined by the following criteria mentioned in Decision No 768/2008/EC (Article 4):

- Whether it is appropriate to the type of product;

[73] Ecodesign Directive 2009/125/EC Annex VII point 6.b, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0125&from=EN

[74] Decision No 768/2008/EC of the European Parliament and of the Council of 9 July 2008 on a common framework for the marketing of products, and repealing Council Decision 93/465/EEC, OJ L 218, 13.8.2008, p. 82–128

- The nature of the risks entailed by the product and the extent to which conformity assessment corresponds to the type and degree of risk;
- Where third party involvement is mandatory, the need for the manufacturer to have a choice between quality assurance and product certification;
- The need to avoid imposing modules which would be too burdensome in relation to the risks covered by the legislation concerned.

The relevance of 3rd party testing depends very much on the type of fuel, which affects the potential risk of faulty measurements. The assessment of need for 3rd party conformity assessment has therefore been split into consideration of electric and gas/liquid heaters, respectively. However, it should be considered that having different conformity assessment requirements for different product groups in the same Regulation might affect the intended level playing field.

The drawbacks of third party conformity assessment include increased testing cost (and eventually increased product purchase prices for consumers) and could potentially lengthen the time to market for new products.

The advantages of third party conformity assessment include higher certainty for end-users of the accuracy of the test results, especially for products with high variability in test results depending on small adjustments in external parameters. Third party conformity assessment makes it much harder to place non-compliant products on the market, and in case it happens, they are easier to detect through simple document control, without needing to perform tests. This means that market surveillance can inspect a larger number of products with the same resources.

Third party conformity assessment for electric heaters

As pointed out by some manufacturers of electric space heaters, the third-party certification seems disproportionate to the risk, since there is no extraordinary health or safety risks related to electrical heaters. Furthermore, the test standards are quite straight-forward without much room for interpretation. According to industry this is true for both the energy efficiency and safety tests. Furthermore, Decision 768/2008 specifies that Conformity assessments shall be carried out in a proportionate manner, avoiding unnecessary burdens for economic operators”[75].

The economic burden of introducing third party conformity assessment need to be investigated further, however, according to stakeholders it would be significant.

Third party conformity assessment for gas and liquid fuel heaters

[75] Article R27 of Decision 768/2008

For gas and liquid fuel heaters, the associated human health risk of the combustion gasses might make third-party testing relevant. Due to the large number of uncertainty parameters (fuel quality, air flow, flue duct settings), it is easier to adjust the test, even within allowed parameters, to obtain a better result. Since this will not only affect energy efficiency but also human health, 3rd party testing could thus be relevant for liquid and gas fuelled local space heaters.

Gas and liquid local space heaters are required to be type tested under the Gas Appliances Regulation (GAR)[76], which requires a mandatory 3rd party certification for this product group. Therefore determination of efficiencies and emissions are carried out as a third party type test by a Notified Body.

According to stakeholders the results from the tests performed under the GAR are also used for the ecodesign declarations. As mentioned in the special review study for 3rd part conformity assessment of solid fuel products[77], the legal implication of introducing 3rd party conformity assessment in the ecodesign regulation, could be that laboratories need to be accredited twice (for GAR and for ecodesign), which will cause additional administrative costs, without adding any value, if the GAR results are already used.

The cost for implementing 3rd party requirements for gas and liquid fuel local space heaters would be the additional accreditation and notification costs for the laboratories. These are estimated to be around 2500-3000 € per lab each 18 months as well as the cost for auditing which is around 300 € per day[78]. This cost would be passed on to the manufacturers though testing fees. Furthermore, if the laboratories accredited under GAR and ecodesign respectively were not the same laboratories, test times might increase significantly, leading to a longer time to market for the products involved.

A pragmatic approach could be not to introduce 3rd party conformity assessment for gas and liquid local space heaters, since it is already today the norm, that the results from GAR tests (performed by 3rd party laboratories) are used. In order to be certain that this is the practice, it could be written in the ecodesign regulation (and possibly the energy label regulation, which is not part of this review study) that results should be based on the declaration of conformity issued by the 3rd party notified body under the GAR. This solution would not result in any extra costs, since all ecodesign (and possibly energy labelling) calculations would still be performed by the manufacturers themselves.

[76] OJ 99, 31.3.2016, p. 81 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016R0426
[77] https://www.3rdpartysolidfuel.eu/
[78] These costs are collected form stakeholders (laboratories specifically) in connection with the special review study on 3rd party conformity assessment of solid fuel heaters.

2. Market and stock

The data presented in task 2 are mainly based on the preparatory study, impact assessment, inputs from stakeholders and PRODCOM. The sales data from PRODCOM is often considered to be unreliable[79] so more emphasis is put on the data found in the impact assessment, even though the product categories in the impact assessment does not fit exactly with the categories in Regulation (EU) 2015/1188. The sales data for the categories are fitted by comparing data in the impact assessment and the preparatory study to form a basis for discussion with stakeholders.

In general, the impact assessment is used as a baseline for discussion in connection with:

- Sales data. The sales data in the impact assessment ends in 2030. The subsequent years are based on linear projections from 2020 to 2030.
- Lifetime estimations
- Consumer expenditures such as the purchase price[80], installations costs and repair and maintenance costs.

These values are then corrected based on stakeholder inputs to fit the current situation after the introduction of Regulation (EU) 2015/1188. In task 2 the impact of the regulation is taken into account in:

- Sales data as the impact of the regulation effect on the market by applying higher cost for certain products due to energy efficient improvements (controls). These considerations are established by the help of stakeholders.
- Increase in efficiency of products. Inefficient products are effectively removed from the market due to the minimum requirements.
- Consumer expenditures such as the purchase price[81], which has increased due to the minimum efficiency requirements.

As no databases currently fits with the categories in Regulation (EU) 2015/1188 it is not possible to determine the above-mentioned points without inputs from stakeholders.

2.1 Sales

The PRODCOM statistics are the official source for product data on the EU market. It is based on product definitions that are standardised across the EU thus guaranteeing comparability between Member States. Data are reported by Member States to Eurostat.

[79] experience from other studies and also the MEErP guidance document itself shows that the PRODCOM data are not very reliable for the analysis of individual products.
[80] In the impact assessment the correlation between purchase price and level of efficiency is determined.
[81] In the impact assessment the correlation between purchase price and level of efficiency is determined.

The PRODCOM statistics have some limitations given the complexities in the market and are therefore not always as detailed as necessary to support decision making within ecodesign preparatory studies. This is also the case for data on local space heaters.

Within this study, the PRODCOM statistics are used solely for comparison against product data obtained from other data sources such as expert assumptions and data from the preparatory study. The product data was used to establish annual sales for product categories in scope, and subsequently for establishing the installed base in the EU (i.e. stock). PRODCOM EU sales and trade (i.e. the EU consumption) is derived by using the following formula based on data from PRODCOM:

$$EU\ sales\ and\ trading = production + import - export$$

The results can be seen in Table 17, where the following PRODCOM categories (Table 16) have been used to search for available data in the database.

Table 16: PRODCOM codes and nomenclature

	PRODCOM Nomenclature – (NACE Rev 2, from 2007)
27.51.26.30	Electric storage heating radiators
27.51.26.50	Electric radiators, convection heaters and heaters or fires with built-in fans
27.51.26.90	Other electric space heaters
27.52.12.33	Iron/steel gas domestic appliances with an exhaust outlet (including heaters, grates, fires and braziers, for both gas and other fuels; excluding cooking appliances
27.52.12.35	Iron/steel gas domestic appliances (including heaters, grates, fires and braziers, for both gas and other fuels radiators; excluding cooking appliances and plate warmers, those with an exhaust outlet)
27.52.12.50	Iron or steel liquid fuel domestic appliances, including heaters, grates, fires and braziers (excluding cooking appliances and plate warmers)
27.52.13.00	Air heaters/hot air distributors n.e.c., of iron or steel, non- electric

Table 17: Data from PRODCOM – production, import, export and the calculated EU sales

	2009	2010	2011	2012
	27512630 - Electric storage heating radiators			
Production	619.857	801.258	445.775	638.531
Import	332.333	332.941	342.972	262.330
Export	406.067	311.707	359.624	283.389
Sales	546.123	822.492	429.123	617.472
	27521300 - Air heaters or hot air distributors n.e.c.. of iron or steel. non-electric			
Production	1.930.630	2.200.053	2.542.014	1.624.707
Import	0	0	0	0
Export	0	0	0	0
Sales	1.930.630	2.200.053	2.542.014	1.624.707
	27521250 - Iron or steel liquid fuel domestic appliances. including heaters. grates. fires and braziers (excluding cooking appliances and plate warmers)			

	2009	2010	2011	2012
Production	112.981	600.728	347.622	81.387
Import	842.873	1.347.384	1.225.957	542.248
Export	137.252	125.089	93.060	31.076
Sales	818.602	1.823.023	1.480.519	592.559
	27521235 - Iron or steel gas domestic appliances. including heaters. grates. fires and braziers. for both gas and other fuels radiators (excluding cooking appliances. plate warmers and appliances with an exhaust outlet)			
Production	1.523.564	1.687.590	1.349.983	0
Import	2.469.321	2.735.633	2.808.235	0
Export	294.164	241.786	236.738	0
Sales	3.698.721	4.181.437	3.921.480	0
	27521233 - Iron or steel gas domestic appliances with an exhaust outlet. including heaters. grates. fires and braziers. for both gas and other fuels (excluding cooking appliances and plate warmers)			
Production	649.365	673.651	626.351	0
Import	86.822	153.421	204.076	0
Export	86.963	66.978	69.622	0
Sales	649.224	760.094	760.805	0
	27512690 - Other electric space heaters			
Production	7.970.802	8.915.862	12.000.000	11.700.000
Import	10.437.039	13.861.311	17.256.141	17.672.707
Export	4.423.462	8.006.730	8.789.139	9.741.416
Sales	13.984.379	14.770.443	20.467.002	19.631.291
	27512650 - Electric radiators. convection heaters and heaters or fires with built-in fans			
Production	6.453.667	6.384.216	5.796.166	4.532.085
Import	15.220.682	18.910.184	21.265.702	15.200.982
Export	1.724.605	1.540.037	1.957.690	1.401.069
Sales	19.949.744	23.754.363	25.104.178	18.331.998

As seen in Table 17, the newest obtainable data from PRODCCOM was in 2012 for the presented product categories. Furthermore, for one of the categories the data for import and export is 0 (PRODCOM code: 27521300) which seems very unlikely. In addition, experience from other studies and also the MEErP guidance document itself shows that the PRODCOM data are not very reliable for the analysis of individual products. This also applies to local space heaters, since the PRODCOM categories have a different scope than the regulations and the data therefore cannot be used to represent the market of products in scope of the regulations or the study. The difference in scope is e.g. presented in connection with gas and liquid heaters were grates, fires and braziers are included in PRODCOM but not in the regulation.

In addition, according to the PRODCOM values the sales seems to fluctuate a lot which is not considered to be the case.

Hence, the sales volumes of local space heaters within the EU is therefore based on the preparatory study, the impact assessment and inputs from manufactures.

2.1.1 Sales split and market shares

The sales are based on the impact assessment and updated based on stakeholder inputs. The current assumption for sales is shown in Table 19. In general, it is difficult to fit sales numbers from GfK, PRODCOM or other sources to the categories in the regulation as some of the categories are very broad while others are very specific. Furthermore, the categories from the regulation and the categories from the impact assessment are not aligned. The sales from the impact assessment[82] is fitted to categories in the regulation[83] and presented to stakeholders for validation of the numbers. Based on consultation with stakeholders the following is assumed:

- The sales of electric fixed space heaters from the impact assessment are assumed to be correct. However, the future sales of electric space heaters are very difficult to predict, and different stakeholders have suggested both and increase and decrease in future sales. Hence, the sales are assumed to be stable from 2016 towards 2030.
- No sales data is available on radiant heaters (the current legal definition), because no products exists that fit this definition according to manufacturers.
- The sales of domestic gas appliances are too high in the impact assessment as the market has been declining for years. So, the current sales of domestic gas appliances are corrected and based on sales from the UK and the Netherlands[84] assuming that these two countries are responsible for 80 % of the total market. For domestic gas appliances the future sales are expected to decrease with 30 % towards 2030. After 2030 the sales are assumed to be stable.

Regarding liquid heaters no stakeholders have supplied any information, so the sales are in principle unknown. However, the sales are estimated to be roughly 10 % of the sales of gas heaters and follows the same trend.

The average growth rate for the different products are presented in Table 18.

Table 18: Assumed average annual increase in sales from 2016-2030

Product	Average annual increase/decrease between 2018-2030
All types of electric heaters	0%
Commercial types gas/liquid	-2,5 %
Domestic types gas/liquid	-2,5 %

[82] Impact assessment, available at: http://ec.europa.eu/transparency/regdoc/rep/10102/2015/EN/SWD-2015-90-F1-EN-MAIN-PART-1.PDF
[83] Note that the sales also have been adjusted to include sales from Norway.
[84] CEFACD and HHIC

In Table 19, the sales from 2000-2050 is presented. Note that the sales of towel heaters and air curtains are included in the table.

Table 19: Expected sales from 2000 - 2050

	2000	2010	2020	2030
Electric (1000 units)				
Electric portable local space heaters	6622	7304	7578	7578
Electric fixed local space heaters with a nominal heat output above 250 W	4503	5088	5323	5323
Electric fixed local space heaters with a nominal heat output equal or below 250 W	1126	1272	1331	1331
Electric storage local space heaters	299	300	285	285
Electric underfloor local space heaters	1177	1300	1349	1349
Electric radiant local space heaters	0	0	0	0
Electric visibly glowing radiant local space heaters with a nominal heat output above 1,2 kW	138	154	160	160
Electric visibly glowing radiant local space heaters with a nominal heat output equal or below 1,2 kW	59	66	69	69
Towel heaters	1500	2000	2000	2000
Air curtains	25	30	38	43
Total	15449	17514	18134	18138
Gas fuel (1000 units)				
Gaseous luminous local space heaters (commercial)[85]	39	30	22	17
Gaseous tube local space heaters (commercial)	39	30	22	17
Gaseous fuel open combustion/open fronted with exhaust restriction	186	110	60	46
Gaseous fuel open combustion/closed fronted	371	221	119	91
Gaseous fuel balanced flue	148	88	48	37
Gaseous flueless heaters	13	13	12	9
Gaseous open to Chimney heaters	26	26	24	18
Total	822	517	306	234
LIQUID fuel (1000 units)				
Liquid tube local space heaters (commercial)	4	3	2	2
Liquid fuel open combustion/open fronted with exhaust restriction	19	11	6	5
Liquid fuel open combustion/closed fronted	37	22	12	9
Liquid fuel balanced flue	15	9	5	4
Liquid flueless heaters	1	1	1	1
Liquid open to Chimney heaters	3	3	2	2
Total	78	49	28	22

[85] Liquid luminous local space heaters do not exists and are not included in this report

In general, electric local space heaters are the most sold type of heaters with an expected combined sale of above 18 million units in 2020. In comparison, the expected sales of gas heaters in 2020 is approximately 0,3 million units. Electric heaters are sold across all of Europe while gas heaters are mostly popular in the UK, the Netherland and Hungary. For gas appliance the market is expected to decrease since the policy of some member states are to be completely free from the use of fossil fuels in 2050 and some also have a ban on gas appliances in new buildings.

Regarding liquid fuel heaters no data was available for the study team and it has therefore not been possible to quantify the sales though the sales are expected to be low. This was also the case during the impact assessment were the following was stated[86]: "*Liquid fuels have not been assessed as no data existed to identify the number of liquid fuel fired local space heaters in the sales or stock.*" As no data have been presented it is assumed that the sales of liquid fuel heaters are 10 % of the sales of gas heaters. The sales of liquid luminous local space heaters (commercial) are assumed to be null, as this technology does not exist[87]. Hence, liquid luminous local space heaters are not further mentioned or considered in this report.

The most sold type of heater (in terms of units sold) is the electric portable heater with a predicted sale of 7,6 million units in 2020 or about 50% of the total sales of electrical local space heaters. For gas fuelled heaters to most popular type is the open fronted heater with an assumed sale of 179.000 units in 2020 or above 50% of the total sales. In addition, it should be noted that about 80% of the heating mats, 95 % of heating cables, 100% of heating films and 99% are sold without controls today according to a stakeholder[88]. This means that the sales of underfloor heaters may be considerable higher than the presented values.

2.2 Stock

The stock of local space heaters in Europe is determined based on the sale and the expected lifespan.

2.2.1 Lifespan

In the preparatory study, it was determined that the lifetime of local space heaters ranged between 9 years e.g. for portable heaters and up to 30 years for electric underfloor heating systems. The lifetime of the different heaters is a key parameter for assessing the stock, life cycle cost and the resource consumption. The lifetime used is this study is the "economic product life" which represents the lifetime where the product is in normal use,

[86] Impact assessment http://ec.europa.eu/transparency/regdoc/rep/10102/2015/EN/SWD-2015-90-F1-EN-MAIN-PART-1.PDF
[87] ELVHIS
[88] Based on comments on Task 1 and Task 2 from stakeholders

and it is the lifetime between the design lifetime and the behavioural lifetime. The different definitions of lifetime are presented in Table 20.

Table 20: Different definitions of lifetime

The design lifetime	The behavioural (or social) lifetime	Definition in current study
Is the intended lifespan regarding functioning time, the number of functioning cycles, etc., foreseen by the manufacturer when he designs the product, provided that it is used and maintained by the user as intended by the manufacturer. The design lifetime must not be confused with the guarantee period of products, which is a service offered by the Manufacturer and fulfils other constraints, namely commercial.	Is defined as the number of years until the device is replaced for other reasons than technical failure or economic unattractiveness. This generally regards social and consumption trends, a product including new feature has been released and is preferred, e.g. a more powerful computer	The term "lifetime" or "Economic product life" used in the current study must be understood as the period (i.e. the number of years) during which the appliance is used and consumes electricity ("actual time to disposal"). Therefore, it is a value included between the social lifetime and the design lifetime.

In the context of this study, the focus is on the 'economic lifetime', i.e. the time in service, but this is of course influenced by the other types. In general, the design lifetime of most local room heaters is expected to be long since these alliances have few moving parts (low tear) and are made of durable materials due to safety reasons[89]. The lifetime is also very dependent on the use and maintenance and whether the appliance is used continuously every day or only are used occasionally when the temperature is very low. In some circumstances the appliance is replaced to improvement in technology or simply the aesthetics of the appliance.

In the preparatory study the lifetime of the different appliances was based on inputs from stakeholders, which were also applied in the impact assessment. During the stakeholder consultation in the review study, some of the lifetimes have been adjusted according to industry knowledge. The lifespans used in this study are presented in Table 21.

[89] Preparatory study

Table 21: Estimated lifetime of local space heaters

Product	Lifetime
Electric	
Electric portable local space heaters	9
Electric fixed local space heaters with a nominal heat output above 250 W	15
Electric fixed local space heaters with a nominal heat output equal or below 250 W	15
Electric storage local space heaters	15
Electric underfloor local space heaters	40
Electric radiant local space heaters	9
Electric visibly glowing radiant local space heaters with a nominal heat output above 1,2 kW	9
Electric visibly glowing radiant local space heaters with a nominal heat output equal or below 1.2 kW	9
Towel heaters	15
Air curtains	15
Gas fuel	
Gaseous luminous local space heaters (commercial)	15
Gaseous tube local space heaters (commercial)	20
Gaseous fuel open combustion/open fronted with exhaust restriction	20
Gaseous fuel open combustion/closed fronted	20
Gaseous fuel balanced flue	20
Gaseous flueless heaters	7
Gaseous open to Chimney heaters	7
Liquid fuel	
Liquid tube local space heaters (commercial)	20
Liquid fuel open combustion/open fronted with exhaust restriction	20
Liquid fuel open combustion/closed fronted	20
Liquid fuel balanced flue	20
Liquid flueless heaters	7
Liquid open to Chimney heaters	7

2.2.2 Local space heater stock

The stock of local space heaters in Europe is determined based on the sale and the expected lifespan. In the stock model, the average product life varies from 7 to 40 years as discussed in the previous section. In the current stock model, the statistical standard deviation of the lifetime is assumed to be 2 to 6 years. This is used to calculate the number of local space heaters in the stock, using a normal distribution for their lifetime of years +/- the standard deviation of years. The sales figures and the lifetime assumptions above are combined to obtain the stock model. The stock of all base cases is shown in Table 22 for every 10th year from 2000-2050.

Table 22: Stock of local space heaters from 2000 to 2050

	2000	2010	2020	2030	2040	2050
Electric (1000 units)						
Electric portable local space heaters	58849	66392	71265	71931	71931	71931
Electric fixed local space heaters with a nominal heat output above 250 W	46277	71970	79570	82284	82423	82423
Electric fixed local space heaters with a nominal heat output equal or below 250 W	11569	17993	19893	20571	20606	20606
Electric storage local space heaters	2917	4409	4527	4434	4411	4410
Electric underfloor local space heaters	12333	24778	38149	50499	53363	54476
Electric radiant local space heaters	0	0	0	0	0	0
Electric visibly glowing radiant local space heaters - nominal heat output >1,2 kW	1217	1394	1508	1523	1523	1523
Electric visibly glowing radiant local space heaters - nominal heat output ≤1,2 kW	503	595	644	652	652	652
Towel heaters	14745	25208	30032	30969	30969	30969
Air curtains	242	399	504	606	656	665
Total	148652	213139	246092	263470	266535	267655
Gas fuel (1000 units)						
Gaseous luminous local space heaters (commercial)	465	561	429	324	270	260
Gaseous tube local space heaters (commercial)	477	729	611	461	374	346
Gaseous fuel open combustion/open fronted with exhaust restriction	2452	3443	2339	1379	1018	940
Gaseous fuel open combustion/closed fronted	4904	6886	4678	2759	2035	1879
Gaseous fuel balanced flue	1964	2901	1839	1071	806	749
Gaseous flueless heaters	97	98	98	98	98	98
Gaseous open to Chimney heaters	191	196	190	153	137	137
Total	10551	14814	10183	6244	4737	4409
LIQUID fuel (1000 units)						
Liquid tube local space heaters (commercial)	48	73	61	46	37	35
Liquid fuel open combustion/open fronted with exhaust restriction	245	344	234	138	102	94
Liquid fuel open combustion/closed fronted	490	689	468	276	204	188
Liquid fuel balanced flue	196	275	187	110	81	75
Liquid flueless heaters	10	10	9	8	7	7

	2000	2010	2020	2030	2040	2050
Electric (1000 units)						
Liquid open to Chimney heaters	19	20	19	15	14	14
Total	1009	1411	978	593	445	412

When looking at the sales and the stock in compiled graphs (Figure 10 for electric heaters, Figure 11 for gaseous heaters and Figure 12 for liquid heaters), it is seen that the sales (and thus the stock) reaches a plateau, resulting in a total stock just below 240 million electric local space heaters, approximately 6 million gaseous space heaters and approximately 0.6 million liquid heaters by 2030. The sales and stock figures will be used in subsequent tasks to estimate annual energy consumption and the resource consumption.

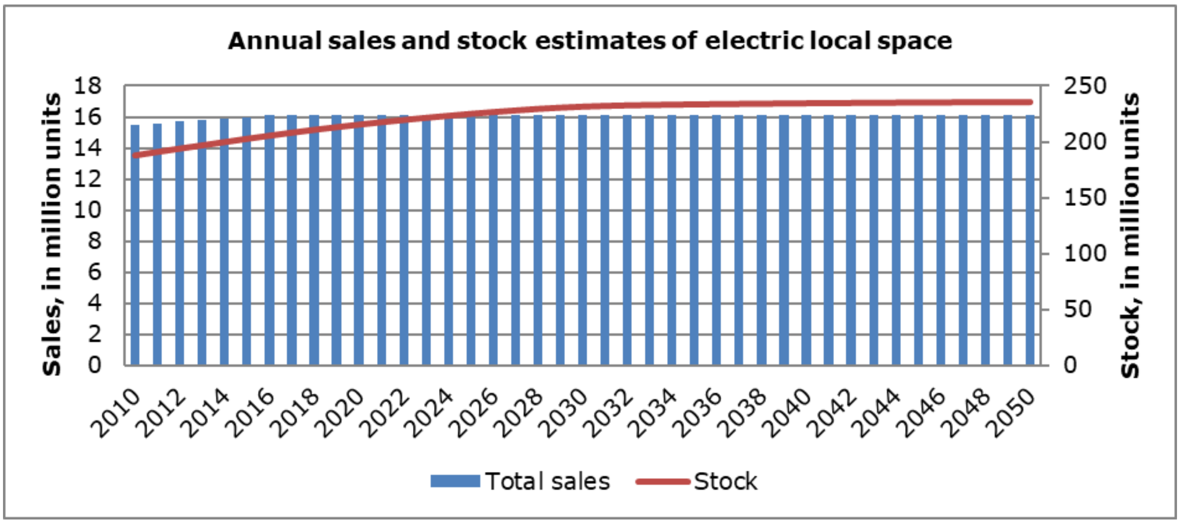

Figure 10: Total annual sales and stock of electric local space heaters

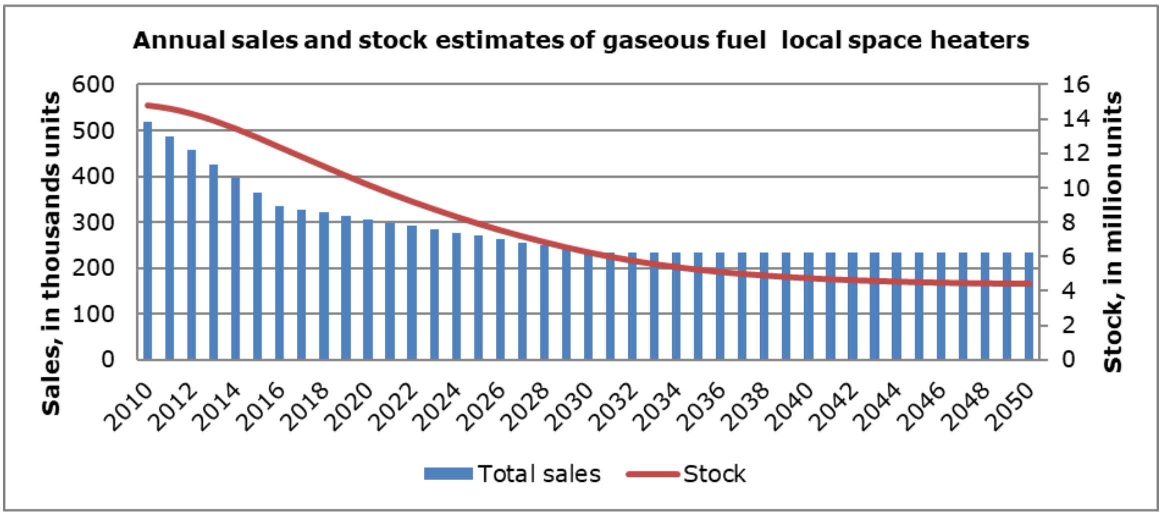

Figure 11: Total annual sales and stock of gaseous local space heaters

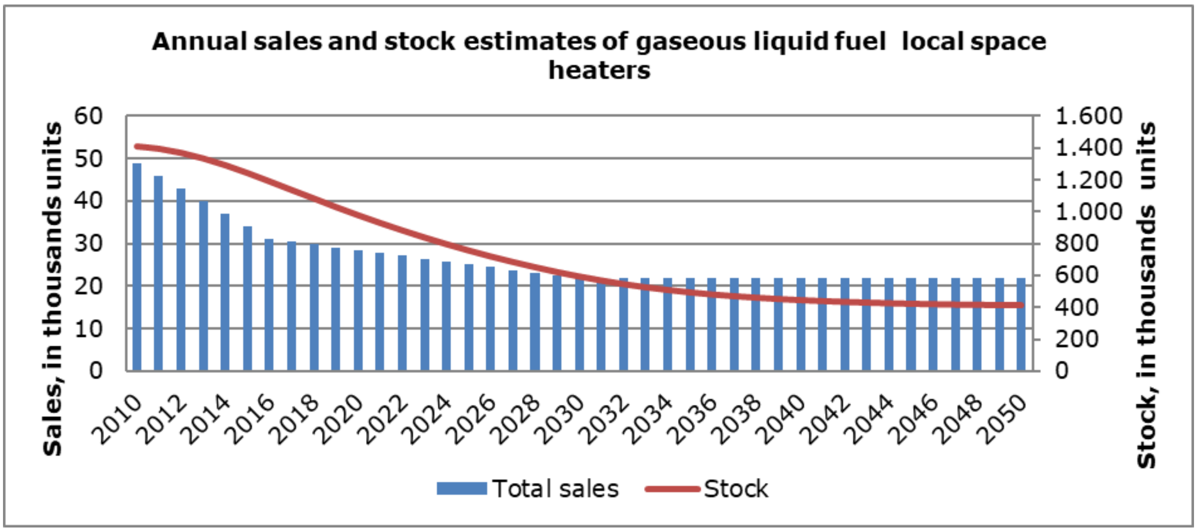

Figure 12: Total annual sales and stock of liquid local space heaters

2.3 Market trends

2.3.1 Market channels and production structure

Due to the diversity of the products covered by regulation 2015/1188, the market channels and production structures are equally diverse. The different product types are therefore described individually in this chapter, depending on the nature of the market.

Generally speaking, local space heaters are a very diverse product group with many designs and technology variants being specific to a certain country or region in the EU. Manufacturers therefore tend to have large variance in their product types with high numbers of different model and relatively low sales of each model.

Electric

The prevailing type of local space heaters runs on electricity as energy source, with sales totalling around 19 million units in the EU (including Norway). The well-developed infrastructure and high security of supply of electricity, makes it easy to install at low cost and use electric local space heaters. The specific design and technology, however, varies greatly between the electric local space heaters. In the following the markets for fixed heaters, portable heaters, and the remaining types are described separately.

Fixed electric heaters

Sales of fixed electric heaters total around 5,5 million units per year in the EU. The far majority (around 4 million) are sold in France, which is to a large degree because of their high share of nuclear power in the grid. Figure 13 gives an overview of the fixed electric local space heater market in Europe, where it is seen that also UK, Norway and Spain have relatively large markets for these product types. Norway has the highest share of electric heaters per citizen, see Annex D for further details.

Most of the manufacturers of fixed electric heaters are large companies, who produce the majority of the products inside Europe. The primary market channel for fixed heaters is for the majority of the countries in EU through professional installers, while only a very minor part is sold in retail, e.g. through DIY markets. However, in some countries e.g. Norway, a large share of fixed heaters is sold in retail, with plugs for connection to standard wall outlets.

Since France is the largest market for fixed heaters, this is also the market where the most detailed information exists, but it can be assumed that this will also reflect the overall trends in the total EU market. In France there are 10 million houses heated by electricity, corresponding to approximately 80 million installed fixed heater panels[90]. Scales to EU, based on sales, this corresponds to almost 14 million households and 110 million panels.

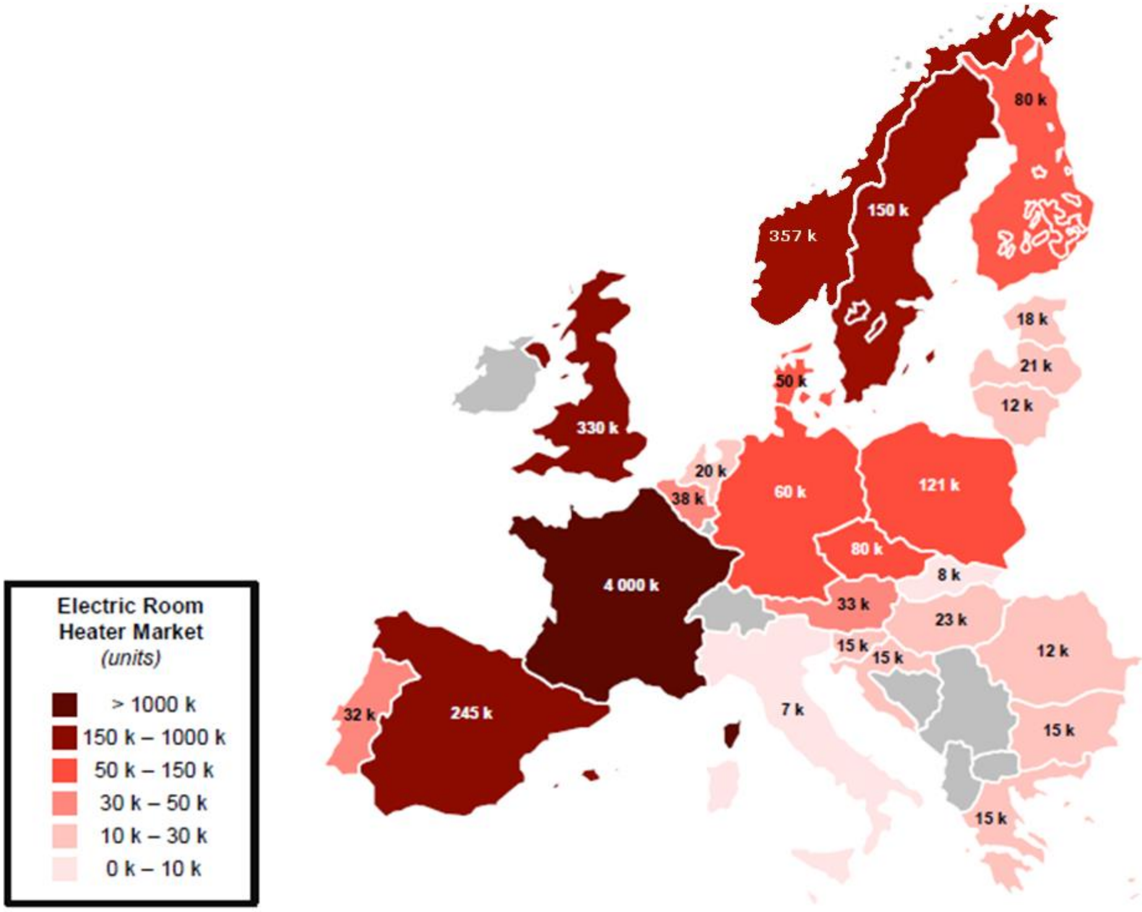

Figure 13: approximate yearly sales of fixed electric local space heaters in different European countries. Source: Groupe-Atlantic

[90] Information provided by Groupe-Atlantic

The distribution of technologies of fixed heaters is changing from convector types to modern type radiators, which usually have a combination of radiant and convector technologies and are equipped with more advanced and accurate controls. Also, the number of electric towel heaters that is increasing.

Portable electric heaters

Portable electric heaters are the largest single product category defined in the regulation, with sales volumes of 7,4 million units per year. The market channels are almost exclusively through retail market, where portable electric cheaters are sold in e.g. DIY markets.

Air curtains

The market channels for air curtains are divided into two, where small units are primarily distributed through the retail market whilst big units are sold as B2B. However, it is assumed that most air curtains are large units of several kW. Air curtains are equipped with different heating technologies and approximately 50% of the market are electric heated air curtains. The remaining part of the market are heated by water, heat pumps and a few by gas (industrial appliance). In this study, only the direct electric heated air curtains are included, and is assumed to be a B2B market.

Other electric heaters

Other electric heaters can be either fixed or portable and the above considerations for fixed and portable heaters are assumed to be representative for these products as well.

The only commercial type electric heater considered in this study is the air curtains, which are exclusively sold to end-users by professional installers.

Gas/liquid

The market for gas/liquid fuel local space heaters is substantially smaller than for electric local space heaters, as noted in previous chapters. The markets are primarily the UK, Netherlands and Hungary, with some sales in Germany as well. The general market characteristics are shown in Table 23.

Table 23: Overview of gas local space heaters market in the EU

Market	Types of products
United Kingdom	Primarily open fronted
Netherlands	Primarily closed fronted
Hungary	Mixed open and closed fronted
Germany	
Others	

In the UK, which is the largest market of open fronted gas fuelled local space heaters, the sales of gas fired local space heaters decreased drastically from around 750.000 per year in 1994 to the current level of 200.000 per year. This decrease first started due to the closure of British Gas showrooms[91]. Also, other factors, such as increasing sales of wood burning stoves as an alternative and the majority of homes having gas fired central heating, influenced the gas local space heater market. In comparison boiler sales are around 1,6 million in the UK. However, manufacturers advise an estimated 3% increase in recent months compared to last year due to consumers and stockist returning to gas.

2.3.2 Product trends

Electric fixed heaters

In general, the product trend for electric local space heaters move towards more advanced products with more control opportunities and with more and more products being connected to an app or other device to control and plan the heating. High-end products are also getting "smarter" in the sense that they learn to recognise use patterns, and plan heating in individual rooms accordingly.

The ecodesign regulation has, according to industry, played a large role in accelerating this development, since many products were not compliant with the requirements before, and the general solution to improving efficiencies has been to improve the controls. A rough estimate from the industry of fixed heaters is that before the ecodesign regulation entered into force, none of the convectors were compliant with the requirement, only 10% of the radiant heaters, 20% of the radiators and 50% of the towel heaters were compliant. The largest change thus happened for the radiant panels, where around 60% of the market switched to digital controls as a result of the ecodesign regulation.

In some areas the development of the controls goes beyond what is rewarded in the efficiency calculations in the ecodesign regulation (i.e. through the correction factors). This includes the development of:

- Increasingly accurate temperature regulation (accuracy is not taken into account in the ecodesign regulation) due to use of electronic instead of mechanical thermostats
- Auto-programming per room based on recorded use patterns. (while week timer is rewarded in the ecodesign regulation, automatization of this timer is not)
- Adaption to surroundings: presence/absence detection, window opening (presence detection bonus is not possible for fixed panels)

[91] https://www.independent.co.uk/news/business/british-gas-to-shed-1000-jobs-with-closure-of-half-its-showrooms-1368030.html

Before the regulation the average seasonal space heating efficiency was only 30% approximately, since electric heaters have an efficiency of 100% ($\eta_{th,on}$). The seasonal efficiency is then calculated as $\eta_{th,on}$ divided by the conversion coefficient (CC=2,5) which equals to 40% and without any controls the efficiency will be 30%. After the adoption of the current regulation the seasonal space heating energy efficiency has increased, and it assumed that the average product on the market today has improved.

Table 24: Assumed seasonal space heating efficiency of fixed electric local space heaters in 2010 and in 2018[92]

Fuel	Type	Seasonal space heating energy efficiency 2010	Seasonal space heating energy efficiency 2018
Electric	Fixed > 250 W	30%	38%
Electric	Fixed ≤ 250 W	30%	35%

Based on inputs from stakeholders the assumptions presented in Table 24 seems reasonable. For fixed local space heaters further improvements are not awarded as discussed above. The push in energy efficiency has also had an impact on the consumer purchase prices. The impact on consumer prices are discussed in section 2.4.2.

Other electric heaters

As for fixed heaters, the ecodesign regulation has prompted an increase in advanced controllers on the other types of electrical heaters. However, the ecodesign efficiency requirements differ for different product types, meaning that some categories had to improve more than others. The assumed seasonal space heating energy efficiency of other than fixed electric local space heaters in 2010 and in 2018 is presented in Table 25.

Table 25: Assumed seasonal space heating efficiency of other than fixed electric local space heaters in 2010 and in 2018

Fuel	Type	Seasonal space heating energy efficiency 2010	Seasonal space heating energy efficiency
Electric	Storage	30%	39%
Electric	Portable	30%	37%
Electric	Underfloor	30%	33%
Electric	Radiant	30%	36%
Electric	Visible glowing > 1,2 kW	30%	36%
Electric	Visible glowing ≤ 1,2 kW	30%	33%
Electric	Towel heaters	30%	38%

[92] Based on the 2015 Impact Assessment

The assumptions made on the seasonal space heating efficiency in 2010 and 2018 are based on the same assumptions as for the fixed local space heaters. So, it is assumed that no or only a limited number of heaters were equipped with the different control options before the current regulation.

Gas heaters

In the UK where the market is primarily for open fronted gas local space heaters, the majority of the products (between 90 and 99% according to industry[93]) are mechanical products that do not have any electric connection and thus no electric controls. These products are not used for decorative purposes but solely for their function. In many homes in the UK there will often be a central heating system in the building, which provides background heating and the gas stove will be located in the living room to boost the heat in that room. This is a traditional way of heating homes in the UK, and even though there are thermostats on the central heating radiators that can be regulated for each room individually, it is common to have an additional local space heater (gas or other fuel) in the living room.

The retail prices for such simple gas local space heaters are around 250 GBP (290 EUR) without installation. They are often placed in decommissioned fire places or the like with open connection to the chimney. The manufacturers of gas local space heaters in the UK fears that the ecodesign requirements will affect the affordability of the products for end-users and might even have a negative effect on health because of the way the NOx is calculated (based on heat input rather than output) as explained in section 1.2.1. Especially if it slows down innovation towards more efficient products could this be a problem and might cause an increase in the number of UK households in fuel poverty[94] (11% in 2015, corresponding to 2,5 million households[95]).

In other countries like the Netherlands and Germany the prevailing type of local gas space heaters is balanced flued (sealed form the room with closed-off connection to the chimney), while the market for gas local space heaters in Hungary is mixed between open and closed fronted. The assumed energy efficiency of gaseous local space heaters in 2010 and in 2018 is presented in Table 26. The efficiencies of new residential products are derived based on stakeholder inputs. Note that the efficiencies of flueless heaters can be discussed as all the heat is emitted to the room. However, flueless heaters requires a permanent ventilation opening which means that all or most of the heat is lost.

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93 HHIC http://www.hhic.org.uk/

94 https://www.gov.uk/government/collections/fuel-poverty-statistics

95 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/639118/Fuel_Poverty_Statistics_Report_2017_revised_August.pdf

Table 26: Assumed seasonal space heating energy efficiency of other than fixed electric local space heaters in 2010 and in 2018

Fuel	Type	Unit	Energy efficiency 2010	Energy efficiency 2018
Gas	Gaseous luminous local space heaters (commercial)	Gross calorific value moisture free (GCV)	73,3%	86%
Gas	Gaseous tube local space heaters (commercial)	Gross calorific value moisture free (GCV)	64,4%	75%
Gas	Gaseous fuel open combustion/open fronted with exhaust restriction	Net calorific value (NCV)	41,6%	43-80%
Gas	Gaseous fuel open combustion/closed fronted	Net calorific value (NCV)	52,2%	50-80%
Gas	Gaseous fuel balanced flue	Net calorific value (NCV)	64,5%	73-85%
Gas	Gaseous flueless heaters	Net calorific value (NCV)	15-20%	15-20%
Gas	Gaseous open to Chimney heaters	Net calorific value (NCV)	0%	0%

Liquid heaters

Liquid heaters are most often bioethanol fires or paraffin heaters. Where bioethanol fires are usually sold for decorative purposes, paraffin heaters are usually sold for the heating function. However, since the bioethanol fires still produce significant heat, most are also used as an additional heat source. Both products can be sold through retail channels, but especially build-in ethanol fires that requires professional installation, might be sold through the installer rather than in retail shops.

2.4 Consumer expenditure base data

The average consumer prices and costs experienced by the end user throughout the product lifetime are determined by unit prices in the following categories:

- Purchase price
- Installation costs
- Repair and maintenance costs
- Electricity costs
- End of life cost

2.4.1 Interest and inflation rates (MEErP method for LCC calculation)

All economic calculations will be made with 2018 as base year, as this is the latest whole year for which data is available. HICP inflation rates from Eurostat[96] will be used to scale purchase price, electricity prices etc. to 2018-prices. Furthermore, a discount rate of 4% will be used in accordance with the MEErP methodology.

2.4.2 Consumer purchase price

The consumer purchase price is based on the preparatory study, the impacts assessment, an online survey and input from stakeholders. Due to the wide product categories in the regulation it can be difficult to determine the correct price but overall it seems that the prices from the impact assessment still are valid. In the impact assessment[97] the correlation between purchase price and level of efficiency is determined. Based on the efficiency levels from section 2.3.2 the product price is found and compared with prices available online and inputs from stakeholders[98].

Local space heaters are available in a range of qualities, with different functionalities, different aesthetics and different efficiencies. This fact and the broad product categories in the regulation are challenging when determine a suited purchase price. Since the preparatory study the prices has in general increased as more controls are applied to the products to fulfil the minimum requirements.

The product price used in the current study is presented in Table 27 and are updated based on inputs from stakeholders.

[96] http://ec.europa.eu/eurostat/statistics-explained/index.php/File:HICP_all-items,_annual_average_inflation_rates,_2006-2016_(%25)_YB17.png
[97] Impact assessment http://ec.europa.eu/transparency/regdoc/rep/10102/2015/EN/SWD-2015-90-F1-EN-MAIN-PART-1.PDF
[98] This means that the product prices are also affected by the current regulation

Table 27: Unit retail prices in EUR for local space heaters including VAT and installation cost[99]

Energy source	Type	Purchase price €	€/kW
Electric	Fixed > 250 W	270	270
	Fixed ≤ 250 W	180	600
	Storage	900	298
	Portable	32	23
	Underfloor	336	181
	Radiant	-	-
	Visible glowing > 1.2 kW	36	18
	Visible glowing ≤ 1.2 kW	24	24
	Towel heaters	250	417
	Air curtains	2000	140
Gas	Gaseous fuel open combustion/open fronted with exhaust restriction	1175	280
	Gaseous fuel open combustion/closed fronted	2375	565
	Gaseous fuel balanced flue	1663	396
	Gaseous flueless heaters	1000	400
	Gaseous open to Chimney heaters	1000	238
	Gaseous luminous local space heaters (commercial)	1300	65
	Gaseous tube local space heaters (commercial)	1500	50
Liquid	Liquid fuel open combustion/open fronted with exhaust restriction	850	425
	Liquid fuel open combustion/closed fronted	2375	594
	Liquid fuel balanced flue	1589	397
	Liquid flueless heaters	1000	333
	Liquid open to Chimney heaters	1000	250
	Liquid tube local space heaters (commercial)	1500	50

2.4.3 Installation cost

The installation cost of local space heaters is very dependent on the type of appliance since there are no installation costs for portable heaters while underfloor heaters and commercial heaters can have high installation costs. In general, the installation cost for electric local space heaters is considered to be low as the only requirement is a connection to the mains for portable heaters and some sort of fixation to the wall for other types of electric heaters. In some circumstances it is also necessary to install a new power plug in the wall. Such operations will add additional costs but are not included in the installation costs. The electric local space heater with the highest costs is considered to be the installation of an underfloor heating system since this heater requires construction work e.g. concrete pouring and insulation. For gas heaters the installation costs are considered to be higher

[99] Impact assessment http://ec.europa.eu/transparency/regdoc/rep/10102/2015/EN/SWD-2015-90-F1-EN-MAIN-PART-1.PDF

as they require more work by professionals to ensure a secure connection to the gas supply. The assumed installation costs are based on the preparatory study and presented in Table 28.

Table 28: Installation cost

Energy source	Type	Installation costs €
Electric	Fixed > 250 W	30
	Fixed ≤ 250 W	30
	Storage	80
	Portable	0
	Underfloor	155
	Radiant	30
	Visible glowing > 1,2 kW	30
	Visible glowing ≤ 1,2 kW	20
	Towel	30
	Air curtains	100
Gas/liquid	All	250

2.4.4 Electricity cost → EU data

Previously the annual growth in electricity prices in ecodesign studies based on MEErP has proven to be too high and the Commission has decided to use data from PRIMES[100] more realistic projections of the electricity prices. The suggested electricity prices are presented in Table 29.

Table 29: Electricity prices suggested by the Commission, in €/kWh [101].

Electricity	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Industry	0,084	0,097	0,097	0,098	0,099	0,100	0,101	0,102	0,101	0,101
Households	0,156	0,172	0,190	0,203	0,209	0,212	0,217	0,215	0,211	0,209
Services	0,127	0,148	0,157	0,171	0,176	0,179	0,184	0,182	0,180	0,178

The data from PRIMES also include information and projections on the natural gas price development. The natural gas prices used in this study is presented in Table 30.

Table 30: Development of the natural gas price[102]

Natural gas	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Industry	0,030	0,038	0,038	0,043	0,045	0,048	0,051	0,052	0,053	0,054
Households	0,046	0,061	0,071	0,075	0,079	0,084	0,087	0,089	0,090	0,091
Services	0,039	0,050	0,057	0,061	0,065	0,069	0,072	0,074	0,075	0,076

[100] PRIMES 2016
[101] PRIMES 2016
[102] PRIMES 2016

2.4.5 Repair & maintenance costs

The repair and maintenance costs are considered to be low for most of the different local space heaters since there is no wear and tear from moving parts. For electric heaters it is assumed that the repair and maintenance cost are almost null and can be neglected. For gas appliance there may be a small fee in connection with annual inspections of the appliance. If a local space heater needs repair it is assumed that it is done by professionals and the repair price cover both labour and spare part costs, which means that the affordability of repair is very much dependent on the labour costs. The labour cost varies greatly across Europe and are presented in Figure 14.

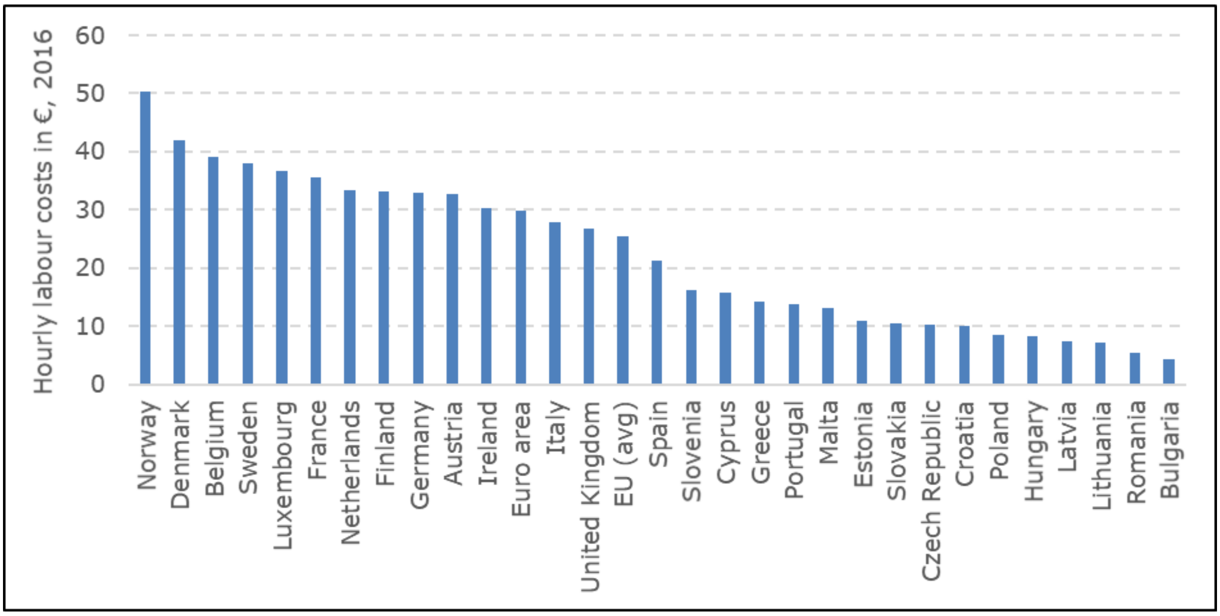

Figure 14: Hourly labour cost in €, 2016 for European countries

The cost of repair and annual maintenance cost are presented in Table 31. The cost is based on the preparatory study and adjusted based on inputs from stakeholders.

Table 31: Cost of repair and annual maintenance

Energy source	Type	Repair €	Maintenance €/year
Electric	Fixed > 250 W	0	0
	Fixed ≤ 250 W	0	0
	Storage	0	0
	Portable	0	0
	Underfloor	0	0
	Radiant	0	0
	Visible glowing > 1,2 kW	0	0
	Visible glowing ≤ 1,2 kW	0	0
	Towel heaters	0	0
	Air curtains	400	40
Gas	Gaseous fuel open combustion/open fronted with exhaust restriction	150	80
	Gaseous fuel open combustion/closed fronted	150	80
	Gaseous fuel balanced flue	150	80
	Gaseous flueless heaters	0	0
	Gaseous open to Chimney heaters	0	0
	Gaseous luminous local space heaters (commercial)	20	50
	Gaseous tube local space heaters (commercial)	30	50
Liquid	Liquid fuel open combustion/open fronted with exhaust restriction	150	80
	Liquid fuel open combustion/closed fronted	150	80
	Liquid fuel balanced flue	150	80
	Liquid flueless heaters	0	0
	Liquid open to Chimney heaters	0	0
	Liquid tube local space heaters (commercial)	30	50

2.4.6 End-of-life costs

Electric local space heaters are covered by the WEEE directive and producers are responsible for paying a WEEE tax or in some other way finance the EOL treatment, it is assumed that end-users will not experience any EOL costs. The disposal costs are paid by the end-user buying the products under the form of the Eco tax under the WEEE directive. For an electric local space heater, this corresponds nowadays to a fee of 80 to 120 EUR/tonne. This fee is adjusted on a country basis and by product category depending on recycling costs. The fee is not always included in the final product price, and even if it is, it is not always allowed to be visible at the point of sale. Local space heaters without any electronics are not covered by the WEEE Directive and is assumed that the can be disposed free of charge for the end-users.

3. Users: Product demand side

This task focuses on the product demand side, namely user behaviour and parameters determining how users purchase, use and dispose of their local space heaters. The product group of local space heaters is very diverse, and so is the use and the reasons for purchasing. However, a few key drivers determining the use pattern and thus the energy consumption has been identified and will be covered in this task:

- Climate conditions; development in number of HDDs (Heating Degree Days)
- The building type and heat demand; commercial, residential, level of insulation etc.

The choice of heating technology by users will be discussed in section 3.3. The preparatory study described a series of factors influencing use patterns and purchase decisions, including buildings, human comfort, functionality and user behaviour. These findings are generally still valid, and only the aspects that have changed since the 2012 preparatory study are examined in detail in this task.

Furthermore this task covers the local infrastructure surrounding the different local space heater types, including the electricity grid and the gas distribution network, as well as the end of life behaviour regarding how end-users dispose of the products.

3.1 Climate

The climate and outside temperature are the key parameter determining the user behaviour in terms of the amount of energy used for heating. The climate and temperatures differ across Europe and there is general trend towards warmer climate due to global warming as well as increasing temperature variability[103]. In this study the same methodology as in the preparatory study is followed but with updated climate and temperature data in terms of Heating Degree Days.

3.1.1 Heating Degree Days

Heating Degree Days, HDD (Δ°C*days/year), are defined relative to a base temperature, meaning the outside temperature below which a building is assumed to need heating or cooling. The base temperature in EU is 15,5 °C[104]. This is the same for both domestic and commercial heating covered in Regulation (EU) 2015/1188, since they are all used for human comfort.

[103] Sci Rep. 2017; 7: 254. Miklós Vincze, Ion Dan Borcia, and Uwe Harlander: "Temperature fluctuations in a changing climate: an ensemble-based experimental approach" Published online 2017 Mar 21: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5428220/

[104] European Environment Agency, Heating and cooling degree days, https://www.eea.europa.eu/data-and-maps/indicators/heating-degree-days , Created 19 Dec 2016 Published 20 Dec 2016 Last modified 21 Feb 2017. And https://ec.europa.eu/eurostat/cache/metadata/en/nrg_chdd_esms.htm

The heating and cooling requirements for a given structure at a specific location are considered to be proportional to the number of HDDs at that location, so the more heating degree days, the higher energy consumption for heating. The actual heating demand depends on other factors like building design, energy prices, income levels and behavioural aspects, but the HDD can be used for approximate calculations of seasonal and regional energy demands.

In the 2012 preparatory study the average HDD in the period 1980-2004 was used for calculations, however, in order to use updated data and take into account the temperature development (especially with the consideration of changes due to climate change), the HDD data for 2000-2017 is used as baseline in this study[105]. Figure 15 shows the difference in HDDs between these two periods for the EU-28 countries. As it can be observed, the number of HDDs/year were higher in the period from 1980-2004 than from 2000 to 2017 in all of the EU-28 countries and Norway[106].

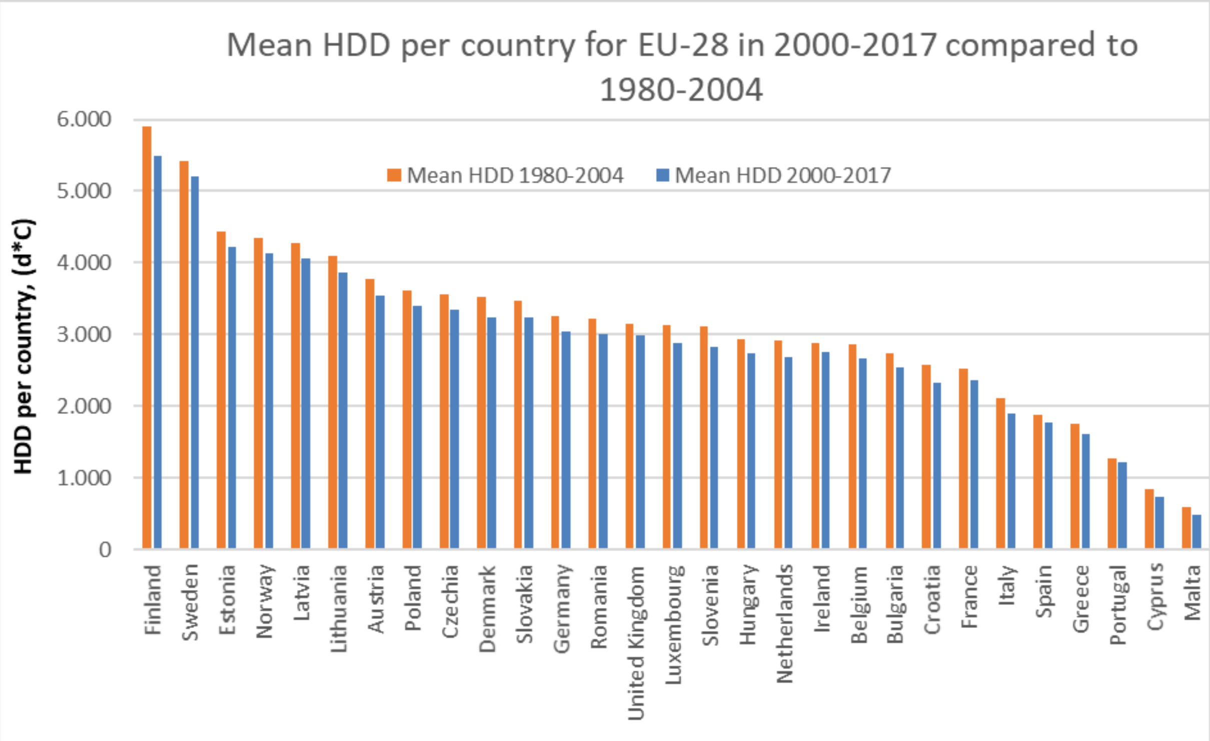

Figure 15. Comparison of mean HDDs for EU countries in the period 2000-2017 and 1980-2004[107]

The same trend as in Figure 15 can be seen in Figure 16 and Figure 17. Figure 16 illustrates the fluctuations compared to the average in the period 2000-2017 and the average in the

[105] Eurostat Cooling and heating degree days by country, code: nrg_chdd_a, https://ec.europa.eu/eurostat/web/products-datasets/product?code=nrg_chdd_a , Last update: 18/10/18. Note that the base temperature is set to a constant value of 15°C in the HDD calculation in the Eurostat database.
[106] Norwegian data from Norwegian Water Resources and Energy Directorate (NVE), calculated HDD as a population weighted average from 5 representative climate stations in Oslo, Kristiansand, Bergen, Værnes (Trondheim) and Tromsø.
[107] HDD data from Eurostat (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_chdd_a&lang=en) and from the Norwegian Energy Agency.

period 1980-2004, which was used in the preparatory study. As it can be observed, the current heating degree days are way below those in the 1980-2004 baseline, with average in the 2000-2017 period being 6% lower. Additionally, on single-country level, the number of heating degree days continues to decline, as seen in Figure 17, where the 2000 and 2017 data is compared. The only exception is Greece, where there are 1% more HDDs in 2017 than in 2000. Note, that this is a comparison between two single years, and annual fluctuations plays an important role as seen in Figure 15.

In the calculations, a decrease in HDDs of 0,45% per year is used, based on the decrease in total average between the periods 1980-2004 and 2000-2017.

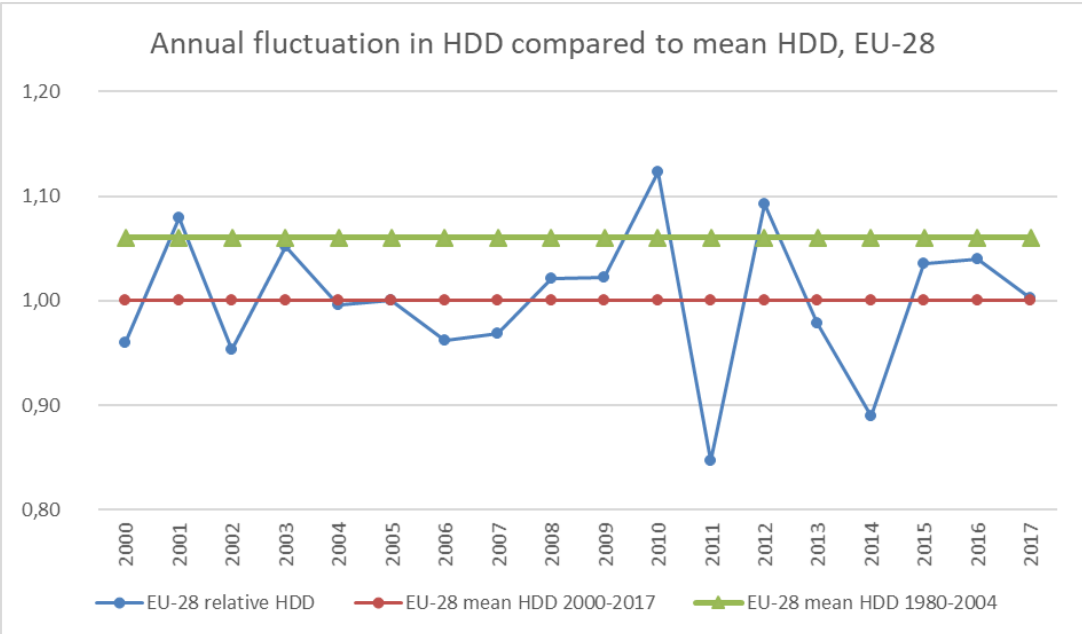

Figure 16: Variation in HDDs as fraction of the average in EU-28 from 2000 to 2017

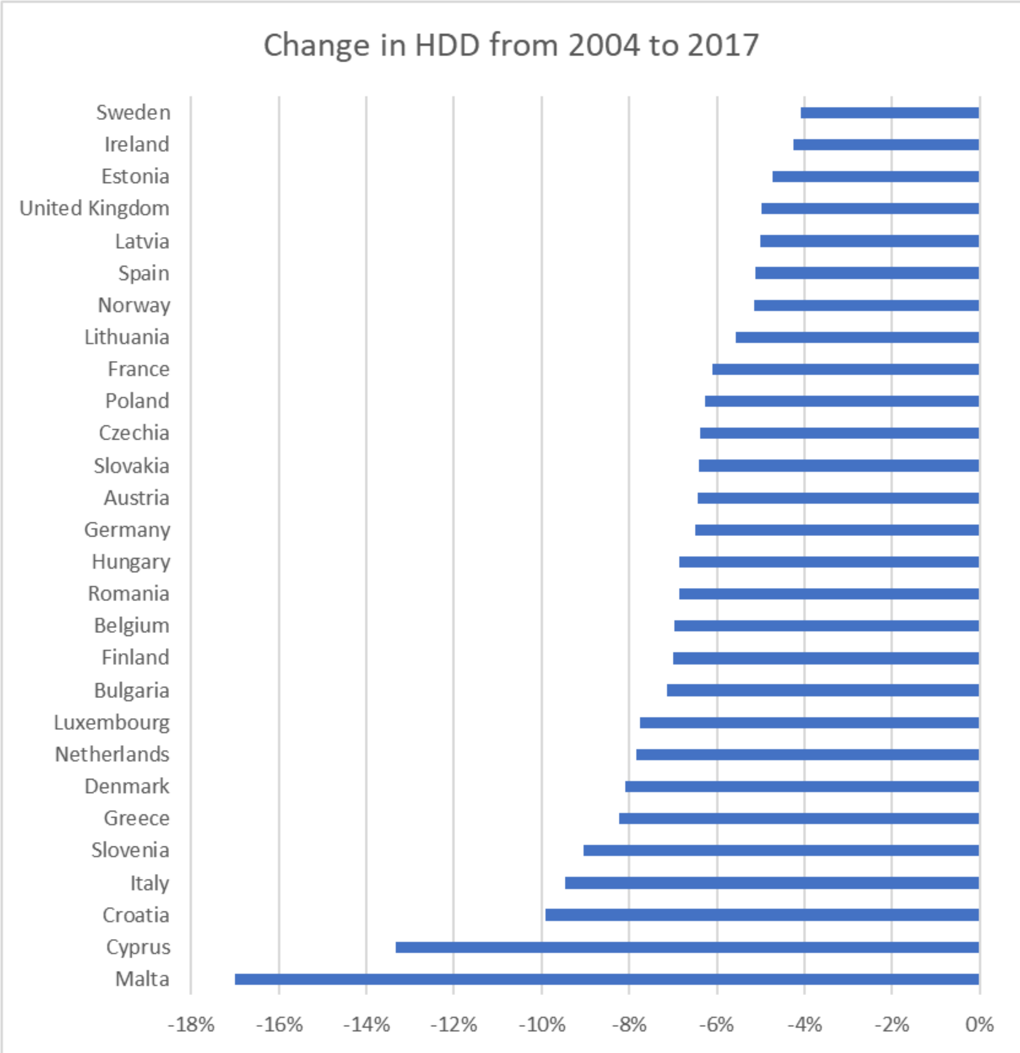

Figure 17. Change in average HDDs in EU countries from the period 1980-2004 to 2000-2017

It is clear that the development towards warmer climate, which was taken into account in the preparatory study, continues. Similar findings are shown in a recent report from JRC regarding the impact of the increase in average temperatures in Europe[108]. Their scenarios found decreasing space heating needs compared to a scenario without climate change, and around 5% higher temperatures in the short term (2020-2050).

Table 32 groups the Member States by number of HDDs in a similar way as the preparatory study[109]. The grouping of Member States is the same, except from Latvia, which was in Group 1 in the preparatory study, but is now in Group 2 (less than 4.200 HDDs). Croatia was not included in the preparatory study but is included here and belongs to Group 3 (less

[108] JRC Science for Policy Report, Assessment of the impact of climate change on residential energy demand for heating and cooling, Kitous, A., Després, J., 2018
[109] The three climatic zones are defined as:
- Cold zone : HDD > 4200°C.day
- Moderate zone : 2200°C.day < HDD < 4200°C.day
- Warm zone : HDD < 2200°C.days

than 2.200 HDDs). In the Preparatory Study, the length of the heating season in months was given, however, it was not apparent how it was calculated, and the values have therefore been scaled based on the decrease in average HDDs for each country.

Table 32. Average heating season in days and months for EU 28 from 2000 to 2017

Member State	Mean HDDs over period 2000-2017	No. of days in heating season	Heating season in months	Grouped by HDDs	Average season (days) in group
Finland	5.485	300	10,0	Group 1	266
Sweden	5.199	293	9,8		
Estonia	4.227	252	8,4		
Norway[110]	4.131	244	8,1		
Latvia	4.053	241	8,0		
Lithuania	3.872	236	7,9	Group 2	199
Austria	3.538	214	7,1		
Poland	3.394	217	7,2		
Czech Republic	3.338	214	7,1		
Slovakia	3.233	206	6,9		
Denmark	3.243	212	7,1		
Germany	3.042	201	6,7		
Romania	2.997	197	6,6		
United Kingdom	2.990	200	6,7		
Luxembourg	2.883	197	6,6		
EU-28 Average	2.832	196	6,5		
Slovenia	2.729	194	6,5		
Ireland	2.682	186	6,2		
Hungary	2.754	193	6,4		
Netherlands	2.660	187	6,2		
Belgium	2.535	186	6,2		
Bulgaria	2.325	174	5,8		
France	2.371	173	5,8		
Croatia	1.904	154	5,1	Group 3	116
Italy	1.780	155	5,2		
Spain	1.603	145	4,8		
Greece	1.224	146	4,9		
Portugal	731	117	3,9		
Cyprus	490	95	3,2		
Malta	-	-	-		
* Scaled from the number of days in the preparatory study					

[110] The method for calculating the average national HDD in Norway might differ from the method used by Eurostat.

3.2 Building characteristics

The building characteristics have a large influence on how the local space heaters are used. The main differentiation is made between commercial and domestic (including tertiary) settings of use. Furthermore, whether the room heater is used as a primary or secondary heating source, determines the temperature settings and the duration local room heating products are used.

3.2.1 Commercial heating

The commercial buildings, where the commercial local space heater types (luminous and tube heaters) are used, include industrial, commercial and public buildings, such as factories, warehouses, logistic buildings, vehicle repair buildings, sports halls, religious buildings, supermarkets, show rooms, shops etc. In the preparatory study it was assumed that these heaters were used 8 hours a day at a temperature setting of 18 °C and 16 hours a day at a temperature setting of 14 °C. These assumptions have not changed and will be used in this review study as well, however since the HDDs have decreased, so has the number of days in the heating season when these appliances are used.

Table 33: Annual use hours (full hour equivalents) in commercial settings

Fuel type	Full load hour equivalents	Type of use pattern	Heating hours per year, 2018
Electric	Air curtains	Commercial	352
Gas and liquid	Luminous	Commercial	1.408
	Tube	Commercial	1.408

3.2.2 Residential heating

The use patterns of domestic local space heaters are split based on whether they are used as secondary or primary heat source.

Secondary heat source

Secondary residential heating will be necessary when the capacity of the heating system in the dwelling is not sufficient to cover the entire heat load in the climatic conditions. The primary (often central) heating system will serve as base load and the local space heater will provide supplementary heat. The heat load for the secondary heater will be a (small) fraction of normal heat load of a building, but for the actual heater most likely often full load. The same use pattern as in the preparatory study, which was also applied in the Impact Assessment, will be used for calculations in this study: An average of 1,5 full load hours / day in the heating season.

Primary heat source

Local space heaters which are used as the primary source of space heating are used both in households in warmer climate zones, as well as households in more temperate climate zones, where local space heating is favourable for some reason, for example low electricity prices (for electric heaters). In the first case, the consumer choice would often be portable space heaters, since they would be used only a few months a year, and can be put away in the remaining time. In the second case, the use of local space heaters is often culturally determined or based on the infrastructure. For example in France where electricity comes largely from nuclear power; Norway where electricity comes from hydronic power; or UK or Hungary where many homes have a gas connection and there is a history of using gas for heating. Since the primary heat sources are often considered fixed installations in the homes users often tend to prefer the heating types they are used to, due to social norms. One study[111] finds that it is a combination of embodies habits, well know technologies and personal and societal values that determines practices for both choice and use of heating types.

For the calculations in this study the same use pattern as in the preparatory study and Impact Assessment is used: An average of 8 use hours at a setting of 20 °C and 16 hours at a setting of 15,5 °C as recommended in standard EN 12831.

Table 34: Annual use hours (full hour equivalents) in non-commercial settings for primary and secondary heating

Energy source	Local space heater type	Type of use pattern	Heating hours per year, 2018
Electric	Portable Electric	Secondary	436
	Fixed electric >250 W	Primary	1.408
	Fixed electric <250 W	Primary	1.408
	Electric storage heaters	Primary	469
	Electric underfloor	Equal secondary and primary	836
	Radiant	Primary	1.408
	Visibly glowing >1,2	Equal secondary and primary	819
	Visibly glowing <1,2	Equal secondary and primary	836
	Towel heaters	Equal secondary and primary	836
Gas and liquid	Open fronted	Equal secondary and primary	836

[111] Building Research & Information, Volume 38, 2010 - Issue 2, Pages 175-186, Kirsten Gram-Hansen, "Residential heat comfort practices: understanding users", Published online: 10 Feb 2010 https://www.tandfonline.com/doi/abs/10.1080/09613210903541527

Energy source	Local space heater type	Type of use pattern	Heating hours per year, 2018
	Closed fronted	Equal secondary and primary	836
	Flueless	Secondary	264
	Open to chimney	Secondary	264

It should be noted that the use patterns shown in Table 34 are approximations over the entire EU, and specific end-user preferences and behaviours lead to a large variation in actual use. One key driver is for example the indoor temperature. In the above, 18 °C day temperature setting of heaters is assumed for commercial heaters and 20 °C temperature setting for all other types. However, as mentioned in the preparatory study factors such as age of the people in the heated areas can influence the average temperature. Studies about comfort temperatures and user habits also show variation between populations and regions. Scandinavians for example tend to heat up all of their dwellings and show less tendency to shut down for the night. People in UK on the other hand lower the temperatures in unoccupied rooms during night and day time[112].

The heating hours of portable heaters can be difficult to predict and in particular the share of portable heaters used for primary heating. In Table 34 it is assumed that 15% of the consumers uses their portable heater for primary heating. Some stakeholders have suggested that portable heaters only are used for secondary heating. However, no data is available to support this statement, so it assumed that some consumers also use their portable heater for primary heating. All assumptions on heating degree days and how the products are used (secondary or primary heating) are presented in Annex E

3.2.3 Energy poverty

Since the lot 20 preparatory study in 2012 new studies about energy poverty, building energy consumption and households heating habits have been performed, which can all influence how space heaters are used. These findings are not expected to change the assumptions used in the calculations, but are important factors to understand how and why end-users take certain choices regarding heating options.

Overall the building stock in EU is old and build with other requirements to energy efficiency and comfort than today:

[112] Wilhite et al. (1996), Isaacs et al. (2010), *Air – to -air Heat Pumps: A Wolf in Sheep's Clothing?* Toke Haunstrup Christensen, Kirsten Gram-Hanssen, Poul Erik Petersen, Preben Munter Rob Marsh, Troels Fjorbak Larsen, Erik Gudbjerg, Lisbet Stryhn Rasmussen (ECEEE 2011) and energy-supply.dk (2011)

- Residential buildings account for 75% of the European building stock, from which more than 40% was built before 1960 and more than 90% before 1990[113]
- The renovation of existing buildings could improve energy efficiency and comfort, but the current refurbishment rate is below 1% per year[114]

In the calculations, the same assumption as in the Impact Assessment will be used; that the heat demand will decrease with 1% per year due to building energy upgrades.

Low income households

As buildings are being out-dated, general degradation and ageing of buildings occurs and energy performance of the buildings will decrease as well as the housing prices, which tend to attract households with the lowest incomes.

About 17% of households in the EU are LIH (Low Income Households, defined by earning less than 60% of their respective national median equivalised disposable income)[115]. LIH are more often living in old buildings with insufficient heating systems. As an example, the consumers connected to the district heating networks in Romania, which cover over 1,6 million dwellings that are mostly low income blocks of flats, and they often cannot adjust the heating level in the dwellings, resulting in inability to keep the home adequately warm[116]. According to a 2015 study on energy poverty, the most relevant indicator for energy poverty is households unable to keep the home adequately warm. Nearly 11% of the European Union population – an estimated 54 million people – are unable to adequately heat their homes at an affordable cost with the highest reporting from Bulgaria (46%), followed by Lithuania, Cyprus (30-35%), Portugal, Greece, Malta and Italy (20-30%). Relatively large shares of households even in some countries with milder climates experience these problems[117]. Typical reasons are building envelopes with little thermal insulation and high air leakage of (cold) outdoor air and heating systems that, as explained above, are inefficient and insufficient to keep the indoors warm. Also, many of these countries have experienced strong economic downturns, and spending on heating is likely to have been more restricted.

[113] "A blind spot of European policy? Energy efficiency policies for low-income households", Jose Antonio Ordonez et al, Fraunhofer, ECEEE Summer Study 2018 https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2017/6-buildings-policies-directives-and-programmes/a-blind-spot-of-european-policy-energy-efficiency-policies-for-low-income-households/

[114] European Commission, 2016, Towards a smart, efficient and sustainable heating and cooling sector

[115] ECEEE Summer Study 2018: A blind spot of European policy? Energy efficiency policies for low-income households, Jose Antonio Ordonez et al, Fraunhofer.

[116] Energy poverty and vulnerable consumers in the energy sector across the EU: Analysis of policies and measures, Steve Pye (UCL), Audrey Dobbins (USTUTT), Insight_E, Policy Report 2, 2015; https://ec.europa.eu/energy/sites/ener/files/documents/INSIGHT_E_Energy%20Poverty%20-%20Main%20Report_FINAL.pdf

[117] *Energy poverty and vulnerable consumers in the energy sector across the EU: Analysis of policies and measures*, Steve Pye (UCL), Audrey Dobbins (USTUTT), Insight_E, Policy Report 2, 2015 , link: ec.europa.eu/energy/sites/ener/files/documents/INSIGHT_E_Energy%20Poverty%20-%20Main%20Report_FINAL.pdf

Low income households struggling to keep their dwellings warm often use local space heaters as secondary heat source. For example, experiences from a Croatian support scheme for LIHs show that due to the low quality of dwellings they have higher energy needs and greater reliance on electricity for heating[118]. Also fuelled local space heaters are more used in these areas[119], depending on the local infrastructure. In these cases, the central heating system or district heating is a base load being supplemented with portable local space heaters as secondary heating.

Middle income households

For middle- and higher-income households with electric local space heating there is a move away from the traditional direct electric heating to heat pumps often as air-conditioners for heating. This is indicated by the HVAC industry and in several studies. Studies from Finland and Portugal e.g. found that:

- Households with higher incomes are replacing direct electrical heating with heat pumps, often air conditioners for heating.
- This development is spreading to middle income households.

In Finland the electricity consumption for secondary heating with heat pumps doubled from 2006 to 2011 and this trend is expected to continue[120]. Also, lot 33 Ecodesign preparatory study on Smart Appliances, assumes that the sales of radiant electric heaters decrease to an extent that it will be aligned with the increased sales of air to air heat pumps, keeping the EU stock of these heating appliances constant for the period 2015-2030[121].

Another electric heating source that is becoming more common in middle- and high-income homes is electric underfloor heating, which is often installed as retrofit in older bathrooms.

3.3 Choice of heating technology

The choice of heating technology used for indoor heating is highly dependent on various climatic, national, regional, and local conditions, culture and the history of heating technology choices in each Member State[122]. For example, Member States such as Latvia,

[118] Energy poverty and vulnerable consumers in the energy sector across the EU: Analysis of policies and measures, Steve Pye (UCL), Audrey Dobbins (USTUTT), Insight_E, Policy Report 2, 2015

[119] http://www.buildheat.eu/going-sustainable-to-rejuvenate-the-suburbs/ *Going sustainable to rejuvenate the suburbs*, Buildheat, 2016

[120] Proceedings of the 7th International Conference EEDAL'2013: Trends in Residential Electricity Use and - Other Lesson from Data Analysis, Virve Rouhiainen, Adato Energia Oy and Measuring Electric Energy Efficiency in Portuguese Households: A tool for energy policy Thomas Weyman-Jones, Júlia Mendonça Boucinha, Catarina Feteira Inácio, Portugal

[121] *Ecodesign Preparatory study on Smart Appliances (Lot 33) MEErP Tasks 1-6* (Jan 2017) circabc.europa.eu/webdav/CircaBC/Energy/Energy%20Efficiency/Library/Ecodesign%20preparatory%20studies/Lot%2033%20-%20DG%20ENER%20-%20Smart%20appliances/Ecodesign%20Preparatory%20Study%20on%20Smart%20Appliances%20_Tasks%201%20to%206.pdf)

[122] https://www.euroheat.org/wp-content/uploads/2016/02/Ecoheatcool_WP1_Web.pdf

Denmark, Estonia and Lithuania have highly developed infrastructure for district heating with around 60% of citizens served by district heating[123], even though some countries have higher security of supply than others. Other countries, such as Norway, have cheap and low-CO_2 electricity (due to large production of hydropower), which makes electric local space heaters widely popular.

Furthermore, the heat demand of course influences the size and nature of the heat source chosen in different Member States. In Member States with generally warm climate (e.g. Italy, Greece and Spain[124]), air conditioners, which can also be used as heat sources, are more common, rendering additional local space heaters unnecessary in many cases.

Even though direct electric local space heaters in principle have the same efficiency (100% of electricity input turned into heat output), both consumer organisations and scientific studies have found that different electric heating appliances can have (small) differences in energy consumption for the same task. The reason is, that the correct choice of local space heater will lead to a more even temperature distribution increasing the thermal comfort and thereby resulting in slightly lower consumption, even for direct electric heaters[125]. The consumer awareness about the most suitable local space heaters for specific room categories and positioning of the heaters is therefore important for comfort and efficiency.

3.3.1 Consumer perception of connectivity and controls

An important new development in the market is the spreading of controls that allow for connectivity and "smart home systems", where end-users can control for example their heating appliances from an app, even when not in the house.

A consumer survey[126] among 2000+ consumers from 2016 shows that people perceive the heating appliances in their homes as one of the primary product groups with potential to be connected to such smart home systems. For example more than 50% of the respondents agreed or strongly agreed that they would like to be able to control their heating system remotely and that they would like to automatically go to a more energy efficient setting when they leave the house. In comparison, less than 40% would like smart

[123] https://www.euroheat.org/news/district-energy-in-the-news/top-district-heating-countries-euroheat-power-2015-survey-analysis/
[124] https://www.statista.com/statistics/721746/ac-demand-units-by-country-europe/
[125] Comparing electric heating systems at equal thermal comfort: An experimental investigation, of Jérémie Léger, Daniel R. Rousse, Kilian Le Borgne, Stéphane Lassue Building and Environment, Elsevier, Volume 128, 2018. In the study a baseboard heater, a convector and a radiant heater are compared at equal thermal comfort conditions. Results show that the convector consumes a little less energy than the baseboard and radiant heaters despite achieving similar thermal comfort in enclosed rooms. The case is different for other rooms and usage situations.
[126] *Switch on to the connected home*, The Deloitte Consumer Review (2016)

functions on their refrigerators, coffee machines and washing machines. The domestic end-user market can therefore be expected to be ready for such smart functions.

One barrier for smart controls and smart systems platforms for both Android and IOS is the complexity. The UK consumer organization emphasize that an important factor of smart thermostats is ease of setting up the app and instructions for use[127].

3.3.2 Air Curtains

Air curtains is a specific type of commercial heaters currently not in scope of the Regulation, with specific use patterns different to those of luminous and tube heaters and are therefore elaborated in more detail in this chapter.

Air curtains differ from other commercial local space heaters in the sense that room heating is only the secondary purpose, whereas the primary purpose is division of climatic zones in open doorways. Air curtains are used where people are working close to a door that is opening frequently - in order to maintain those people's comfort. This is typically in shops, offices, hotel receptions, supermarkets, hospitals and the industry where they are installed, above doorways, gates or other openings and are a part of the building envelope.

The air curtains considered in this review study are those with a direct electric heating element. According to the industry organisation Eurovent Air curtains of this type are almost exclusively used in places where the door opens and closes many times during the day but is not continuously open. In use situations where the doors are continuously open, other heating technologies such as heat pumps or connection to a central heating system will most often be preferred by the end-users to reduce operation costs. The air curtains are thus not operating all of the time but scales the heat and fan load according to the door opening and closing.

The main purchase parameter for the consumers is the function of the product and less on other parameters such as the aesthetics, even though more discrete appliance design is often desired. In order to function properly an air curtain must be designed in relation to the specific width and height of the opening. The air curtain must blow air along the entire width of the opening and must have an air stream strong enough to reach the floor. Typically, a third-party company with expertise about air curtains do the design, installation and regulation of the system to make sure the setup is optimal.

Air curtains are installed in combination of a door or a gate and are in use during the opening hours of a shop/supermarket or during the working hours in the industry where people are entering and exiting the opening frequently. Outside these hours the door/gate

[127] https://www.which.co.uk/reviews/smart-thermostats/netatmo-thermostat/test-results

above which the air curtain is installed create the same function as the air curtain. Operation hours of air curtains highly depends on the use of the building. For instance, in hospitals air curtains are in operation day and night as the hospital do not close, whereas air curtains in shops, supermarkets and most industries are in operation 8-10 hours a day.

In this study is assumed that the air curtains are used 8 hours a day in the heating season (as other commercial heaters), but that the doors are only open 25% of the time, resulting in 2 full load equivalent hours per day in the heating season.

3.3.3 Towel rails

Stakeholders has suggested to expand scope to include towel rails as a specific category as they were mentioned as a major loophole by stakeholders, since many are used also heat the room, even though they might be claimed not to be for space heating purposes.

Towel rails are typically found in bathrooms. Their purpose is as per the name to dry and heat towels and they could also be used for other drying and heating tasks like bathrobes or even clothes. For this purpose, towel rails are found in wattages from as low as 15 W and up to 200-300 W. Above this wattage towel heaters are be sold and used for space heating as well as for heating towels. According to industry, towel heaters are typically installed in fixed installations but could be mobile as well, and often in relatively small rooms down to five square meters. According to a consumer survey made in France, the average bathroom is 5 m^2, and people spend on average 26 minutes in the bathroom in the morning[128].

The expected bathroom temperature is important for the heat consumption. According to a study made by the French Groupe Atlantic, most people (75%) want the bathroom to be warmer than the average temperature of rooms in use (19 °C) when they are taking a shower, as seen Figure 18. When they are not in the bathroom, however, 50% wants the bathroom to be the same temperature as the rest of the house when not in use (16 °C), and 30% don't mind if it is 1-2 °C lower. When in the bathroom, but not showering, 50% of the users also want it to be the same temperature as the rest of the house when in use (19 °C), however, 35% would like it to be warmer, and only 15% do not mind if it is colder[129].

[128] Results provided by Groupe Atlantic, based on a study from 2013.
[129] The reference temperature of "the rest of the house" depends on whether rooms are occupied or not. Hence, in a situation where the bathroom is not occupied, the wanted temperature is compared to the average temperature of un-occupied rooms (16 °C). The same goes for situations where the bathroom is occupied, where it is then compared to the average temperature of other occupied rooms (19 °C)

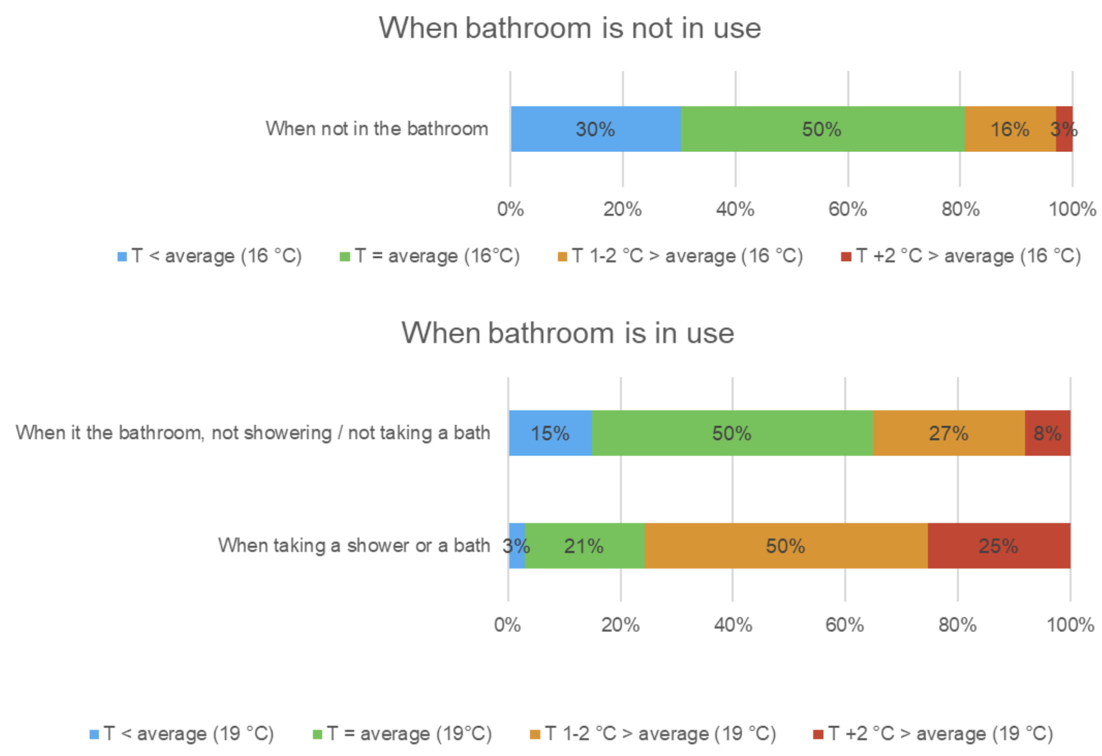

Figure 18: Comfort temperature in bathrooms in different room usage situations. Source: Groupe Atlantic.

This expected comfort by end-users has led to special features in the towel heaters also used for room heating, which separates them from other local space heater types, for example a "boost" function. According to industry, the main benefit of the booster function is that it allows for fast heating immediately before using the bathroom, e.g. in the morning the room can quickly be heated an additional 1-3 °C, to allow for high comfort. According to user surveys performed by Groupe Atlantic, the boost is used by more than 65% of the users who have it on their towel heaters[130].

Some stakeholders find that the current requirements of the regulation 2015/1188 for fixed electric local space heaters fits very well to end-user demand and usage of bathroom heaters. They are mainly used to heat up the bathroom to a comfort temperature level for short time periods in the morning and evening hours. Implementing an electronic control with week timer plus an adaptive start function is a perfect fit to the customer demands. This is sufficient to reach the 38% limit of the seasonal space heating efficiency. others argue that the boost function helps safe energy, because it allows for a lower average temperature in the bathroom throughout the day when users expect the temperature to be the same as the average temperature in the home or lower (as seen in Figure 18), and then increasing the temperature by a few degrees (1-3 °C) only when using the bathroom. Based on this argument, APPLIA suggests making a category specifically for bathroom

[130] Based on 1050 answers from French end-users

radiators and to give a bonus (in terms of correction factors) for the boost function because it requires a very reactive heater which is best achieved with a timed boost function. APPLIA propose the following definition below for boost function: "Heat function time limited (2 hours maximum) which purpose is to increase quickly the room temperature and to bring a certain level of human thermal comfort on a limited time".

However, a counter-argument is made that functions such as the boost function on towel heaters, could lead to higher energy consumption rather than an overall energy saving. The saving potential is based on the assumption that users would have a constant high temperature in their bathroom if they do not have a boost function. However, the opposite could also be true, that users would keep the bathroom temperature on the average all day, and without the additional consumption of the boost function, if it is not available to them. As seen in Figure 18 the majority of users expect the temperature to be the average home temperature or colder when not taking a shower, which is the majority of the time (approximately 24 hours minus the 26 minutes spend in the bathroom in the morning).

Hence, if a boost function was not available, many users might choose to just keep the bathroom at the same temperature as the rest of the home and live without the added comfort the boost function provides. Other users, on the other hand, might choose to have higher temperatures more time than necessary if the boost function was not available. In many ways the boost function might thus be a comfort function, rather than an energy saving function, while for some users it might save energy. This is highly dependent on the real-life user behaviour, but the presence of a boost function alone is not enough to ensure energy savings.

Mixed heaters

Some towel heaters connected to central heating through hydronic systems can additionally be equipped with an electric heat element. This can provide heat for the towel heater alone, when the central system is not running. Again, this could lead to either energy savings or increased energy consumption, based on user behaviour. It could on one hand motivate the houseowner to turn off the central heating system for summer season earlier than normally. On the other hand, it could add an energy consuming service in the summer season which normally would not have been there.

3.3.4 Flueless liquid fuel heaters

In dwellings flueless mobile heaters on liquid fuels are typically used as a supplement to other heating alternatives, including electrical local space heaters because they heat up cheaper and often quicker. They are rarely used as the only heat source. Portable flueless local space heaters could be stored away outside the heating season. Other typical uses for flueless heaters are in winter gardens, annexes, summer houses, etc. as primary heating. When used as supplementary heating in dwellings it would typically be in buildings:

- where electricity is the main heating source, and being considered too expensive
- where only few rooms are heated, and the building user/owner do not want to start the central heating system, perhaps in changing seasons
- with inadequate heating central systems perhaps as a consequence of building envelope with high infiltration rate of outside air or inadequate insulations.

Main functional purchase parameters are:

- Clean and efficient combustion
- Quick heating/ramp up
- Good temperature distribution – keep the room evenly warm
- Low temperature fluctuation
- Adjustment of power
- Easy handling including filling of fuel

These heaters usually contain mechanic controls, although the controls could also be modulated. This is one of the cheapest heat sources in most countries – much cheaper than electric heat – especially if the user does not ventilate adequately and therefore has low heat loss. However, if these products are used properly, there should be a high rate of ventilation in order to maintain a good indoor climate, which in turn decrease the heating efficiency.

Even though they may be sold as clean and efficient the products do pollute the indoor climate, which has been proven by in situ measurements and lab tests. Recent investigations in British households have found that gas and kerosene heaters emit different pollutants including polyaromatic hydrocarbons, sooth, ultrafine particles, water vapour, NO_2 and CO_2 exceeding guideline values[131]. However, since they are sold as having a clean combustion, consumers tend to forget or are not aware of, the need for ventilation for burning fuels inside. Today it is required that manufacturers write that ventilation is needed, however not how much ventilation.

It could be considered to require improved information in the instruction manual about minimum ventilation rate and instructions about airing (e.g. open windows twice per hour depending on room size and capacity), or maybe warning signs outside the packaging,

[131] Indoor levels of NO2 associated with gas cookers and kerosene heaters in inner city areas of England. J.W.Melia, S.Chinn, R.J.Rona, Atmospheric Environment, Elsevier (1990) and Impact of kerosene space heaters on indoor air quality, B. Hanoune and M. Carteret, Chemosphere, Elsevier, (2014), https://www.sciencedirect.com/science/article/pii/095712729090023N

which is visible before buying the product. Another suggestion from stakeholders is to either limit the emissions of CO, NOx and OGC, but this would not eliminate the need for ventilation in the room during use of the heater, and it is still important to inform the user about this.

3.4 Local infrastructure

The local infrastructure is, as mentioned above, important for the choice and use of local space heaters. This is both for practical reasons (how easy it is to install different types of local space heaters, the security of supply etc.), but also for political reasons, for example the share of renewable energy in the grid and incentive schemes from Member States. The power sector in the EU is in a transitional state, moving from fossil fuels to renewable energy, which challenges the existing infrastructure, but also gives rise to new opportunities.

3.4.1 Electricity

The power sector is in a transition state moving from fossil fuels to renewable energy. The origin of the electricity is very important factor to consider regarding the environmental impact by using an electric local space heater and how it may affect the consumer behaviour. Within the EU there are a number of renewable energy targets for 2020 set out in the EU's Renewable Energy Directive[132,]. The overall target within the EU is 20% final energy consumption from renewable sources by 2020. To achieve this goal the different EU countries has committed to set their own individual goal ranging from 10% in Malta to 49% in Sweden. In 2015 the share of renewable energy was almost 17%[133]. In November 2016, the Commission published a proposal for a revised Renewable Energy Directive to make the EU a global leader in renewable energy and ensure that the target of at least 27% renewables in the final energy consumption in the EU by 2030 is met[134].

The electricity consumption is a major part of the final energy consumption and the electricity mix is highly relevant for local space heaters. The electricity mix in 2015 is presented in Figure 19. Almost half of the electricity consumption still originates from combustible fuels and renewable energy sources only constituted around 25% of the electricity generation in 2015.

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[132] https://ec.europa.eu/energy/en/topics/renewable-energy
[133] http://ec.europa.eu/eurostat/documents/2995521/7905983/8-14032017-BP-EN.pdf/af8b4671-fb2a-477b-b7cf-d9a28cb8beea
[134] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52016PC0767R%2801%29

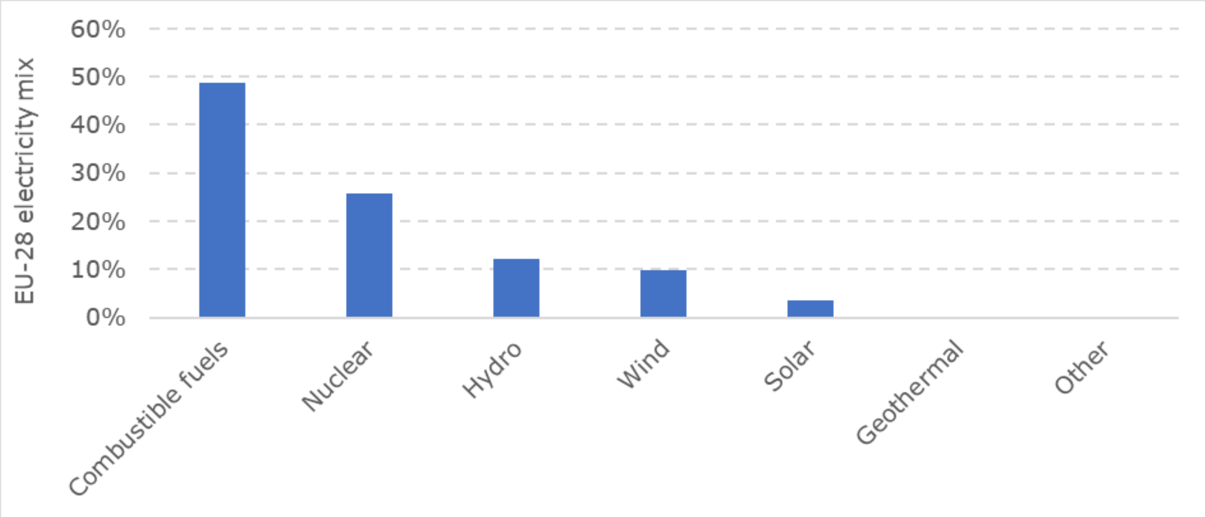

Figure 19: Net electricity generation, EU-28, 2016 (% of total, based on GWh)[135]

The reliability of the electricity grid could to some extent be affected by the transition to a renewable energy system. With more renewable energy in the system, new challenges occur e.g. with excess production of wind energy and the two-directional transfer of energy where some consumers also are suppliers e.g. with rooftop solar cells. Due to technological development, the reliability in many EU countries is ensured via the expansion of the electricity grid to distribute renewable energy. The quality of the electricity grid in Europe is considered to be high and among the best in the world. Every year the World Economic Forum release a Global Energy Architecture Performance Index report. The report is ranking the different countries on their ability to deliver secure, affordable, sustainable energy. In recent years European countries have dominated the top spots[136], as seen in Table 35.

Table 35: Grid reliability in selected countries

Country	2017 score	Economic growth and development	Environmental sustainability	Energy access and security
Switzerland	0,8	0,74	0,77	0,88
Norway	0,79	0,67	0,75	0,95
Sweden	0,78	0,63	0,8	0,9
Denmark	0,77	0,69	0,71	0,91
France	0,77	0,62	0,81	0,88
Austria	0,76	0,67	0,74	0,88
Spain	0,75	0,65	0,73	0,87
New Zealand	0,75	0,59	0,75	0,9
Uruguay	0,74	0,69	0,71	0,82

[135] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Net_electricity_generation,_EU-28,_2016_(%25_of_total,_based_on_GWh).png
[136] https://www.weforum.org/reports/global-energy-architecture-performance-index-report-2017

The use of local space heaters might notably increase the energy consumption in some countries in certain time periods since the use of local space heaters in particular occurs in the same time periods when it is cold. January is generally the month with the highest electricity consumption across EU except for some of the southern countries like Spain, Italy and Greece which all peaks in July due to the need for cooling. The lowest monthly electricity consumptions occur in June for most countries within the EU. In the below table the monthly electricity consumptions are presented for most of the EU countries[137]. In Table 36 the peak consumption is marked with red and the lowest consumption is marked with blue.

Bulgaria, France, Norway, Sweden and Finland are all among the countries with the highest share of electrical space heating installed. This is properly one of the reasons why these countries have peak electricity consumption in the coldest month, January, and the highest level of electricity consumption in January compared to June (more than 40% higher and for France even 58% higher).

[137] Data provided by ENTSO-E

Table 36: Monthly electricity consumption, where red indicates high electricity consumption and blue indicates low electricity consumption

MONTHLY CONSUMPTION (IN GWh)													
Country	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Austria	6498	5984	6203	5542	5468	5376	5588	5436	5271	5900	6005	6234	69505
Belgium	8057	7312	7653	6940	6795	6657	6548	6609	6731	7221	7202	7284	85009
Bulgaria	3455	3068	3111	2639	2404	2363	2611	2537	2416	2703	2766	3171	33244
Cyprus	368	364	338	283	314	343	452	495	441	351	298	358	4405
Czech Republic	6019	5584	5774	5200	4972	4818	4859	4641	4865	5509	5553	5624	63418
Germany	48952	45608	46179	40889	39607	39875	41470	39824	40911	45723	46280	45289	520607
Denmark	3188	2909	2916	2306	2648	2907	2556	2692	2697	1943	2555	3113	32430
Estonia	816	719	743	679	634	573	574	593	624	719	714	751	8139
Spain	23883	22048	22279	19837	21016	21614	24972	22341	20897	20964	20985	22069	262905
Finland	8437	7336	7645	6756	6268	5838	5941	6008	6118	7138	7279	7730	82494
France	52475	48579	45707	36847	33873	33225	34887	31582	33483	39167	40985	44593	475403
United Kingdom	32243	29083	31380	26097	26044	24327	24569	24361	25082	28320	30380	30768	332654
Greece	4829	4299	4504	3772	3823	3965	4855	4687	4086	3835	3895	4610	51160
Croatia	1538	1429	1461	1314	1292	1288	1573	1494	1336	1351	1369	1539	16984
Hungary	3629	3316	3507	3218	3209	3249	3484	3342	3313	3507	3490	3491	40755
Ireland	2498	2279	2397	2154	2192	2055	2100	2087	2120	2276	2353	2445	26956
Italy	26786	24948	26793	24169	25027	26328	31970	24458	26449	25907	25675	25818	314328
Lithuania	1005	891	920	873	862	825	846	863	866	955	958	995	10859
Luxembourg	574	538	579	516	497	503	542	512	492	554	547	514	6368
Latvia	692	616	635	589	571	522	549	568	562	625	626	654	7209
Netherlands	10343	9183	9588	8741	8881	8823	9191	9049	9149	9685	9763	10119	112515
Norway	13526	12065	12244	10410	9989	8880	8391	8585	8979	10632	11726	12872	128299
Poland	13546	12327	13116	12060	12011	11716	12333	12295	12099	13257	13066	13254	151080
Portugal	4713	4232	4167	3727	3939	3964	4280	3907	3883	3987	3977	4189	48965
Romania	5023	4598	4791	4435	4258	4202	4636	4398	4266	4665	4634	4877	54783
Sweden	14100	12610	12851	10967	10494	9602	8907	9561	9888	11578	12242	13130	135930
Slovenia	1233	1130	1178	1067	1092	1088	1149	1073	1099	1175	1164	1199	13647
Slovakia	2470	2277	2393	2194	2157	2115	2191	2136	2128	2360	2350	2405	27176

High peak loads in electricity consumption typically leads to increased power production from conventional power plants (e.g. coal) and increased cost and CO_2 emissions. If it is possible to minimize the peaks by shifting part of the load away from the peak time the increased cost and CO_2 emissions can be minimized.

The hourly load values for a random Wednesday in March 2015 for selected countries are presented in Figure 20. All presented countries have similar hourly load values with two peaks, one in the morning and one in the evening. It is barely visible for Denmark, but this is due to scale of the graph. There are though small shifts in the peaks. In Denmark, the peaks occur a little earlier than in Spain. The first peak fits well with the start of the workday and the second peak fits with the end of the workday. Between the two peaks there is a falling trend in the energy consumption. The lowest electricity consumption across the different countries are at 5 AM. For most countries, this hourly load curve fits this description the majority of the days. For months and days with a higher or lower consumption tendency the profile are the same it is just shifted up or down.

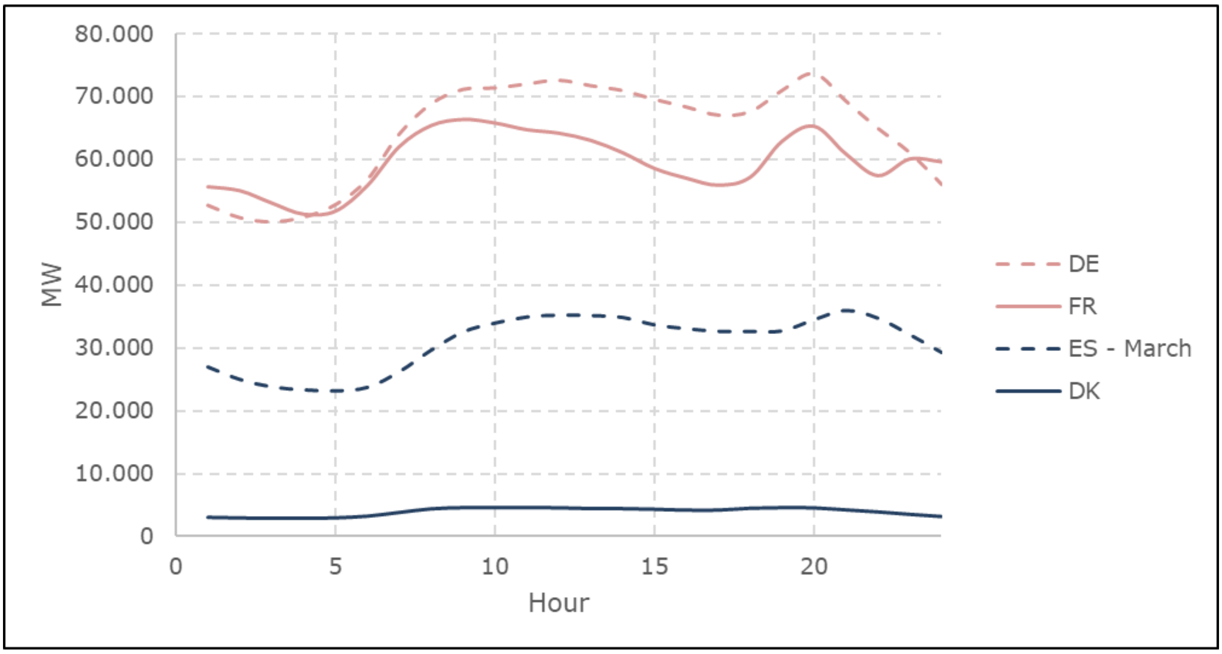

Figure 20: Hourly load values a random day in March

Time-of-use-pricing and demand response-products

The electricity grid, and to some extend also the gas grid in many countries, could be subject to pressure from the space heating in the peak hours. At the same time, particular electrical heating appliances, including local space heating are in the group of appliances with potential for shifting the use time up to one hour without loss of comfort. Thereby the excess CO_2 emissions and cost from peak power supply can be avoided. Several experiments and experiences show that 2% of the electricity consumptions could be moved from peak periods if consumers have the right motivation and means[138].

A number of countries like France, Germany, Denmark and Sweden have implemented or are experimenting with differentiated low and high/peak pricing on electricity. This includes night and day tariffs, winter and summer rates, or even a combination of all, to see if this can move the consumption to low peak hours. Also, some suppliers of electricity offer a spot price contract to the consumers. Such contract may only affect the electricity bill and

[138] *Tariffs in Nordic countries – survey of load tariffs in DSO grids*, NordReg report 3/2015 www.nordicenergyregulators.org/wp-content/uploads/2015/03/Tariffs-in-Nordic-countries-survey-of-load-tariffs-in-DSO-grids.pdf

not the consumer behaviour. To affect the consumer behaviour, the consumers' need information on the pricing, or at least the electrical products/appliances should be able to react on the information.

To enable price or load response from electricity consumers the installation of automatic meter reading (AMR), advanced meter systems (AMS) or smart meters can be necessary. The difference between AMW, AMS and Smart reader is to which extend the different meters have two-way communication capabilities with smart meters having the most extended functionalities. Below they are all called smart meters since the literature sources do not distinguish consequently.

Sweden has rolled out the smart-meters for all of the electricity consumers[139] and ADEME (French Environment & Energy Management Agency) and ENEDIS (the national grid operator for 95 % of the public electricity distribution grid of continental France) are rolling out smart meters for all its consumers. This process will be completed in 2021[140]. Norway has also rolled out advanced meter systems for all consumers in 2019[141].

The French electricity company Électricité de France (EDF) has since 1995 offered the product *Option Tempo*. Here the electricity prices vary according to the expected peak load on the electricity production. All days have peak and off-peak hours, the last from 22h to 6h. In addition, the days through the year are categorized in three categories, blue, white and red, with prices varying from 0,11 €/kWh in off peak on "blue" days to 0,55 €/kWh in peak hours on Red" days (2018). The last occurs on winter days. The category is announced on a day-to-day basis via an information board with light diodes installed in the individual household[142]. In 2010 the electricity company had around 350.000 residential electricity consumers. In average these consumers saved around 10% on their electricity bills during the introduction phase[143]. Because of its complexity and the discipline need from consumers it never became a more widespread success. Due to various developments on the electricity market EDF has discontinued offering this product to new costumers but focus on the less complex peak / off-peak prices[144].

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[139] *Tariffs in Nordic countries – survey of load tariffs in DSO grids*, NordReg report 3/2015 www.nordicenergyregulators.org/wp-content/uploads/2015/03/Tariffs-in-Nordic-countries-survey-of-load-tariffs-in-DSO-grids.pdf
[140] https://www.ademe.fr/particuliers-eco-citoyens/habitation/bien-gerer-habitat/compteurs-communicants-linky-gazpar
[141] https://www.nve.no/energy-market-and-regulation/retail-market/smart-metering-ams/
[142] https://www.jechange.fr/energie/fournisseurs/edf/tempo
[143] *Time-based pricing and electricity demand response: Existing barriers and next steps,* Cherrelle Eid, Elta Koliou, Mercedes Valles, Javier Reneses, Rudi Hakvoort, Utility Policies, Elsevier, 2016.
[144] https://www.fournisseur-energie.com/edf-fournisseur-historique/tempo/
https://www.jechange.fr/energie/fournisseurs/edf/tempo

Special tariffs for heating

Several countries have lower electricity rates for electricity intended for use for the heating of buildings, for example Germany and Denmark. Germany has *household-electricity* and *heating-electricity* tariffs (*Househaltstrom/Heizstrom*). The electricity tax is lower on electricity for space heating like heat pump, electrical underfloor heating or electrical panel heaters and the households need to have two meters installed to differentiate the consumption [145]. In Denmark the electricity tax on electricity for heating (meaning electricity consumption on more than 4000 kWh/year) in households with electrical space heating is half of the normal tax[146].

Smart appliances

More smart appliances are expected to enter the market, and this includes electrical heaters. Smart appliances are defined in the ecodesign preparatory study on smart appliances (Lot 33)[147] as "an appliance that supports Demand Side Flexibility" (in a more recent report of the preparatory study, these are called Energy Smart Appliances, to be more specific about which the kind of "smart" the appliance is capable of):

- It is an appliance that is able to automatically respond to external stimuli e.g. price information, direct control signals, and/or local measurements (mainly voltage and frequency);
- The response is a change of the appliance's electricity consumption pattern. These changes to the consumption pattern are what we call the 'flexibility' of the smart appliance;
- The specific technical smart capabilities do not need to be activated when the product is placed on the market; the activation can be done at a later point in time by the consumer or a service provider.

The ecodesign study identified three groups of appliances where potential is greatest, based on appliances that a) consume a relatively high level of electricity and b) can be used flexibly by consumers. The third of the groups is "residential and tertiary cooling and heating which can be shifted for 1 hour, but with an additional constraint to avoid loss of comfort".

Electrical heaters and in particular storage space heaters have the potential to add some flexibility to the electricity system. The main constraints on demand side response could be loss of thermal comfort when heating appliances stop to function for a longer period as a consequence of a demand response signal.

[145] www.eon.de/frag-eon/themen/strom-heizstrom/fragen-und-antworten/was-ist-heizstrom-und-welche-tarife-gibt-es/
[146] 6 c/kWh respectively 12 c/kWh, sparenergi.dk/forbruger/varme/elvarme
[147] http://www.eco-smartappliances.eu/Documents/Ecodesign%20Preparatory%20Study%20on%20Smart%20Appliances%20_Tasks%201%20to%206.pdf

There are already local space heaters with network capability available on the market that can be controlled via smart phones, tablets and other devices remotely via network, and even grid communication capability that allows control of devices according to electricity prices. However, these are not Energy Smart Appliances as defined in the ecodesign preparatory study on smart appliances[148]. Furthermore, these networked local space heaters currently on the market do not vary significantly from products without network capabilities.

Depending on the number of energy smart appliances in the system these appliances can provide energy system services both in day-ahead and in real-time by shifting operation. Day-ahead services leads to a reduced cost and CO_2 emission compared to a situation without smart appliances, since additional generation by conventional power plants (e.g. coal) could be avoided due to a smart shift in load. The same benefits can be observed regarding real-time services[149]. With energy smart appliances it is possible to fit the demand to the production.

Some of the current barriers for energy smart appliances and many of which they share with smart-home products are:

- Estimated high prices (not always the case, but for many premium products)
- Limited consumer demand
- Data safety and concerns about data privacy issues
- Long device replacement cycles
- Fragmentation within the connected home ecosystem. There are many different ways of connecting to the “smart home”. Without any common standards for the smart home it is difficult and confusing for the consumer to set up and control multiple devices.
- Concerns of loose of control and comfort
- The fact that the electricity suppliers do not currently offer demand response, although more and more are introducing price variations for peak and of-peak hours
- Lack of common standards and infrastructure for all types of energy smart appliances for the whole EU.

[148] http://www.eco-smartappliances.eu/Pages/welcome.aspx
[149] http://www.eco-smartappliances.eu/Documents/Ecodesign%20Preparatory%20Study%20on%20Smart%20Appliances%20_Tasks%201%20to%206.pdf

The three major barriers of these, discouraging consumers from adopting smart appliances, are costs, mistrust in providers and concerns about data privacy, according to a large consumer survey in 2010[150].

The impact of standards and knowledge was seen with heat pumps in Germany when the introduction of technical standards, quality assurance and information campaigns which addressed consumer confidence problems changed the market[151]. Regarding prices, a survey by Deloitte[152] found that connected products according to consumers are too expensive, however, according to the ecodesign study, payback periods would be short.

The limited consumer demand for energy smart appliances can be related to the low availability of these products and to the current electricity consumer price structure in EU. In most of the EU countries more than half of the electricity prices constitute of taxes and network cost, so if the difference in electricity price is low there is only little incentive to use electricity in these periods since it is only a minor part of the costs (note that other ways of paying consumers exist in the smart grid[153]). In Figure 21, the composition of the electricity prices for household consumers are presented[154].

On the other hand, with knowledge and benefit from information (e.g. feedback on energy use or energy consumption relevant parameters) consumers generally are willing to accept higher prices for smart appliances[155].

If standards are developed in the coming years as a result of the ecodesign work on Smart Appliances, the potential of electric local space heaters of being energy smart appliance and contribute to savings and grid stabilization at large scale could be realised through a common data model and application protocol, which needs to support a common data model. However, it should be noted that it would require more than a data model and application protocol, e.g. technical requirements such as functional requirements, interface requirements and information requirements.

[150] Ecodesign Preparatory study on Smart Appliances (Lot 33) MEErP Tasks 1-6, 2017
[151] UKERC Technology and Policy Assessment Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply. December 2016, Richard Hanna, Bryony Parrish, Rob Gross https://www.theccc.org.uk/wp-content/uploads/2017/01/UKERC-for-the-CCC-Best-practice-in-heat-decarbonisation-policy.pdf
[152] *Switch on to the connected home*, The Deloitte Consumer Review, July 2016, https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/consumer-business/deloitte-uk-consumer-review-16.pdf
[153] https://www.smartgrid.gov/the_smart_grid/consumer_engagement.html
[154] Eurostat, http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics
[155] Mert et al., 2008 and *Ecodesign Preparatory study on Smart Appliances (Lot 33) MEErP Tasks 1-6*, VITO, Viegand & Maagøe, Armines and Bonn University, 2017

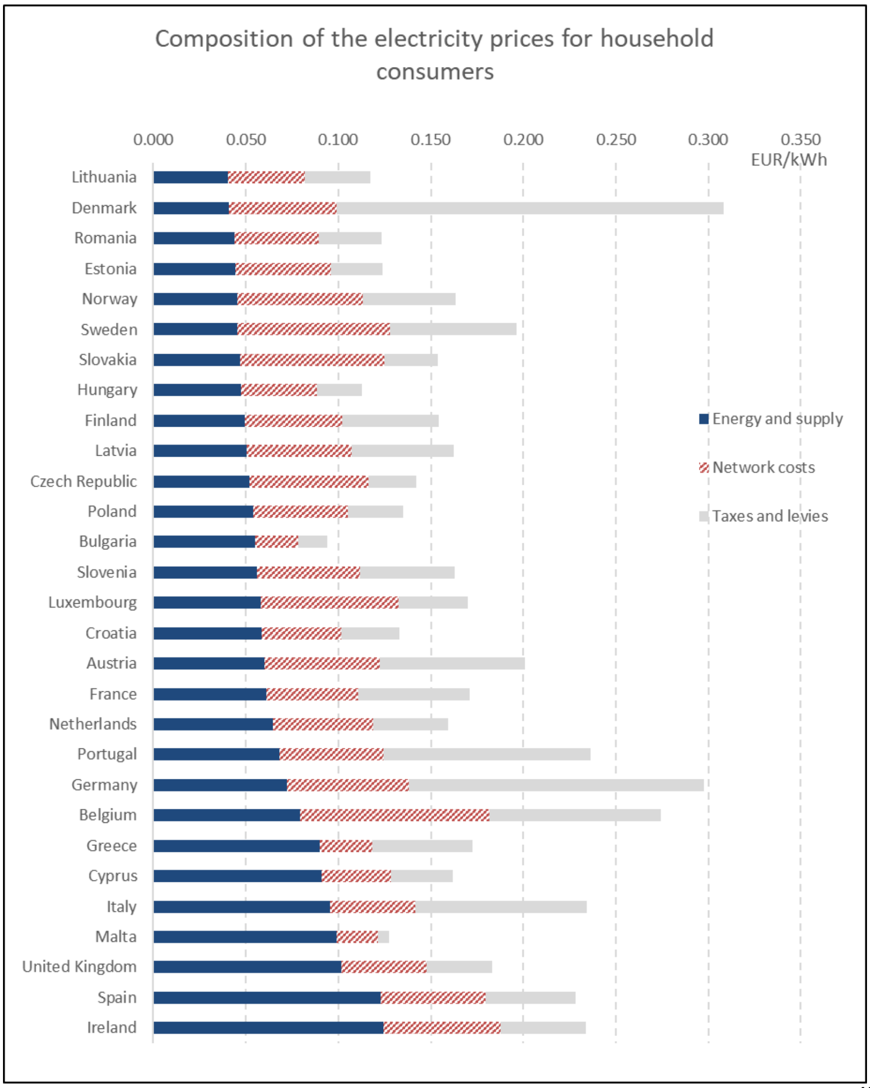


Figure 21: Composition of the electricity prices for household consumers[156]

3.4.2 Gas

The Netherlands, United Kingdom, Denmark and in the future Norway has passed their peak production from their natural gas fields in the North Sea. In the Netherlands in particular the production at the major Groningen field – formerly the worlds' largest gas field – has decreased drastically and is to be phased out completely by 2030. Consequently, the European gas supply faces a double challenge with the transition from a high degree of self-sufficiency to widespread dependence of imported natural gas (from Russia mainly) or imported liquified natural gas (LNG) and the EU climate plans to cut down CO_2 emissions. This leads to the decision to work for a long term cut down on gas dependency in Europe. For the same reason, an increasingly high pressure is expected to be put on gas and oil driven appliances such as local space heaters.

[156] Eurostat, http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics

For example, the Netherlands has decided that all residential buildings should be off gas in 2050. The objective is to reduce CO_2 emissions from the built environment. 31 municipalities, including the largest cities like Amsterdam, Rotterdam and Utrecht, have signed a 'Green Deal' for 'gas-less neighbourhoods'. Amsterdam city council has published its plan to get rid of the city of gas-fired cooking and central heating by 2050. The aim is to remove 10.000 housing corporation homes from the gas network. New houses are not supposed to be on the gas grid but on the district heating network mainly[157].

The Netherlands' local municipalities are given the responsibility to decide which measures that are necessary to switch away from natural gas and the above-mentioned cities plans is a result of this. The Netherlands' plans for switching away from natural gas says that in principle new gas infrastructure will no longer be created in newly built residential districts. Therefore, the target is from start primarily directed to dwellings, while energy for buildings for business and green houses will be handled at a later stage[158].

Besides allocating costs so that households and businesses will have similar heating bills even if they are changing away from natural gas as heating energy source the Netherlands in 2016 adjusted the tax on electricity and gas in order to make electricity for heating more favourable. During the coming years the Netherlands will develop more concrete plans for reducing CO_2 emissions including the plans for phasing out natural gas[159].

However, the gas grid may also be a keystone in the future with a high degree of renewable energy. The gas grid can store a high amount of energy and ensure flexibility to the energy system. Also, it can function as storage for biogas and upgraded biogas to natural gas quality. For example, in Denmark, 5% of the gas consumption in 2017 was upgraded biogas, and the connection of upgraded biogas facilities continues to increase[160]. Other gas types, such as hydrogen, which can be produced from renewable energy sources, are also being investigated, for example by CEN and CENELEC[161].

3.4.3 End-of-life behaviour

The material consumption and resource impact from products is closely related to the end of life processing. Local space heaters are collected at end-of-life and send to the selected facility for reprocessing, mainly as Electrical and Electronic Equipment (EEE) covered by the WEEE directive. Products without electrical or electronical parts; which as described is a smaller and smaller ratio of local space heaters are collected as ordinary scrap. Illegal

[157] https://www.dutchnews.nl/news/2016/11/amsterdam-homes-to-be-gas-free-by-2050/
[158] The Netherlands Ministry of Economic Affairs, *Energy Agenda Towards a low-carbon energy supply* (2017) https://www.government.nl/ministries/ministry-of-economic-affairs-and-climate-policy/documents/reports/2017/03/01/energy-agenda-towards-a-low-carbon-energy-supply
[159] *Government kicks off climate agreement efforts.* (2018) https://www.government.nl/latest/news/2018/02/23/government-kicks-off-climate-agreement-efforts
[160] https://energinet.dk/-/media/F2CEF64B7D9F489DB89E27B95132DF80.pdf
[161] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC99525/sfem%20wg%20hydrogen_final%20report%20(online).pdf

trade and sales of scrap of some product categories, mainly electronics and IT products with expensive raw materials, reduces the collection rate. The statistics from Eurostat shows products put on the market and waste collected for small household appliances. This statistic does not refine the actual number of local space heaters collected so the actual collection rate can be difficult to quantify but is expected to be in line with the aggregated rate of collection.

From 2019 onwards, the minimum collection rate to be achieved annually shall be 65% of the average weight of EEE placed on the market in the three preceding years in the Member State concerned, or alternatively 85% of WEEE generated on the territory of that Member State[162]. In Table 37 the collection rate is calculated for large household appliances based on the average weight of EEE placed on the market in the three preceding years in the Member State concerned[163].

The average collection rate of large household equipment for the EU was below 40% in 2014. The collection rate does also cover other appliances, but it is assumed that the rates are representative for local space heaters. The collection rate should be improved to 65 % in 2019. The low collection rate of local space heaters cannot be addressed in the ecodesign regulation but should be addressed by each EU country who should decide how to fulfil their obligation regarding the WEEE directive.

Table 37: Calculated collection rate in EU 2014[164]

	Average EEE put on the market 2011-2013	WEEE collected 2014	Collection rate
Austria	77,662	31,199	40%
Belgium	107,115	50.781	47%
Bulgaria	38.664	30.286	78%
Croatia	23.445	5.275	22%
Cyprus	8.350	1.222	15%
Czech Republic	72.575	27.828	38%
Denmark	65.210	32.890	50%
Estonia	8.223	1.854	23%
Finland	71.690	33.917	47%
France	918.570	292.730	32%
Germany	748.121	239.662	32%
Greece	86.162	27.317	32%
Hungary	45.004	28.682	64%
Iceland	3.305	1.696	51%
Ireland	38.306	23.797	62%

162 http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_waselee&lang=en
163 http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_waselee&lang=en
164 Due to how the numbers are calculated it is possible to collect more than 100 % (This is also related to how the values are compiled in each country)

	Average EEE put on the market 2011-2013	WEEE collected 2014	Collection rate
Italy	501.190	142.666	28%
Latvia	8.728	2.490	29%
Liechtenstein	36	75	208%
Lithuania	15.352	12.429	81%
Luxembourg	4.690	2.586	55%
Malta	6.206	971	16%
Netherlands	112.119	64.496	58%
Norway	70.451	49.402	70%
Poland	244.980	81.082	33%
Portugal	73.738	33.154	45%
Romania	75.341	20.465	27%
Slovakia	25.087	11.590	46%
Slovenia	17.030	4.535	27%
Spain	355.992	101.827	29%
Sweden	107.447	71.306	66%
United Kingdom	708.172	296.520	42%
Total	4.638.962	1.724.730	37%

Recyclability of local space heaters

After collection, the electronic scrap is treated at specialised facilities which mechanically process the appliances. The expected waste process flow for WEEE local space heaters are visualised in Figure 22. Note that electrical local space heaters and fuelled local space heaters with electronics are mixed and shredded with other types of products End-of-Life, and the following does not only relate to the handling of local space heaters.

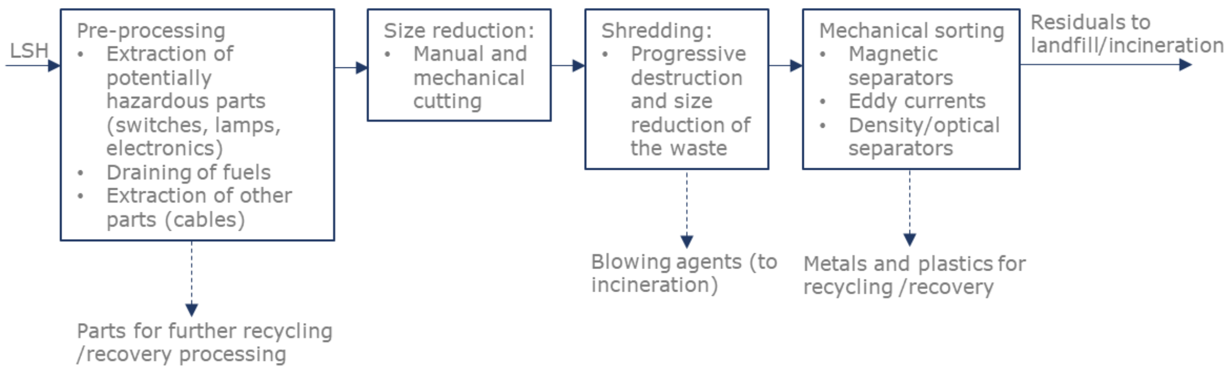


Figure 22: Expected reprocessing of local space heaters End-of-Life

The pre-processing is the first step in the recycling process of local space heaters. This first step often consists of manual removing of targeted components and/or materials for further treatment. The pre-processing is very important in connection with an effective recycling process by reducing the risk of contamination, quickly recover selected valuable materials for further reprocessing and allow compliances with current directive on hazardous substances[165] and waste[166] and prevent damage to the facility in the following steps. According to the WEEE directive components such as electronic components (e.g. printed circuit board, capacitors, switches, thermostat, liquid crystal displays) and batteries are additionally dismantled when present (see section below).

Next steps typically consist of a series of shredders, which reduces the products in smaller pieces, so the different materials can be sorted. The dust is removed and captured by cyclones. When the equipment is shredded into smaller pieces (approximately 1 cm to 10 cm) different technologies handles the sorting. These technologies are often[167]:

- Magnetic separation removing ferrous metals
- Eddy current separators removing non-ferrous metals such as copper, aluminium, and zinc
- Density separators: Different types of plastic.

The overall efficiency of the End-of-Life handling (the share of recovered, recycled, and reused materials) in this study is based on the EcoReport tool[168] but updated regarding plastic[169]. The values used in the current study is presented in Table 38.

Table 38: Recycling rates adopted in the current study

	Bulk Plastics, TecPlastics*	Ferro, Non-ferro, Coating	Electronics	Misc.
EoL mass fraction to re-use, in %	1%	1%	1%	1%
EoL mass fraction to (materials) recycling, in %	29%	94%	50%	64%
EoL mass fraction to (heat) recovery, in %	40%	0%	0%	1%
EoL mass fraction to non-recov. incineration, in %	0%	0%	30%	5%
EoL mass fraction to landfill/missing/fugitive, in %	31%	5%	19%	29%
TOTAL	100%	100%	100%	100%

*Adjusted values compared to the EcoReport tool[168]

As local space heaters primarily consist of metals the overall recycling rate is assumed to be high, as 94% of the metals are assumed to be recycled. Traditionally it is also easier for recycling facilities to recover metals than for example plastic. Plastic are often mixed with other types of plastics which challenge the quality of the recycled plastic. Often recycled plastic is downgraded if it is not properly separated.

[165] http://ec.europa.eu/environment/waste/rohs_eee/index_en.htm
[166] http://ec.europa.eu/environment/waste/weee/index_en.htm
[167] http://www.sciencedirect.com/science/article/pii/B9780128033630000031
[168] http://ec.europa.eu/growth/industry/sustainability/ecodesign_da
[169] Plastic Europe, Available at: http://www.plasticseurope.org/documents/document/20161014113313-plastics_the_facts_2016_final_version.pdf

4. Technology overview and Technology roadmap

Task 4 will give a description of technologies where there are relevant updates since the preparatory study in 2012. The current average technology (representing BAU) and best available technology (BAT) will be presented. As will be explained in this task, the BAT and BNAT (Best Not yet Available Technology) are the same for most local space heaters, because the technologies are very mature, and no further major improvements are expected compared to what has already been done to meet the current regulation. The description of any updates on technology is important for determining the appropriateness of the efficiency requirements.

A section of this task will investigate the validity of the correction factors used for assessing the seasonal efficiency of local space heaters. This will also depend on the findings from task 3, as potential savings are closely linked to user behaviour.

4.1 Seasonal space heating efficiency

Section 1.2.1 presents the different EU legislation for space heating products. In general, ecodesign regulations for space heating products are using seasonal space heating efficiency as a measure for the energy efficiency. The formula design for seasonal space heating efficiency was first introduced with Commission Regulation (EU) 813/2013 and has been adopted in multiple succeeding regulations[170] since.

4.1.1 Calculation formula

The general formula of the seasonal space heating energy efficiency (η_S) consists in different elements:

- $\eta_{S,on}$: The space heating energy efficiency in active mode
- X %: A percentage subtracted to account for control options
- F(i): Individual correction factors taking into account contributions accounting for heat storage and heat output control, auxiliary electricity consumption and permanent pilot flame energy consumption
- CC: The correction coefficient which in practice is the same as primary energy factor (PEF) of electricity. The correction coefficient is implicitly a part of the space heating energy efficiency in active mode for electric products and the correction factor of the auxiliary electricity consumption.

In case of local space heaters in the scope of Commission Regulation (EU) No 2015/1188, the formulas are:

[170] Commission Regulation (EU) No 2015/1189 (Solid fuel boilers), Commission Regulation (EU) No 2015/1185 (Solid fuel local space heaters), Commission Regulation (EU) No 2016/2281 (Air heaters)

For all local space heaters, except commercial local space heaters:

$$\eta_S = \eta_{S,on} - 10\% + F(1) + F(2) + F(3) - F(4) - F(5)$$

For commercial local space heaters:

$$\eta_S = \eta_{S,on} - F(1) - F(4) - F(5)$$

Stakeholders have questioned the rationale of using the seasonal energy efficiency for some local room space heaters due to their occasional use. Further, the use of control bonuses is questioned. Though the term seasonal energy efficiency may be difficult to interpret for the consumer, the use of the formula for evaluating the efficiency of the products still seems appropriate. The formula includes the efficiency measured according to relevant specific standards ($\eta_{S,on}$) and minimum requirements can be set for the individual product types to accommodate for in some cases even very simple controls. Concerning the consumers, the energy label uses the term energy index which may be easier to interpret for the consumer. Thus, as the regulation has already been in place for several years, it is not foreseen the use of the term seasonal energy efficiency and the corresponding general formula will change.

4.1.2 Thermal efficiency

For all non-commercial local space heaters using gaseous or liquid fuels, the space heating energy efficiency in active mode ($\eta_{S,on}$) equals the useful efficiency ($\eta_{th,nom}$) at nominal output. This means that the part load useful efficiency for multi-stage or modulating heaters is not considered in the calculation of the energy efficiency in active mode. Some stakeholders have requested taking into account part load efficiency in the calculations, but also recognise that test data are not available at the moment. As a response, a stakeholder proposes to include in the next review text an investigation of whether it is appropriate to use data for part load conditions e.g. 30% in the calculations. To get the data base the same stakeholder proposes different options:

- A specific study on testing of products at part load conditions
- Introducing information requirements on part load in the ecodesign regulation
- Keep ecodesign requirements unchanged but include the information requirement in the energy labelling regulation

Local space heater can be equipped with different kind of outlets and flues:

- Horizontal outlet for exhaust directly through the wall or to chimney
- Vertical outlet that can be connected to a vertical flue pipe.

In principal, the useful efficiency for a local space heater should be equal to the thermal efficiency (also known as flue gas efficiency). When measured close to the outlet of the heater, the thermal efficiency should also be independent of the type of outlet: horizontal or vertical.

However, the vertical flue pipe will emit heat to the room and for local space heaters equipped with coaxial balanced flue, heat from the flue gas (inner pipe) will be transferred to the combustion air in the outer pipe resulting in recovery of heat otherwise lost. When extending the local space heater product to include this vertical flue pipe, it results in a useful efficiency that is higher than the thermal efficiency measured close to the outlet without the pipe.

Stakeholders have claimed that due to unclarities in the standards, manufacturers may take advantage of extending the product to include very long vertical flue pipe which may result in unintended high useful efficiencies. Solutions could be to clarify the measuring point of the flue gas loss or to limit the length of the vertical flue pipe that can be taken into account in the calculation of useful efficiency. In on-going standardisation work (prEN 613), a clause limiting the maximum flue length to 8 meters for testing has been implemented for balanced flues. However, the mandate concerning adapting this standard to ecodesign regulations was rejected by CEN and it's unclear how and when this will become a harmonised standard in this regard. The situation of having different flue options for identical local space heaters may in respect to Ecodesign require additional product information or even additional model identifiers.

The term useful efficiency is also used for commercial local space heaters. Stakeholders have claimed this term is not well described in the regulation. It is recommended to replace the terms useful efficiency and thermal efficiency in the revised regulation specifically for tube commercial local space heaters.

4.1.3 Primary energy factor

In the current regulation a conversion coefficient, CC = 2,5 is used for electric heaters to convert the electricity consumption at the point of operation to primary energy, taking into account the efficiency of the electricity production processes and distribution losses. This CC factor is based on the default primary energy coefficient, also known as the PEF (Primary Energy Factor), identified in the Energy Efficiency Directive[171]. In the updated EED, this value was decreased to 2.1 based on the advances and efficiency improvements in electricity production[172].

[171] OJ L 315, 14.11.2012, p. 1–56, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012L0027
[172] https://ec.europa.eu/energy/en/studies/review-default-primary-energy-factor-pef-reflecting-estimated-average-eu-generation

The CC factor will thus need to be adjusted accordingly in Regulation 2015/1188. Changing the CC factor affects only the electricity consuming products, i.e. the electric local space heaters and, to a minor extent, products with auxiliary electricity consumption for controls.

The current requirements for electric local space heaters are based on an assumption that they are 100% at the point of operation (converting 100% of electricity to heat). but due to the CC of 2,5 the maximum efficiency is 100%/2,5=40%. With a PEF/CC of 2,1 the maximum efficiency would instead be 100%/2,1=47,62%.

The change can be implemented in various ways, but in order not to undermine the efforts manufacturers have made to comply with the current regulation by changing all the correction factors for the electric local space heaters, it is suggested to simply change the minimum requirements according to the new PEF/CC. Table 39 shows the requirements for electric local space heaters with the revised PEF/CC.

Table 39: Revised requirements for electric local space heaters based on the revised PEF / CC factor

Product category	Existing regulation requirements with CC=2.5	Revised regulation requirements with CC=2.1
Portable	36%	43,6%
Fixed >250 W	38%	45,6%
Fixed <250 W	34%	41,6%
Storage	38,5%	46,1%
Underfloor	38%	45,6%
Visibly glowing >1,2 kW	35%	42,6%
Visibly glowing <1,2 kW	31%	38,6%

The formula and the correction factors would not need to be changed, 10%-points would still be subtracted from the maximum (now 47,62%), which would yield a "basis" efficiency of 37,62% to which the various correction factors (maximum 10%-point) could then be added to fulfil the requirements in Table 39. The number of decimals on the requirements can be discussed, however an accuracy of 1 decimal (rounded down) is suggested, as in the current Regulation.

The secondary heat, i.e. the electricity used at the point of operation, does not change for these appliances, only the primary energy, i.e. energy produced at the electricity plant. Since the CO2 emissions are calculated based on electricity consumption at point of operation[173], i.e. including the power generation and distribution, the CO_2 emission will

[173] Based on CO2 emission rates for EU power generation and distribution from MEErP 2011, EIA 2016. https://ec.europa.eu/docsroom/documents/26525/attachments/1/translations/en/renditions/native and https://www.eup-network.de/fileadmin/user_upload/Produktgruppen/Lots/Working_Documents/MEErP_Methodology_Part_2_Final.pdf

change with the new CC. However, it changes over time due to assumed increasing efficiency of the European Electricity grid.

4.2 Correction factors

Multiple stakeholders have commented on the correction factors. The comments can be divided into three groups of correction factors:

- Room temperature and user activated control, F(2) & F(3)
- Charge and output control, F(1)
- Auxiliary consumption and pilot flame, F(4) & F(5)

4.2.1 Room temperature and user activated control, F(2) & F(3)

Stakeholders have commented on specific factors and on the justification of the correction factors in general. The latter cannot be done in detail as these were developed based on various sources, stakeholder experience and political consensus not traceable anymore but some general considerations can be provided considering the factors F(2) and F(3).

Energy losses from a room or building can be divided into:

- Transmission losses
- Infiltration and ventilation losses

These energy losses are dependent on the characteristics of the building envelope and systems, but equally important dependent on the temperature difference between room temperature and outside temperature. If the room temperature is 1°C higher this will typical result in 5-8% higher losses and vice versa. The correction factor F(2) is considering the control options related to room temperature with the purposes of keeping this as low as possible within the limits of providing the requested comfort. For an electric fixed heater, the following gains are specified:

- 1%-point: going from no room temperature control to mechanical thermostat
- 2%-points: going from mechanical to electronic thermostat
- 2%-points: going from electronic to electronic with day timer
- 2%-points: going from electronic with day timer to electronic with week timer

The shift from mechanical to electronic thermostat is considering a gain from better accuracy of the temperature control for heating which can be defined in various ways[174] [175]. The closer the temperature control can get to the setpoint, the better. The timer options are as well considering the gains from a lower average room temperature in setback periods.

Even though, studies and sources exist on efficiency gains from different controls, the calculated or experimental determined savings reported do always depend on numerous parameters such as climate, building characteristics (heat capacity, heat loss etc.), user settings and behaviour as well as the characteristics of the space heaters and the controls themselves. In this respect, it is not expected that a more detailed literature study will add substantial value to an already simplified scheme as table 7 and 8 of regulation 2015/1188. In general, the specified control gains (%-points) appear conservative.

A stakeholder has questioned the F(2) values being different for portable and fixed electric space heaters. Besides the energy saving potential realization, the correction factors also serve to prioritize a certain level of minimum control. Fixed heaters are usually part of a complete heating system of a house and with electric thermostats had become the standard in recent years. Portable electric heaters have a different application and have not until now necessarily had a thermostat at all. The largest saving is therefore obtained by getting a mechanical thermostat. In case of portable heaters, to unveil the timer options, an electronic thermostat would typically be required. Taking next step would therefore require electronic thermostats, which is not proposed when considering the adaptions already made to comply with current regulation. Concerning the F(2)-factors in general, it will be investigated how to make room for taking into account the accuracy of the control.

The correction factors F(3) are considering the user activation and can for the electric fixed local space heaters account for 3%-point in total using the different options.

Stakeholders have discussed the presence detection option not being available for fixed heaters. The argument for not having presence detection is that a house heated with multiple fixed heaters as primary heat source will cool completely down if all heaters were turned off due to detection of no presence. Portable heaters are more likely to be secondary heaters, so backup heat may take over if presence is not detected. Based on that it is proposed not to change the situation of presence detection.

[174] EN 15500-1:2017 Energy performance of buildings – Control for heating, ventilating and air-conditioning applications, Part 1
[175] EN 60675:1995 Household electric direct-acting room heaters - Methods for measuring performance

4.2.2 Charge and output control, F(1)

A stakeholder noted that the accompanying text of Table 6 (Annex III) of the Regulation is misleading. The current text is:

"the minimum value of the correction factor F(1) for two stage commercial space heaters is 2,5% and for modulating commercial local space heaters is 5%."

The Formulas in the table, for commercial heaters, are written as:

For two stage: $$F(1) = 5{,}0\% - \left(2{,}5\% * \frac{P_{nom} - P_{min}}{30\% * P_{nom}}\right)$$

For modulating: $$F(1) = 5{,}0\% - \left(5\% * \frac{P_{nom} - P_{min}}{40\% * P_{nom}}\right)$$

However, since the F(1) factor is subtracted from the 'seasonal space heating energy efficiency in active mode' in the formula for 'seasonal space heating energy efficiency' for commercial local space heaters, it is an advantage if the factor is as small as possible[176]. The formulas can result in large negative values, which is not realistic. The table should therefore be corrected to address the limits of the value of F(1) instead of the minimum value of F(1). The limits are for two stage burners (2,5% ≤ F(1) ≤ 5,0%) and for modulating burners (0 % ≤ F(1) ≤ 5,0%). The changes are relevant and should be part of the revised regulation.

Another, lesser, issue that was pointed out, is that percentages and percentage points are mixed in the formulas, which makes them difficult to read. An option could be to write the percentage-points as they are now, but change the percentages to decimal numbers, i.e. 0,3 instead of 30% and 0,4 instead of 40% in the denominator.

4.2.3 Auxiliary consumption and pilot flame, F(4) & F(5)

A stakeholder is questioning the use of heat output as reference instead of heat input. Another stakeholder asked for documentation of the different factors. The calculation formulas and correction factors follow the general formula of seasonal energy efficiency of heating appliances used in Ecodesign regulations. It is therefore proposed to stay with current factors. Though, in case of commercial local space heaters, the F(5) factor could be omitted due to the fact that no burners for these heaters are using pilot flames according to stakeholders.

4.3 NOx emissions

Various stakeholders have claimed the process of meeting the NO_x requirements has been difficult for gas local space heaters and that product adaptions to meet the requirements

[176] This is the opposite of electric storage heaters, where a large F(1) value gives a higher seasonal space heating efficiency

have resulted in lower efficiencies of the products. In this regard, the stakeholders have proposed to develop a new method with reference to a fixed useful heat output (kW/h). The methodology can best be shown by an example provided by the industry, see Table 40. The table show the data for three different gas fired local space heaters (Product A, B and C), and based on the energy efficiency and NO_x emissions it shows the resulting gas consumption and NO_x emissions related to providing 1 kW useful heat per hour to a room. The testing procedures will remain unchanged. It is only the conversion and presentation of NOx emissions related to useful heat that will require a new methodology.

Table 40: Example of the effect of calculating NOx emissions based on 1 kW required useful heat per hour. * The calculation of NOx for 1 hour = gas consumption x NOx mg/kW. i.e. Product B 1,25kW x 130 mg/kWh = 162mg. Please note that in this example the product's energy efficiency is not necessarily compliant but the table demonstrates the principle.

	Energy Efficiency	NOx mg/ kWh input	ECO NOx	Required useful heat per hour	Gas Consumption per hour	NOx emission mg/kWh useful heat*
Product A	40%	130	Pass	1 kW	2,5 kW	325
Product B	80%	130	Pass	1 kW	1,25 kW	162
Product C	20%	130	Pass	1 kW	5 kW	650

The method is aiming at allowing larger specific NO_x emissions for more efficient products. The method should replace the current approach based on heat input and will require the definition of new NO_x limits in the regulation as well. Another stakeholder mentions such approach will increase complexity and that measures on efficiency and emissions should be kept separated. This is in line with all other regulations and also current standards.

Some stakeholders also proposed to use a weighted average of the NO_x emission based on NO_x-measurements at different loads as in current standards. This may support closer to real life operation and result in a lower (weighted average) NO_x emission value compared to the nominal value which is the measure in the Regulation today.

The standards referred to in the overview in Task 1, such as EN 613, EN 1266 and EN 13278 are using a weighted approach for the calculation of the NO_x emission. According to EN 13278, for a two-stage burner the NOx emissions are weighted with the following weights:

- NO_x value measured at nominal input x 0,3 = $NO_{x(max)}$
- NO_x value measured at minimum input specified by the manufacturer x 0,7 = $NO_{x(min)}$
- $NO_{x(max)}$ + $NO_{x(min)}$ = Weighted NO_x value in mg/kWh

There are similar weights for modulating burners, 1-stage and multi-stage burners. The weighing formulas always include the value at nominal input.

The weighted NO_x value is used to declare a certain class (1-5) corresponding to a certain NO_X-concentration limit.

If using the weighted approach, the NO_x-requirements should be updated accordingly.

If a weighted approach for NO_x emissions is used, it would be obvious to also look for a weighted approach for the useful efficiency. The useful efficiency is at nominal heat output in the Regulation today. A weighted approach will in general results in a lower (weighted average) useful efficiency.

The load references must be coherent. Based on this, it is proposed to stick to input based NO_x-emission and useful efficiency – both at nominal heat output - as in the Regulation today. Due to lack of data it has not been possible to evaluate the current products' NO_x-levels up against the current minimum requirement in the Regulation.

4.4 Towel rails and commercial air curtains

4.4.1 Towel rails

Electric towel rails up to a capacity of 250 W are considered being for towel drying purpose only. In case of larger capacities, they are considered to also be used for room heating.

Stakeholders have proposed to include a special bonus for towel rails including a booster heater. The towel rail may have 1000 W capacity and the booster heater additional 1000 W capacity. The control will turn on the booster heater typically two times a day to heat up the bathroom to a higher comfort level. Due to the high capacity of the booster heater, this will happen more rapidly than if only the towel rail should do the job. In between the high comfort level periods, the booster heater will turn off and the general comfort level will be maintained with the towel rail capacity only. The programming of the booster heater schedule can be set in the control in the same way as for a week timer.

Even though, possible to keep a generally low level of comfort and only have the high comfort level for very short periods, it's found that this operation does not differ significantly from what could be obtained with a towel rail with the same total capacity and the existing control option "*with electronic room temperature control plus week timer*". It is therefore suggested not to add an extra bonus.

Some controls include an extra function typically also called 'boost' that should not be confused with the booster heater application above. The 'boost' is typically activated manually by a push on a button on the control box and is thus not programmed. This function overrides the control signal to use the full capacity of the heater to reach a higher comfort level for a short period. After a certain time period e.g. 30 minutes the control signal will take over again to maintain the general comfort level.

4.4.2 Commercial air curtains

Commercial or comfort air curtains are defined as products that realise a climate division between:

- two areas or two rooms, or
- an area and the outdoor air or a room and the outdoor air

where the comfort requirements for people are mandatory for the supply air temperature and speed[177]

Commercial air curtains have an integrated heater or coil to provide heated air. However, their primary purpose is to act as air wall or air door to prevent heat transfer across an opening.

Technical parameters of the typical commercial electrical heated air curtain:

- Width 1,5 meters
- 12 kW
- Manual setting of the heater in stages at 0 %, 50 % or 100% and a thermostat to control the heat after the stage is set
- 2 to 3 fan speeds selected manually
- Cross flow fan wheels with AC motors or forward curved radial fans with AC/EC motors

The BAT includes AC/EC motors and advanced control solutions taking into account week times and cold/warm seasons. Door contacts may prevent the air curtain running when the doors are closed. The BNAT may include even more efficient motors and more advanced controls including dynamic algorithms handling the fluctuating pressure difference over the door opening caused by wind loads and integration of intelligent control via the BMS-system. The jet beam can also be optimised further.

Even though the air curtain may include a heater that contributes to the secondary heating of a room, it is not its primary purpose and it is not marketed as a local space heater. From a technical point of view, the focus on its primary purpose to establish an “air wall” or “air door” would require potential policy measures more related to effectively establishing air streams and to the prevention of transmission and ventilation losses, rather than to the heating function itself. If air curtains should be included in scope, the efficiency of this main

[177] Air curtain unit – Classification, test conditions and energy performance calculations, Eurovent 16/1-2016

function should also be included in the Regulation, which would require a major change of scope and. The low sales also indicate that energy saving potentials are low, especially when focusing on the heating capability.

It is therefore proposed not to propose inclusion of air curtains in the regulation and go on with defining a base case.

4.5 Technology roadmap

In addition to identifying best available technologies (BAT) and give an outlook of technologies yet to enter the market (BNAT), the study will also briefly couple this to potential focus areas for a strategy on effective support under the EU research framework programme, Horizon Europe, to foster the development and production of energy efficient, novel technologies within the European Union. This implies, evaluating the BNAT up against their technology readiness level (TRL).

4.5.1 Technology drivers

Development of technology is driven by different drivers such as science and innovation, policies, consumer behaviour and growth and markets. A part of these are qualified and quantified in Task 2 and Task 3. A non-exhaustive list of technology drivers relevant for local space heaters and commercial space heaters are shown in Figure 23.

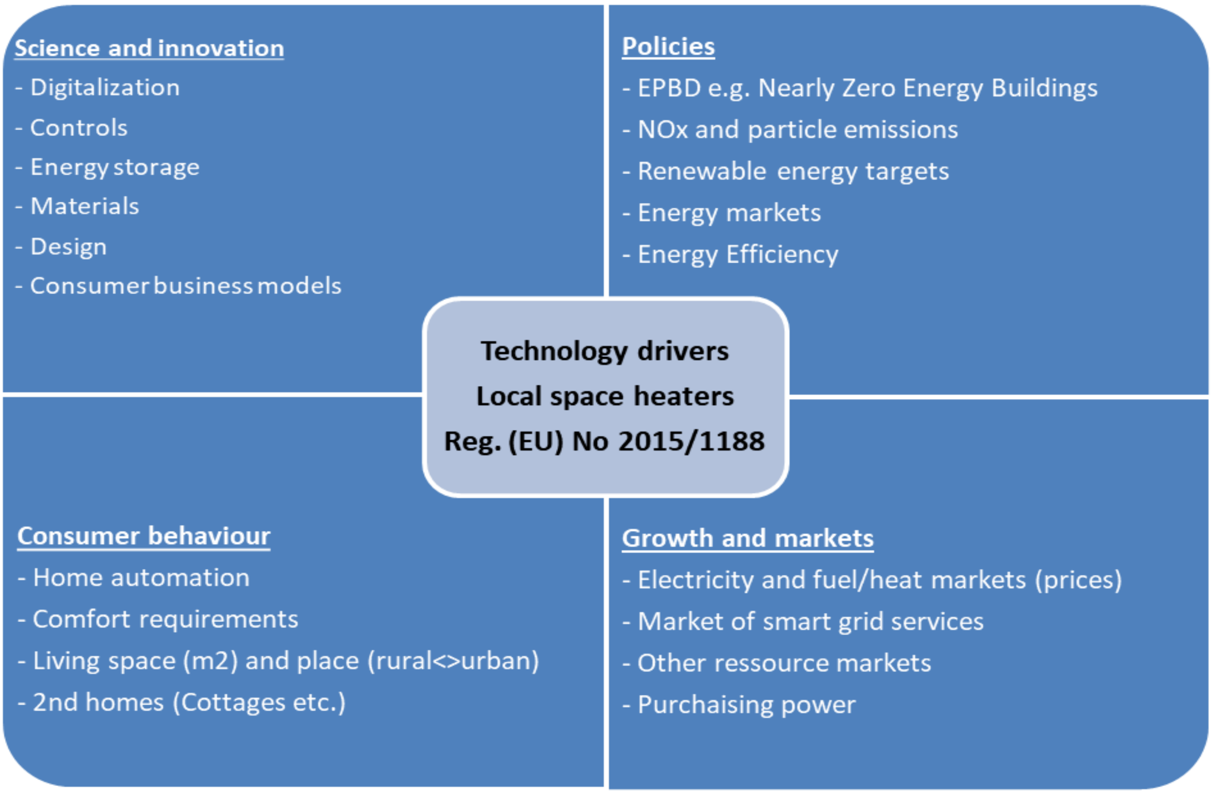


Figure 23: Non-exhaustive list of technology drivers

4.5.2 Best available technology and best not yet available technology

Commission Regulation (EU) No 2015/1188, article 6, provides indicative best available technology levels of local space heaters on the market for seasonal space heating energy efficiency (Table 41) and nitrogen oxide emissions (Table 42).

Table 41: Seasonal space heating energy efficiency minimum requirement and indicative BAT

Local space heater Type	Calorific value Reference	Seasonal space heating energy efficiency	
		Minimum requirement	Indicative BAT
		%	%
Electric	-	31-38,5	> 39
Gas/liquid open fronted	NCV	42	65
Gas/liquid closed fronted	NCV	72	88
Gas/Liquid luminous	GCV	85	92
Gas/Liquid tube	GCV	74	88

Table 42: Nitrogen oxide emissions minimum requirement and indicative BAT

Local space heater Type	Calorific value Reference	Nitrogen oxide emissions	
		Minimum requirement	Indicative BAT
		mg/kWh_{input}	mg/kWh_{input}
Gas/liquid open and closed fronted	GCV	130	50
Gas/Liquid luminous and tube	GCV	200	50

As these BAT levels were applicable by entry into force of the Regulation (2015), and no significant product development has taking place, they are considered to be the same three years after. The following sections will break-down possible ways to achieve the BAT levels by focusing on combustion, controls and auxiliary consumption. In addition, the consequences of air-tight, low energy buildings and the interoperability and/or connectivity of products will be discussed.

4.5.3 Electric local space heaters

Controls

As the useful efficiency is per default 100% for the electric appliances, the options for achieving better seasonal energy efficiency are all on the controls side. Due to the minimum requirements of Commission Regulation (EU) No 2015/1188 fixed and underfloor heaters already require advanced controls to comply. As minimum the controller must be of the type *with electronic room temperature control plus day timer* and have additional attributes such as *Room temperature control with open window detection*, *With distance control option* and *with adaptive start control.* Below a capacity of 250 W, controls for these appliances can be simpler, but still need to be *with electronic room temperature control*. Portable electric heaters can comply *with mechanic thermostat room temperature control* only.

As the minimum requirements are already in force, the products mentioned above represent the average products on the market today. To a wide extent they also represent best available technology (BAT).

The already in place control option *with adaptive start control* is introducing intelligence in the controls by adapting to the time constant of the building/room and a time schedule, the time when the heater must start to be able to deliver the right comfort at the right time. This intelligence can be expanded to also adapt to the user behaviour in regards of occupancy time of the room. The occupancy can be determined from physical sensors but may also be based on other data. This can be data generated through digital life and the use of mobile phones such as data on person position, appointments in digital calendars etc. The crunching of data resulting in a control signal can take advantage of machine learning/artificial intelligence.

Interoperability

Home Energy Manager systems (HEMs), Customer Energy Manager systems (CEMs), Building Automation Control Systems (BACS) and smart meters are outside of scope of this study. Local space heaters can be smart appliances, but the functionalities as investigated in the smart appliance preparatory study are not considered in this review.

Nevertheless, the interoperability in the home with other appliances and systems, may be a future market prerequisite. In relation to smart grid, this may be certainly important for the electric local space heaters. Though, in relation to obtain further savings through e.g. HEMs or CMSs this can be important for all local space heaters. The preparatory study on smart appliances has a specific section on interoperability issues[178].

Low energy buildings application

NZEBs such as for instance Passive houses can be heated by air delivered by the ventilation system and thus do not require hydronic heating system. However, there may still be a need for local space heaters as supplementary peak heating. Electric local spaced heaters can be designed to fit very low heating demands for low energy buildings application.

[178] Task 7 report, October 2018: http://www.eco-smartappliances.eu/Documents/Task_7(2)SEC2_22102018_FINAL.pdf

Outlook

The controls of electric local space heaters are already at advanced level. BNAT technology is mainly focusing on taking advantage of the connectivity, interoperability and introducing more intelligence into controls.

4.5.4 Open-fronted and closed-fronted local space heaters

The product group include both gas-fired and liquid fuel-fired appliances.

Combustion

Oil-fired closed-fronted heaters may have a useful efficiency slightly above 80%, which allow them to comply with current minimum requirements. For gas-fired closed-fronted heaters, the useful efficiency may exceed 88% whereas for compliant open-fronted heaters the useful efficiency may be as low as 52%.

The typical product in the product group will operate without mains electricity connection and have burners with 1 or 2 manual stages. Closed-fronted heaters can be designed for closed combustion where the combustion air is not taken from the room but from the outside (balanced flue). Some closed-fronted heaters are designed for mains electricity connection which facilitate the use of a fan to evacuate the flue gas/supply the combustion air as well as electronic ignition and more advanced burner control

NO_x emissions are expected to be on level with the minimum requirements: 130 mg/kWh_{input}. However, limited data are publicly available yet and no data were provided by stakeholders, see also section 4.3. Data split on the various product groups would be needed to evaluate in more detail technology impact.

Controls

Most appliances are still manual operated, in some cases with a mechanical thermostat. Mechanical thermostats can include accelerating and temperature compensating features improving accuracy, but no data was revealed on exact gains. Though, mechanical thermostats can be designed to be very accurate, there are also electronic controls on the market that can be applied for systems without electricity mains connection. A battery powered control box can be integrated in the local space heater which provides the option for having a remote control. The remote control can also include a temperature sensor that can be used for thermostatic operation of the local space heater corresponding to the control option w*ith electronic room temperature control*. Further control options may be applicable as well e.g. the timer options. For the local space heater with mains electricity connection in principle all control options are available.

Interoperability
Interoperability with other appliances may be a future prerequisite for all local space heaters to be part of home automation systems.

Auxiliary consumption
The manual operated heaters without electricity mains connection, do not have auxiliary electricity consumption, but the flue gas system may be equipped with a fan. The more advanced heaters with closed combustion and electronic ignition (no pilot flame) connected to electricity mains may have built in fan. In this case improvements are mainly improvements related to the fan power consumption.

Low energy buildings application
New buildings, such as NZEBs, are very tight and renovated building may be as well in order to lower infiltration losses, to a satisfactory level, to comply with EPBD-requirements. This means, openings in the building envelope meant to secure sufficient air for open combustion local space heaters, may no longer be applicable. In this case only closed combustion is applicable.

Outlook
Task 2 unveiled a decline in sales of this product group and that products sold are mainly for replacement. Therefore, no large technology development is expected. Concerning the appliances not connected to electricity mains, self-powering based on energy harvesting may be an option to support introduction of more advanced controls. Relevant technologies could be electricity generated by temperature difference (Seebeck-effect) or radiation (PV) of the combustion bed.

Despite, the market situation, there is already a large variation in the useful efficiency across the product group. This is also reflected in the energy labels[179] that range from label 'A' to label 'F' for these products. However, as the energy label has only applied since 1 January 2018, it is too early to draw any conclusions on the impact of this measure. BAT-level is considered to be 'A'-labelled products. However, since the group of gas and liquid fuel local space heaters covers a large variation in technology, which means that not all product types will be able to reach the BAT. For example balanced flue appliances might represent BAT, but this level can never be reached by open fronted appliances through any technical development.

Concerning NO_x emissions, it is too early to draw conclusions on specific BAT- or BNAT-levels of the various product types in this product group. The indicative BAT-benchmark of Commission Regulation (EU) No. 2015/1188 is 50 mg/kWh_{input}. Though, in practice a very

[179] Commission Delegated Regulation (EU) No. 2015/1186

large part of the products is expected to just meet the minimum requirements of 130 mg/kWh_{input} with limited improvement potential on current designs. Again, the BAT levels cover a larger variety of products, and all products will never be technically able to reach the BAT levels.

Commercial luminous or radiant tube local space heaters

The product group include both luminous and tube local space heaters emitting radiant heat towards people and objects.

Combustion

For commercial local heaters, the seasonal space heating efficiency in active mode is defined as:

$$\eta_{S,on} = \eta_{S,\mathrm{th}} \cdot \eta_{S,\mathrm{RF}}$$

$\eta_{S,th}$ is the thermal efficiency with reference to gross calorific value (GCV). For compliant tube local space heaters this can be 80% up to and even exceeding 84%. In case of luminous local space heaters, Commission Regulation (EU) No 2015/1188 is using a fixed reference value of 85,6% calculated according to EN 15316-4-8[180] as luminous heaters in principle are exhausting flue gas to the room (no losses) but in practice part of this is vented and not considered useful. In both cases, the thermal efficiency is a weighted value based on the thermal efficiency of more loads.

$\eta_{S,RF}$ is the emission efficiency which is based on the radiant factor of the commercial local space heater. The radiant factor is a weighted value based on the radiant factor of more loads. The emission efficiency can be less than 1,00 but will for compliant products typical be larger and up to and even exceeding 1,10.

Burners can be 1-stage, 2-stage or modulating. Often the same tube/reflector design can be operated with all three types of burner modes.

NO_x-emissions are expected to be less than the minimum requirements: 200 mg/kWh_{input}. However, limited data are available yet. A variety of tube local space heaters and systems exist including heaters with declared NOx-emissions of 130 mg/kWh_{input} or even less Luminous heaters will according to different technology typical have NOx-emissions below that level.

[180] EN 15316-4-8 Energy performance of buildings – Method of calculating energy system requirements and system efficiencies – Part 4.8: Space heating generation systems, air heating and overhead radiant heating systems including stoves

Auxiliary consumption

Burners of tube local space heaters will be assisted by a fan consuming electricity. In this case improvements are mainly improvements related to the fan power consumption.

Outlook

The BAT of the product group is already at a very high level.

Concerning NO_x emissions, it is too early to draw conclusions on specific BAT or BNAT levels of the various product types in this product group. The indicative BAT benchmark of Commission Regulation (EU) No. 2015/1188 is 50 mg/kWh_{input}. As the indicative benchmark is set for the whole group of commercial local space heaters, luminous and tube heaters, it is likely to be based on what can be achieved with luminous heaters only. Hence the tube heaters will never be able to reach the BAT levels, because these are applicable only for luminous heaters. It could be considered to split the benchmark into one for luminous heaters and one for tube heaters in order to better reflect this and not create the impression that all commercial heaters will be able to reach the benchmark value.

4.6 Overview of Technology readiness levels (TRLs)

Referring to section 4.5, the study will also briefly couple the BNAT up against their technology readiness level (TRL) for local space heaters. The Horizon 2020 programme uses technology readiness levels (TRLs)[181] to assign what type of projects they want to support. TRL are based on a scale from 1 to 9 with 9 being the most mature technology, see list below.

[181] Horizon 2020 – Work programme 2018-2020 - Technology readiness levels (TRL) https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl_en.pdf

Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

Figure 4-24 Horizon 2020 Technology readiness levels (TRLs)[160]

In general, the local space heater technology is mature being on the market for several years. However, the following areas are considered relevant for supporting and achieving the development of local space heaters.

Controls

- Subject: Demonstration and quantification of energy savings by taking advantage of machine learning/artificial intelligence in local space heaters and other space heating products and systems.
- TRL-level: 5-9

Interoperability

- Subject: Development and demonstration of interoperability of local space heaters with other relevant appliances and systems in order to facilitate further energy saving potential.
- TRL-level: 5-9

Combustion

- Subject: Demonstration of affordable NOx reducing technologies for local space heaters
- TRL-level: 7-9

Auxiliary consumption

- Subject: Demonstration of technologies to self-power local space heaters that are not connected to electricity mains in order to facilitate the use of controls.
- TRL-level: 7-9

4.7 Overview of base cases

Table 43 in section 4.7.1 shows different combinations of electric local space heaters and controls. The table of section 4.7.2 shows different combinations of gaseous/liquid local space heaters.

4.7.1 Electric local space heaters

Table 43: Different combinations of electric local space heaters and controls fulfilling the minimum requirement on energy efficiency.

						Manual heat charge control, with integrated thermostat	Manual heat charge control with room and/or outdoor temperature feedback	Electronic heat charge control with room and/or outdoor temperature feedback or controlled by energy supplier	Assisted by a fan	Single stage heat output, no room temperature control	Two or more manual stages, no temperature control	With mechanic thermostat room temperature control	With electronic room temperature control	With electronic room temperature control plus day timer	With electronic room temperature control plus week timer	Room temperature control with presence detection	Room temperature control with open window detection	With distance control option	With adaptive start control	With working time limitation	With black bulb sensor	auxiliary electricity use during on-mode and standby-mode	Permanent pilot flame power requirement	
Electric local space heaters	**Eff_th,on**	**CC**	**Eff_S,on**	**Eff_S,on - 10%**	**Min req**	**F(1.1)**	**F(1.2)**	**F(1.3)**	**F(1.4)**	**F(2.1)**	**F(2.2)**	**F(2.3)**	**F(2.4)**	**F(2.5)**	**F(2.6)**	**F(3.1)**	**F(3.2)**	**F(3.3)**	**F(3.4)**	**F(3.5)**	**F(3.6)**	**F(4)**	**F(5)**	**Eff_S**
Type	**%**	**-**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Portable Electric	100	2,5	40,0	30,0	36,0							6,0												36,0
Fixed electric >250 W	100	2,5	40,0	30,0	38,0										7,0				1,0					38,0
- alternative	100	2,5	40,0	30,0	38,0									5,0			1,0	1,0	1,0					38,0
Fixed electric <250 W	100	2,5	40,0	30,0	34,0								3,0				1,0							34,0
Electric storage heaters	100	2,5	40,0	30,0	38,5			3,5	1,5						3,5									38,5
Electric underfloor	100	2,5	40,0	30,0	38,0										7,0				1,0					38,0
Visibly glowing >1,2 kW	100	2,5	40,0	30,0	35,0										4,0		1,0							35,0
Visibly glowing <1,2 kW	100	2,5	40,0	30,0	31,0							1,0												31,0
Towel rails	100	2,5	40,0	30,0	38,0										7,0				1,0					38,0

4.7.2 Gaseous and liquid local space heaters and commercial space heaters

Table 44: Different combinations of gaseous/liquid local space heaters and controls and different combinations of luminous and tube local space heaters. For each type of space heater a combination fulfilling the minimum energy efficiency requirement is shown. Different alternatives including combinations meeting the BAT-benchmark of Commission Regulation (EU) No 2015/1188.

						Single stage	Two stage	Modulating	Assisted by a fan	Single stage heat output, no room temperature control	Two or more manual stages, no temperature control	With mechanic thermostat room temperature control	With electronic room temperature control	With electronic room temperature control plus day timer	With electronic room temperature control plus week timer	Room temperature control with presence detection	Room temperature control with open window detection	With distance control option	With adaptive start control	With working time limitation	With black bulb sensor	auxiliary electricity use during on-mode and standby-mode	Permanent pilot flame power requirement	
Gas/liquid local space heaters	**Eff_S,th**	**EFF_S,RF**	**Eff_S,on**	**Eff_Son - X %**	**Min req**	**F(1.1)**	**F(1.2)**	**F(1.3)**	**F(1.4)**	**F(2.1)**	**F(2.2)**	**F(2.3)**	**F(2.4)**	**F(2.5)**	**F(2.6)**	**F(3.1)**	**F(3.2)**	**F(3.3)**	**F(3.4)**	**F(3.5)**	**F(3.6)**	**F(4)**	**F(5)**	**Eff_S**
Type	%	-	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Gas/liquid open fronted	52,0		52,0	42,0	42,0						1,0												1,0	42,0
- alternative w/o ctrl	68,0		68,0	58,0	42,0						1,0												1,0	58,0
- alternative (BAT), 1188	71,0		71,0	61,0	42,0								4,0											65,0
Gas/liquid closed fronted	82,0		82,0	72,0	72,0						1,0												1,0	72,0
- alternative w/o ctrl	88,0		88,0	78,0	72,0						1,0													79,0
- alternative (BAT), 1188	88,0		88,0	78,0	72,0										7,0	1,0	1,0	1,0						88,0
Gas/liquid flueless					-																			
Gas/liquid open to chimney					-																			
Gas/Liquid luminous	85,6	1,05	90,0	90,0	85,0	5,0																		85,0
- alternative (BAT) 1188	85,6	1,09	93,0	93,0	85,0			1,0																92,0
Gas/Liquid tube	80,0	1,00	80,0	80,0	74,0	5,0																1,0		74,0
- alternative, 2 stage	82,0	1,05	86,0	86,0	74,0		3,0															1,0		82,0
- alternative (BAT), 1188	84,0	1,07	90,0	90,0	74,0			1,0														1,0		88,0

4.7.3 Bill of materials for local space heaters

The material composition of local space heaters is expected to be unchanged since the preparatory study which is why the assumptions from the preparatory study are adopted to the current review study. The average expected material composition of local space heaters is presented in Table 45 to Table 47.

Table 45: Material composition of electric local space heaters

	Portable	Fixed > 250 W	Fixed ≤ 250 w	Storage	Underfloor	Visible glowing > 1,2	Visible glowing ≤ 1,2	Towel heaters	Air curtains
Bulk plastic (e.g. ABS) g	195	300	75	0	560	390	195	300	300
TEC plastic (e.g. PA6) g	650	300	75	100	2503	1300	650	300	0
Ferro (cast iron) g	195	3750	938	30000	50	390	195	3750	76000
Non-ferro (CU) g	98	307	77	75	280	195	98	307	7000
Non-ferro (Al) g	98	307	77	300	280	195	98	307	7000
Coating g	0	311	78	100	0	0	0	311	300
Electronics (PCBs) g	65	75	75	100	0	130	65	75	300
Miscellaneous g	0	0	0	109000	300	0	0	0	0
Total	1300	5275	1319	139675	3973	2600	1300	5275	90900

Table 46: Material composition of gas/liquid heaters

	Open combustion /open fronted with exhaust restriction	Open combustion /closed fronted	Balanced flue	Flueless	Open to chimney
Bulk plastic (e.g. ABS) g	25	25	25	13	13
TEC plastic (e.g. PA6) g	25	25	25	13	13
Ferro (cast iron) g	17820	17820	17820	8910	8910
Non-ferro (CU) g	396	396	396	198	198
Non-ferro (Al) g	396	396	396	198	198
Coating g	732	732	732	366	366
Electronics (PCBs) g	25	25	25	13	13
Miscellaneous g	346	346	346	173	173
Total	19765	19765	19765	9883	9883

Table 47: Material composition of commercial heaters

	Luminous local space heaters (non-residential)	Tube local space heaters (non-residential)
Bulk plastic (e.g. ABS) g	0	0
TEC plastic (e.g. PA6) g	0	0
Ferro (cast iron) g	17000	76500
Non-ferro (CU) g	0	307
Non-ferro (Al) g	0	307
Coating g	800	3600
Electronics (PCBs) g	400	1800
Miscellaneous g	1800	8100
Total	20000	90614

Based on the material composition the complexity of local space heaters is low. All products, regardless of type of appliance, consist primarily of different types of iron. Iron is cauterised by its high recyclability End-of-Life. Also, the amount of electronics is low compared to the weight of the product. The electronics present in local space heaters is assumed to be of a very low grade, which means that the amount of valuable materials is limited.

All types of heaters may contain several raw materials categorised as critical or precious. Raw materials like vanadium and phosphorous are in some designations of steel used as alloying elements. These alloying elements are not included in this assessment as they are very difficult to quantify, and more obvious choices are present such as:

- Printed circuit boards which may contain several critical materials such as gold, silver, palladium, antimony, bismuth, tantalum etc. Present in most heaters.
- Wires which may contain copper. Present in most heaters.

The composition of printed circuit boards is difficult to quantify but it is estimated as low grade for local space heaters. The product development of local space heaters indicates higher grades of boards in the future due to the implementation of more functions.

Printed circuit board are already targeted components according to the WEEE-directive and wires are already target due to their high amount of copper. Copper is also very important to remove before shredding to minimise the risk of copper contamination in the iron fraction since it directly can influence the mechanical properties of the recycled iron/steel. However, most of the printed circuit boards are considered to be small in size.

The presented bill-of-materials are used in the following task to calculate the environmental impacts of local space heaters.

5. Environmental and economic impact

In accordance with the MEErP methodology task 5 quantifies the current baselines in terms of economic and environmental impact for each of the base cases. The economic impact is calculated as the life cycle costs of products for the end-user, while the environmental impact is quantified in terms of energy and resource aspects. The inputs for the calculations consist of the data presented in the previous tasks.

The calculations are performed with the ErP EcoReport tool, which is an Excel sheet developed specifically to aid in the impact analysis of Energy-related Products[182]. All calculations in this task are based on the year 2018, which is the latest year with sufficient available data. The EcoReport tool includes a range of background data for calculating impacts of different materials, distribution, and disposal methods.

The calculations in EcoReport tool are made for each of the following base cases identified in task 4:

- BC 1 – Electric local space heaters (all heaters calculated individually)
- BC 2 – Non-Commercial gas and liquid fuel local space heaters (all heaters calculated individually)
- BC 3 - Commercial local space heaters (all heaters calculated individually)

Note that the overall conclusion from the preparatory study is still valid, which means that task 5 is briefly described and used to calculate the baseline for energy consumption and emissions of CO_2-eq, SO_2-eq PO_4-eq. The overall conclusion from the preparatory study was that the use phase is the most dominant phase of the entire life cycle in terms of total Energy Consumption and CO_2 emissions. However, the distribution of the environmental impacts varies considerably across the analysed Base Cases. For example, more than 90% of impacts of indicators are due to the use phase for some Base Cases, while for other Base Cases, the use phase and the material acquisition phase have similar contributions (even if distributed differently on the impacts). This is due to the influence of the input parameters such as the weight of the appliance, its lifespan and its power output.

[182] https://www.eup-network.de/fileadmin/user_upload/Produktgruppen/Methodology_prep_study/MEErP_study_by_vhk/20110819_Ecoreport_2011_MEErP.xls

5.1 Inputs for baseline calculations

The inputs needed from the previous tasks to establish a baseline scenario for each base case, is summarised in the following.

Sales, stock and economic base data is all found in task 2 and is summarised in in Table 48.

Table 48: Base case economic and market data for EcoReport, from task 2. All data is for 2016.

Description	Unit	From section
Product Life	years	Presented in section 2.2.1
Annual sales	mln. Units/year	Presented in section 2.1.1
EU Stock	mln. Units	Presented in section 2.2.2
Product price	€ / unit	Presented in section 2.4.2
Electricity rate	€ / kWh	Presented in section 2.4.4
Repair and maintenance costs	€ / unit	Presented in section 2.4.5
Discount rate (interest minus inflation)	%	Presented in section 2.4.1
Escalation rate (projected annual growth of running costs)	%	Presented in section 2.4.1
Present Worth Factor (PWF)	(years)	Automatically calculated in EcoReport

The present worth factor, is automatically calculated by the EcoReport tool using the following formula:

$$PWF = \{1 - 1/(1 + r)^{N} \}/r$$

Where:

- *N* is the product life
- *r* is the discount rate minus the growth rate of running cost components (e.g. energy and water rates)

The energy consumption inputs are derived from the use patterns in task 3 (section 3.2.1 and 3.2.2) and the technical product data from task 4. The derived average energy consumption for each base case 2016 is shown in Table 49.

Table 49: Average annual energy consumption for each base case in 2018 (in BAU scenario).

Description	Average capacity, kW	Average efficiency	Annual energy consumption, kWh/year 2018
Portable Electric	1,00	88%	246
Fixed electric >250 W	1,00	88%*	801
Fixed electric <250 W	0,25	82%*	214
Electric storage heaters	2,75	93%	764
Electric underfloor	1,00	77%*	531
Visibly glowing >1,2	2,00	86%	904
Visibly glowing <1,2	1,00	78%	541
Towel heaters	0,60	79%	321
Air curtains	14,25		2.901
Gaseous luminous local space heaters (commercial)	20	86%	16.100
Gaseous tube local space heaters (commercial)	30	79%	26.115
Gaseous fuel open combustion/open fronted with exhaust restriction	4,20	44%	4.034
Gaseous fuel open combustion/closed fronted	4,20	58%	3.004
Gaseous fuel balanced flue	4,20	72%	2.436
Gaseous flueless heaters	2,50	17,5%	1.886
Gaseous open to Chimney heaters	4,20	44%	1.281
Liquid tube local space heaters (commercial)	30,00	79%	26.115
Liquid fuel open combustion/open fronted with exhaust restriction	2,00	44%	1.921
Liquid fuel open combustion/closed fronted	4,0	58%	2.861
Liquid fuel balanced flue	4,00	72%	2.320
Liquid flueless heaters	3,00	100%	2.263
Liquid open to Chimney heaters	4,00	44%	1.220

*Average efficiency based on share of compliant heaters and slave heaters

Besides the energy consumption during the use phase, the materials in the product itself contain a considerable amount of embedded energy e.g. the energy used to mine the raw materials and produce the finished materials. Some of this energy can be recovered at End of Life (EOL) when products are either reused, recycled, or incinerated for energy production. When products are landfilled this energy is lost. The needed inputs are presented in Table 50.

Table 50: Inputs to calculate the environmental impacts and where they are presented

Description	Presented in section:
The material composition and weight of the materials for the different local space heaters	Presented in section 4.6.3
Description of the manufacturing process and the values used in the EcoReport tool	Below in this section (value used in EcoReport tool)
The distribution phase and values used in the EcoReport tool (Volume of package during transportation.	Below in this section
Share and weight of materials send to re-use, recycling, incineration and landfill at End of life	Presented in section 3.5.4

The manufacturing process is assumed to be negligible or at least small compared to other impacts which also was the case in the preparatory study. Furthermore, it is not possible to add or adjust values for the manufacturing process itself.

5.2 Outputs from baseline calculations

For each base case the following environmental and economic impacts are calculated:

- Life cycle Impacts per product over its life time – one product
- Impacts of all appliances in the stock presented as the baseline scenario (BAU)

All impacts are divided into five different life cycle phases[183]:

- The material phase: In this phase the weight of the materials is multiplied with the LCA Unit Indicators[184] so the impacts of using the different materials can be calculated.
- The manufacturing phase: The manufacturing phase describes the (OEM) manufacturing of metals and plastics materials. The specific weights per process are calculated automatically from the material phase.
- The distribution phase: This phase covers all distributing activities from OEM components to the final customer.
- The use phase: For the use phase, the average product life in years and the annual energy consumption are multiplied with each other to calculate the energy consumption during the whole lifetime.
- The disposal and recycling phase: These phases deal with the impacts of End of life. In the recycling phase, the recycling of the different materials is credited, and a negative value can appear (due to avoiding the production of new materials).

[183] The lifetime and the life cycle are different parameters. However, the lifetime of local space heaters is included in the use phase of the life cycle
[184] see MEErP 2011 Methodology, Part 2

Besides total energy consumption and greenhouse gas emissions, other impacts are calculated in the EcoReport Tool. All the impacts over the product life cycle are presented in Annex F for the different base cases. The impact categories are:

- Other Resources & Waste
  - Total Energy (MJ)
    - of which, electricity (MJ)
  - Water – process (litre)
  - Water – cooling (litre)
  - Waste, non-hazardous/ landfill (g)
  - Waste, hazardous/ incinerated (g)
- Emissions (air)
  - GWP100 (kg CO_2-eq.)
  - Acidification (g SO_2-eq.)
  - Volatile Organic Compounds (VOC) (g)
  - Persistent Organic Pollutants (ng i-Teq)
  - Heavy Metals (mg Ni eq.)
  - PAHs (mg Ni eq.)
  - Particulate Matter (g)
- Emissions (Water)
  - Heavy Metals (mg Hg/20)
  - Eutrophication (g PO_4)

All impacts are further divided in the different life phases of the product which are the material phase, manufacturing phase, distribution phase, use phase, disposal phase and the recycling phase.

5.2.1 Electric local space heaters

The energy consumption, emission of CO_2-eq, emission of SO_2-eq and emission of PO_4-eq in the different life phases of local space heaters are presented in Table 51 to Table 54. Note that the life cycle phase with the highest impact is marked with red, and the life cycle phase with the lowest impact is marked with blue.

Table 51: Energy consumption in the different life cycle phases of electric local space heaters

Product	Material MJ	Manufacturing MJ	Distribution MJ	Use MJ	Disposal MJ	Recycling MJ	Total MJ
Portable	274	37	146	16.759	7	-61	17.161
Fixed > 250 W	475	38	192	90.847	8	-137	91.424
Fixed ≤ 250 w	245	10	131	24.259	6	-60	24.590
Storage	2.401	75	278	86.689	50	-673	88.821
Underfloor	444	130	146	160.492	8	-108	161.113
Visible glowing > 1,2 kW	548	73	182	61.538	14	-123	62.233
Visible glowing ≤ 1,2 kW	274	37	146	36.823	7	-61	37.225
Towel heaters	475	38	192	36.448	8	-137	37.024
Air curtains	3.718	306	710	329.055	33	-1.297	332.525

Table 52: Emission of CO_2-eq in the different life cycle phases for electric local space heaters

Product	Material Kg CO2	Manufacturing Kg CO2	Distribution Kg CO2	Use Kg CO2	Disposal Kg CO2	Recycling Kg CO2	Total Kg CO2
Portable	16	2	11	715	0	-4	741
Fixed > 250 W	28	2	14	3.878	0	-8	3.913
Fixed ≤ 250 w	14	1	10	1.036	0	-4	1.056
Storage	141	4	19	3.701	0	-41	3.824
Underfloor	28	7	11	6.851	0	-7	6.890
Visible glowing > 1,2 kW	32	4	13	2.627	0	-7	2.669
Visible glowing ≤ 1,2 kW	16	2	11	1.572	0	-4	1.597
Towel heaters	28	2	14	1.556	0	-8	1.591
Air curtains	240	17	47	14.047	0	-85	14.266

Table 53: Emission of SO_2-eq in the different life cycle phases for electric local space heaters

Product	Material g SO2	Manufacturing g SO2	Distribution g SO2	Use g SO2	Disposal g SO2	Recycling g SO2	Total g SO2
Portable	129	9	32	3.166	0	-33	3.303
Fixed > 250 W	234	9	41	17.162	0	-73	17.373
Fixed ≤ 250 w	114	2	29	4.583	0	-30	4.699
Storage	576	18	58	16.376	2	-165	16.865
Underfloor	209	31	32	30.316	0	-63	30.527
Visible glowing > 1,2 kW	258	18	39	11.625	1	-67	11.875
Visible glowing ≤ 1,2 kW	129	9	32	6.956	0	-33	7.093
Towel heaters	234	9	41	6.886	0	-73	7.097
Air cutains	3.084	74	142	62.179	3	-1.128	64.353

Table 54: Emission of PO_4-eq in the different life cycle phases for electric local space heaters

Product	Material g PO4	Manufacturing g PO4	Distribution g PO4	Use g PO4	Disposal g PO4	Recycling g PO4	Total g PO4
Portable	1	0	0	3	0	0	5
Fixed > 250 W	4	0	0	17	0	-1	20
Fixed ≤ 250 w	1	0	0	5	0	0	5
Storage	2	0	0	16	0	-1	18
Underfloor	5	0	0	30	0	-1	35
Visible glowing > 1,2 kW	3	0	0	12	0	-1	14
Visible glowing ≤ 1,2 kW	1	0	0	7	0	0	8
Towel heaters	4	0	0	7	0	-1	10
Air curtains	7	0	0	62	0	-2	67

The energy consumption in the use phase of all electric local space heaters has decreased over the past years due to the current regulation and more advanced controls. However, the use phase still imposes the greatest energy consumption in the life cycle with at least 97% of total energy consumption. All other lifecycle phases are responsible for less than 3% combined. This is due to the high energy consumption in the use phase and the long lifetime of electric local space heaters.

The energy consumption and greenhouse gas emissions are closely connected and there is a high correlation between the parameters. In the use phase there is a direct correlation between energy used and CO_2 emitted. For materials, on the other hand, the total energy consumption and emitted CO_2 differs depending on the materials used. For electric local space heaters, the use phase is responsible for more than 96% of the global warming potential (GWP) due to emission of greenhouse gasses.

Regarding emission of PO_4-eq and SO_2-eq the use phase is also dominant due to the high energy consumption. These emissions come from the electricity production as SO_2 and PO_4 are emitted when lignite is burned.

Besides total energy consumption and the emission of CO_2-eq, PO_4-eq and SO_2-eq, other impacts are calculated in the EcoReport Tool. All the impacts over the life cycle are presented in Annex F. Here it can be seen that the use phase has the highest impact in at least 13 out of the 15 impact categories. Compared with other products groups recently reviewed (vacuum cleaners[185], air conditioners[186] and tumble driers[187]) it is rather unusual that the impacts imposed by the energy consumption in the use phase are dominant in 13

[185] https://www.review-vacuumcleaners.eu/
[186] https://www.eco-airconditioners.eu/
[187] https://www.review-tumbledriers.eu/

out the 15 impact categories. However, this is mainly due to the long lifetime and high energy consumption of the product.

5.2.2 Gaseous and liquid fuel local space heaters

The energy consumption, emission of CO_2-eq, emission of SO_2-eq and emission of PO_4-eq in the different life phases of local space heaters are presented in Table 55 to Table 58. Note that the life cycle phase with the highest impact is marked with red, and the life cycle phase with the lowest impact is marked with blue.

Table 55: Energy consumption in the different life cycle phases of gaseous/liquid fuel local space heaters

Product	Material MJ	Manufacturing MJ	Distribution MJ	Use MJ	Disposal MJ	Recycling MJ	Total MJ
Open combustion/open fronted with exhaust restriction	626	48	152	307.740	4	-228	308.343
Open combustion/closed fronted	626	48	152	229.162	4	-228	229.764
Balanced flue	626	48	152	185.808	4	-228	186.410
Flueless heaters	313	24	131	50.351	2	-114	50.708
Open to Chimney heaters	314	25	131	34.204	2	-114	34.563

Table 56: Emission of CO_2-eq in the different life cycle phases of gaseous/liquid fuel local space heaters

Product	Material Kg CO2	Manufacturing Kg CO2	Distribution Kg CO2	Use Kg CO2	Disposal Kg CO2	Recycling Kg CO2	Total Kg CO2
Open combustion/open fronted with exhaust restriction	42	3	11	17.014	0	-16	17.055
Open combustion/closed fronted	42	3	11	12.670	0	-16	12.710
Balanced flue	42	3	11	10.273	0	-16	10.314
Flueless heaters	21	1	10	2.784	0	-8	2.808
Open to Chimney heaters	21	1	10	1.891	0	-8	1.916

Table 57: Emission of SO_2-eq in the different life cycle phases of gaseous/liquid fuel local space heaters

Product	Material g SO2	Manufacturing g SO2	Distribution g SO2	Use g SO2	Disposal g SO2	Recycling g SO2	Total g SO2
Open combustion/open fronted with exhaust restriction	273	12	33	4.958	0	-100	5.176
Open combustion/closed fronted	273	12	33	3.693	0	-100	3.911
Balanced flue	273	12	33	2.995	0	-100	3.213
Flueless heaters	137	6	29	812	0	-50	934
Open to Chimney heaters	137	6	29	552	0	-50	674

Table 58: Emission of PO_4-eq in the different life cycle phases of gaseous/liquid fuel local space heaters

Product	Material g PO4	Manufacturing g PO4	Distribution g PO4	Use g PO4	Disposal g PO4	Recycling g PO4	Total g PO4
Open combustion/open fronted with exhaust restriction	8	0	0	0	0	-3	5
Open combustion/closed fronted	8	0	0	0	0	-3	5
Balanced flue	8	0	0	0	0	-3	5
Flueless heaters	4	0	0	0	0	-1	3
Open to Chimney heaters	4	0	0	0	0	-1	3

The energy consumption in the use phase of all gaseous and liquid fuel local space heaters have decreased over the past years due to the current regulation and more advanced controls. However, the use phase clearly still imposes the greatest energy consumption in the life cycle with at least 95% of total energy consumption. All other lifecycle phases are responsible for less than 5% of the combined impacts. This is due to the high energy consumption in the use phase and the rather simple product design with only little electronics, which result in low material consumption and thus material energy. Note, that flueless and open to chimney heaters are used less than open and closed fronted heaters. However, the energy consumption in the use phase is still clearly dominant in the life cycle.

The energy consumption and greenhouse gas emissions are connected and there is a high correlation between the parameters. However, gas and liquid fuel local space heaters have lower emission factors per kWh heat than electric heaters (due to the PEF factor), which means that the energy consumption in the use phase is less dominant regarding impacts calculated as CO_2-eq. For gaseous and liquid fuel local space heaters, the use phase is responsible for more than 99% of the global warming potential (GWP) due to emission of greenhouse gasses.

For SO_2-eq emissions the use phase is also dominant for most heaters as SO_2 is emitted during combustion of fuels. However, for flueless heaters the highest impact occurs in the material phase as these heaters are used less and the lifetime is shorter. The material phase is also connected with the highest emission for PO_4 for all heaters as no PO_4 is released when gas and liquid fuels are burned according to the EcoReport Tool. However, NO_x is emitted which also can lead to eutrophication.

Besides total energy consumption and emissions of CO_2-eq, PO_4-eq and SO_2-eq, other impacts are calculated in the EcoReport Tool, which are presented in Annex F. Here it is visible that the use phase has the highest impact in approximately 4 out of the 15 impact categories, which means that the use phase is less dominant for gaseous and liquid fuel local space heaters than for electric heaters. This is due to a shorter lifetime and the different emissions from heat produced from gas and electricity (including the PEF factor). The material phase has the highest impacts in the remaining categories which are e.g. PAHs, heavy metals and persistent organic pollutants.

5.2.3 Commercial local space heaters

The energy consumption, emission of CO_2-eq, emission of SO_2-eq and emission of PO_4-eq in the different life phases of commercial local space heaters are presented in Table 59 to Table 62. Note that the life cycle phase with the highest impact is marked with red, and the life cycle phase with the lowest impact is marked with blue.

Table 59: Energy consumption in the different life cycle phases of commercial local space heaters

Product	Material Kg CO2	Manufacturing Kg CO2	Distribution Kg CO2	Use Kg CO2	Disposal Kg CO2	Recycling Kg CO2	Total Kg CO2
Luminous local space heaters (commercial)	1.378	37	350	921.085	32	-367	922.515
Tube local space heaters (commercial)	6.294	174	1.310	1.992.072	144	-1,689	1.998.305

Table 60: Emission of CO_2-eq in the different life cycle phases for commercial local space heaters

Product	Material Kg CO2	Manufacturing Kg CO2	Distribution Kg CO2	Use Kg CO2	Disposal Kg CO2	Recycling Kg CO2	Total Kg CO2
Luminous local space heaters (commercial)	84	2	24	50.925	0	-23	51.011
Tube local space heaters (commercial)	383	10	85	110.138	1	-106	110.509

Table 61: Emission of SO_2-eq in the different life cycle phases for commercial local space heaters

Product	Material g SO2	Manufacturing g SO2	Distribution g SO2	Use g SO2	Disposal g SO2	Recycling g SO2	Total g SO2
Luminous local space heaters (commercial)	508	9	72	14.837	2	-124	15.303
Tube local space heaters (commercial)	2.398	42	259	32.100	9	-602	34.205

Table 62: Emission of PO_4-eq in the different life cycle phases for commercial local space heaters

Product	Material g PO4	Manufacturing g PO4	Distribution g PO4	Use g PO4	Disposal g PO4	Recycling g PO4	Total g PO4
Luminous local space heaters (commercial)	1	0	0	3	0	0	5
Tube local space heaters (commercial)	4	0	0	17	0	-1	20

The energy consumption in the use phase of all commercial local space heaters have decreased over the past years due to the current regulation and more advanced controls. However, the use phase still imposes the greatest energy consumption in the life cycle with at least 99% of total energy consumption. All other lifecycle phases are responsible for less than 1% of the combined impacts. This is due to the high energy consumption in the use phase and the rather simple product design with only little electronics, which result in low material consumption and this low material energy. For commercial local space heaters, the use phase is more dominant than for domestic gaseous and liquid fuel local space heaters due to the more intensive use.

The energy consumption and greenhouse gas emissions are connected and there is a high correlation between the parameters. For gaseous commercial local space heaters, the use phase is responsible for more than 99% of the global warming potential (GWP).

Regarding SO_2-eq emissions, the use phase is also dominant for commercial local space heaters. However, regarding emissions of PO_4 the material phase has the highest impacts for commercial local space heaters as no PO_4 are released when gas and liquid fuel are burned according to the EcoReport Tool. However, NO_x is emitted which also can lead to eutrophication, but this is included in the EcoReport tool.

Besides total energy consumption, emissions of CO_2-eq, PO_4-eq and SO_2-eq and other impacts are calculated in the EcoReport Tool. All the impacts over the life cycle are presented in Annex F. Here it can be seen that the use phase has the highest impact in approximately 5 out of the 15 impact categories. The material phase has the highest impacts in the remaining categories which are e.g. PAHs, heavy metals and persistent organic pollutants.

5.3 EU Totals – Baseline scenario

The EU totals are the environmental impacts aggregated to EU level (including Norway). For the EU totals the following is calculated:

- Environmental impacts of local space heaters (EU-28 stock) is calculated by multiplying the current stock with the impacts of each of the base cases and presented in Figure 25.

Based on the lifecycle impacts presented in section 5.1 it can be seen that the energy consumption in the use phase is connected with the highest impacts regarding energy consumption and emissions of CO_2 and SO_2. Other categories are of course also important but assumed to have less overall environmental impact. In addition, the products consist mostly of different types of metals which have a high recycling rate (approximately 95 %, see section 3.5.4), which means that the impacts imposed by the material phase are limited. Other lifecycle phases such as the manufacturing and distribution phases have low impacts. The following Figure 25 only presents the energy consumption in the use phase of local space heaters as the regulation has an impact on the energy consumption. The regulation has also an impact on the emission of NO_x, but due to lack of data it has not been possible to calculate the NO_x-emission which also was the case in the in the 2015 Impact Assessment due to lack of data[188].

[188] According to the 2015 Impact Assessment page 9

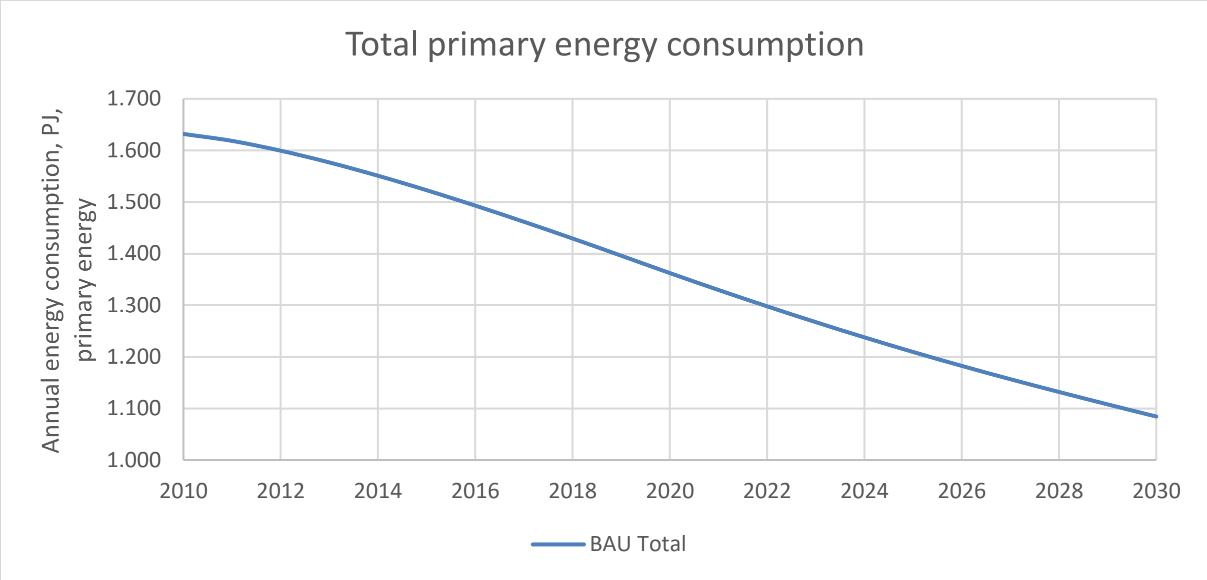


Figure 25: Combined energy consumption of the stock towards 2030

The combined energy consumption of all space heaters will account to above 1400 PJ in 2018 resulting in 65 Mt CO2-eq emitted. It can be seen that the energy consumption is decreasing. This is due to multiple reasons, including decreasing sales (gas and liquid), higher efficiency of space heaters and fewer heating degree days. The development in these parameters is presented in Figure 26 to Figure 28. Note that the figures present the increase/decrease from 2018 (100%) in percent.

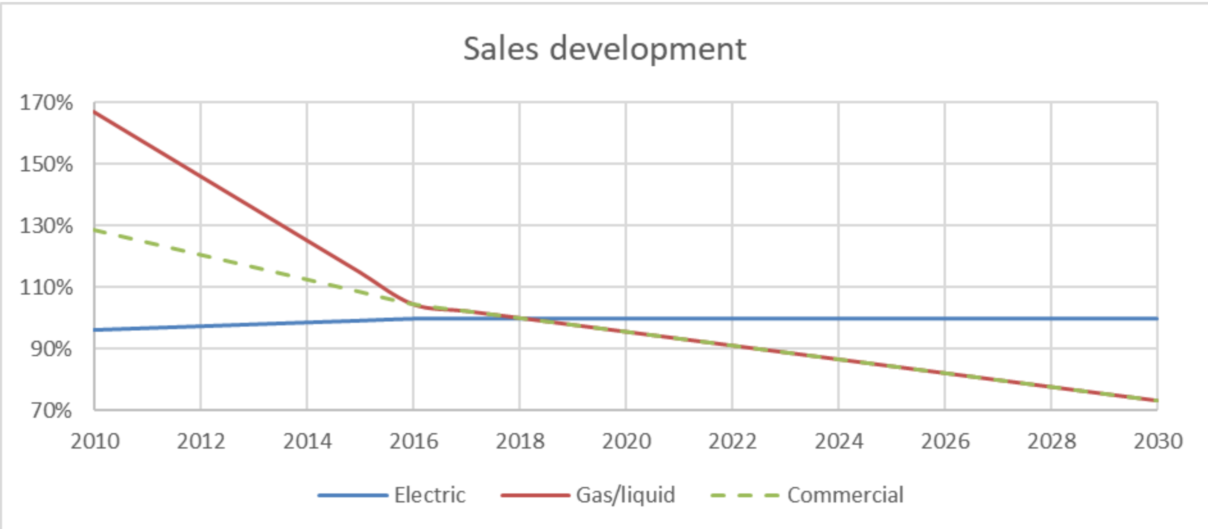


Figure 26: Sales development of local space between 2010 and 2030 (2018=100%)

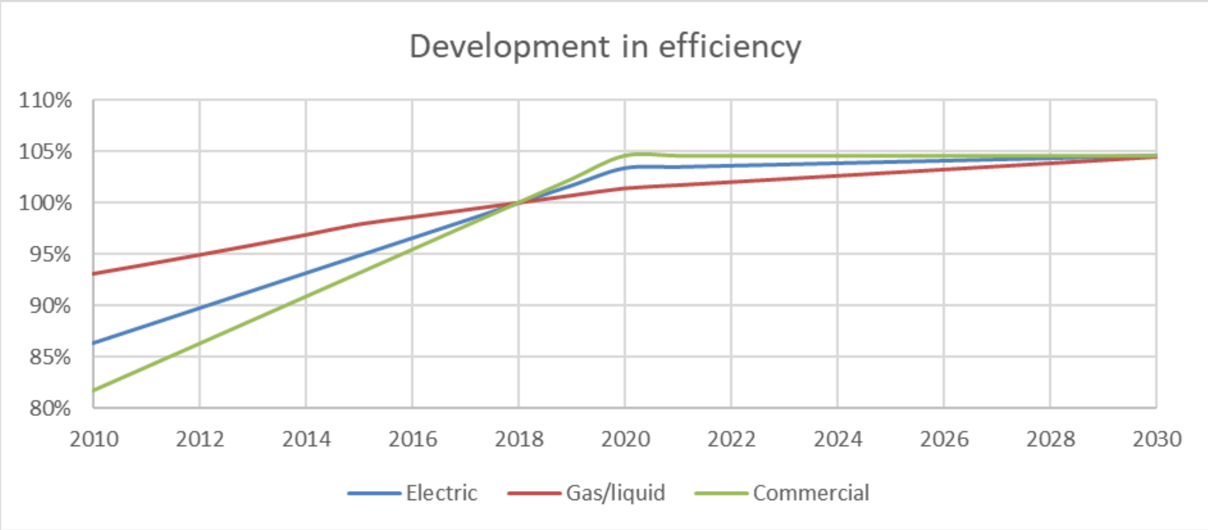


Figure 27: Development in sales weighted efficiency between 2010 and 2030 (2018=100%)

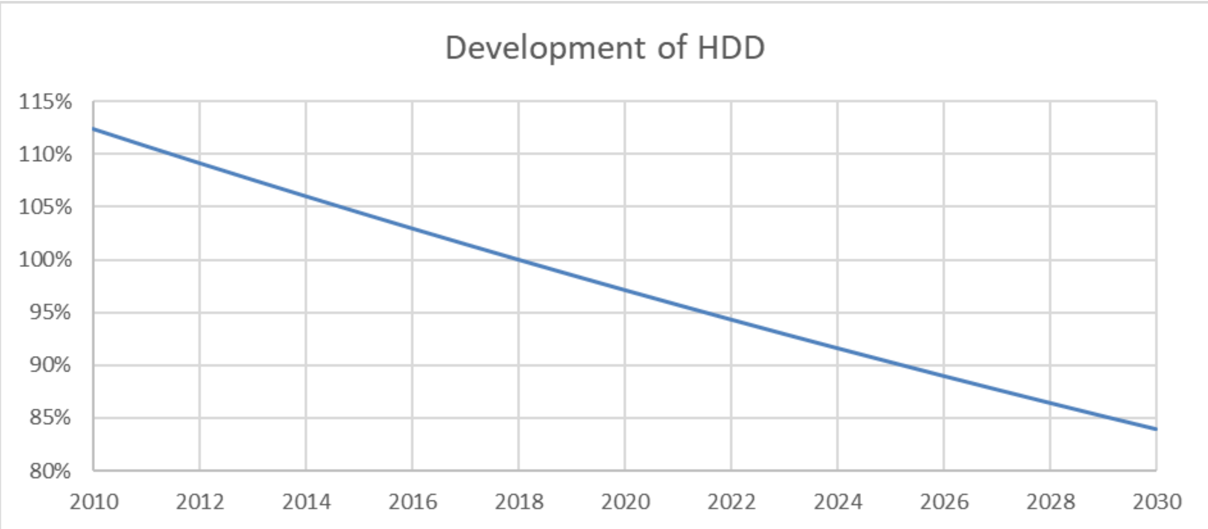


Figure 28: Development in efficiency between 2010 and 2030 (2018=100%)

The figures show that the main reason for the reduced energy consumption is the reduction in heating degree days, which simply means that the need for heat is lower today than in 2010. This trend was also included in the calculations in the preparatory study and the impact assessment and is assumed to continue.

Regarding the efficiency it is assumed that most heaters has improved due to the current regulation. However, it will take some time before the stock are replaced due to the long lifetime. For gas and liquid fuel local space heaters, the sales have decreased considerably. However, the impact of gas and liquid fuel local space heaters are limited as the sales are much lower than for electric appliances. The energy consumption per heating technology is presented in Table 63.

Table 63: Energy consumption divided on the different types of local space heater.

Type of heater	Energy consumption PJ and share of energy consumption in %					
	2010		2020		2030	
	PJ	%	PJ	%	PJ	%
Portable Electric	202	12%	162	12%	129	12 %
Fixed electric >250 W	717	44%	615	45%	488	45 %
Fixed electric <250 W	45	3%	40	3%	33	3%
Electric storage heaters	40	2%	32	2%	23	2%
Electric underfloor	184	8%	192	13%	214	18 %
Visibly glowing >1,2	16	1%	13	1%	11	1%
Visibly glowing <1,2	3	0%	3	0%	3	0%
Towel heaters	89	5%	87	6%	73	7%
Luminous local space heaters (commercial)	46	3%	27	2%	16	1%
Gas tube local space heaters (commercial)	102	6%	67	5%	38	4%
Gas open combustion/open fronted with exhaust restriction	62	4%	35	3%	17	2%
Gas open combustion/closed fronted	99	6%	55	4%	26	2%
Gas balanced flue	34	2%	17	1%	8	1%
Gas flueless heaters	1	0%	1	0%	0	0%
Gas open to Chimney heaters	1	0%	1	0%	1	0%
Liquid tube local space heaters (commercial)	10	1%	7	0%	4	0%
Liquid open combustion/open fronted with exhaust restriction	3	0%	2	0%	1	0%
Liquid open combustion/closed fronted	9	1%	5	0%	2	0%
Liquid balanced flue	3	0%	2	0%	1	0%
Liquid flueless heaters	0	0%	0	0%	0	0%
Liquid open to Chimney heaters	0	0%	0	0%	0	0%

The majority of the energy consumption origins from electric heaters and almost 80% of the total energy consumption from all local space heaters origins from portable heaters, fixed heaters, storage heaters and underfloor heaters.

5.4 Life cycle cost per product

Based on these inputs EcoReport automatically calculates the Life cycle costs (LCC) with the following formula:

$$LCC = PP + PWF \times OE + EoL$$

Where:

- LCC is Life Cycle Costs
- PP is the purchase price of the local space heaters
- OE is the operating expense and are the combined costs of electricity/fuel and the repair and maintenance.
- PWF (Present Worth Factor) is a formula described below and is based on the concept of time value of money.
- EoL is End of life costs (disposal costs, recycling charge) or benefit (resale) which are assumed to be negligible.

5.4.1 Electric local space heaters

The lifecycle cost including the purchase price (including installation), repair and maintenance cost and electricity cost is presented in Table 64.

Table 64: LCC for average electric local space heaters

	Lifetime	Size, kW	Purchase price	Repair and maintenance	Electricity cost	Total
Portable Electric	9	1	32	0	380	0
Fixed electric >250	15	1	270	0	1.897	0
Fixed electric <250	15	0,25	150	0	506	0
Electric storage heaters	15	2,75	820	0	1.809	0
Electric underfloor	40	1	181	0	2.439	0
Visibly glowing >1,2	9	2	250	0	0	0
Visibly glowing <1,2	9	1	36	0	1.395	0
Towel heaters	15	0,6	24	0	835	0

For all electric heaters, the greatest cost is related to the use phase and a least 75% of the LCC cost origins from the electricity consumption. This is due to the long lifetime of electric heaters and the high energy consumption in the use phase. Regarding repair and maintenance, the cost is assumed to be negligible. The LLC presented in Table 64 fits with the LCC presented in the impact assessment.

5.4.2 Gaseous and liquid fuel local space heaters

The lifecycle cost including the purchase price (including installation), repair and maintenance cost and fuel cost is presented in Table 65.

Table 65: LCC for average gaseous and liquid fuel local space heaters

	Lifetime	Size, kW	Purchase price	Repair and maintenance	Fuel cost	Total
Gas open combustion/open fronted with exhaust restriction	20	4,2	1175	1305	4732	7213
Gas open combustion/closed fronted	20	4,2	2375	1305	3524	7205
Gas balanced flue	20	4,2	1663	1305	2857	5826
Gas flueless heaters	7	2,5	1000	0	925	1925
Gas open to Chimney heaters	7	4,2	1000	0	925	1925
Liquid open combustion/open fronted with exhaust restriction	20	2	850	1305	2632	4788
Liquid open combustion/closed fronted	20	4	2375	1305	3920	7601
Liquid balanced flue	20	4	1589	1305	3178	6073
Liquid flueless heaters	7	3	1000	0	925	1925
Liquid open to Chimney heaters	7	4	1000	0	628	1628

Since the preparatory study the purchase prices of the different gaseous and liquid fuel local space heaters have changed considerable, which is largely due to the changed scope of the categories. The prices presented here are based on updated inputs form stakeholders to fit the product categories included in the Regulation.

Despite the higher purchase prices for open and closed fronted gas and liquid fuel local space heaters, the majority of the cost still origins from the use phase. However, the cost from the use phase is not as dominant as for electric local space heaters. For flueless and open to chimney the purchase price is higher than the fuel cost. This is because the lower lifetime and less intensive use of these type of heaters.

5.4.3 Commercial local heaters

The lifecycle cost including the purchase price (including installation), repair and maintenance cost and fuel cost is presented in Table 66.

Table 66: LCC for average gaseous and liquid fuel local space heaters

	Lifetime	Size, kW	Purchase price	Repair and maintenance	Fuel cost	Total
Gas luminous	15	20	1.300	614	8.364	10.278
Gas tube	20	30	1.500	761	16.916	19.177
Liquid tube	20	30	1.500	761	11.902	14.163

Since the preparatory study the purchase prices of luminous heaters have changed considerable. As for the domestic heaters, the purchase price is based on updated inputs from stakeholders the price has been adjusted to better fit the category. Commercial local space heaters have long lifetimes and an intensive energy consumption during use. This means that the majority of the cost occurs in the use phase.

5.5 End-user expenditure baseline

The life cycle cost for each of the base cases are also aggregated to EU level (EU-28 and Norway). For the EU totals the annual consumer expenditure in EU-28 is calculated based on the life cycle costs per product. The calculated price takes into account the efficiency of the products in stock (electricity/fuel price), annual repair and maintenance and the purchase price (including installation) multiplied with the annual sales. The annual consumer expenditures in EU-28 of all local space heaters are presented in Figure 29.

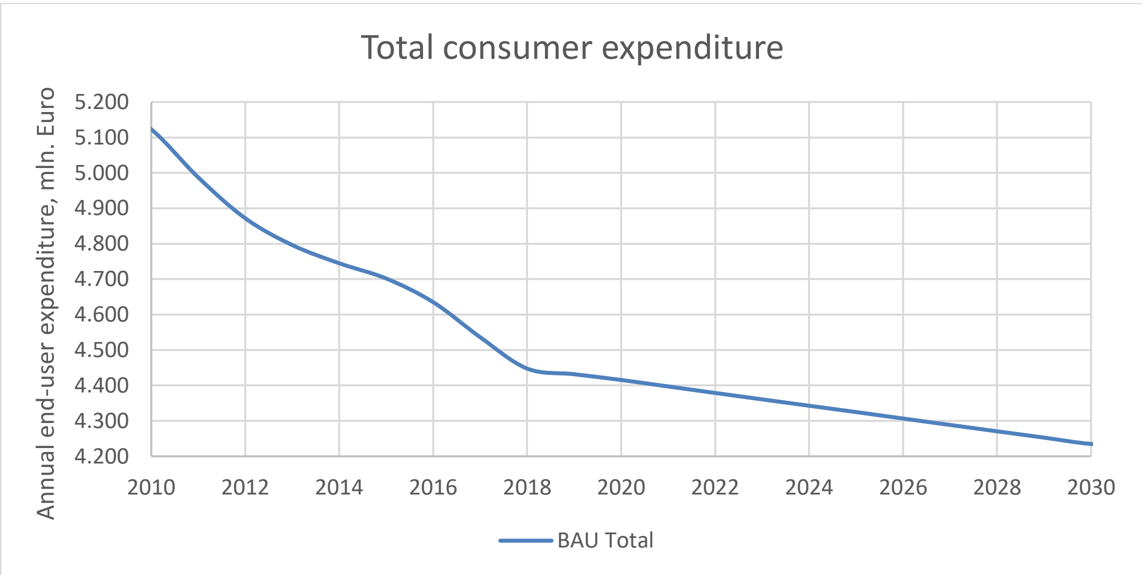


Figure 29: Annual consumer expenditure in EU28

The total annual end-user expenditure amounts to above 4,4 billion EUR in 2018. Figure 29 shows that the annual consumer expenditure is decreasing which is caused by a combination of falling sales (gas and liquid), higher efficiency and fewer heating degree days. The development in these parameters are already presented in section 5.3 (Figure

26 to Figure 28). The annual consumer expenditure for the different types of heaters is presented in Table 67.

Table 67: Annual consumer expenditure in EU 28 divided on the different types of local space heater.

Type of heater	Annual consumer expenditure in Euro and share of expenditure in %					
	2010		2020		2030	
	EUR	%	EUR	%	EUR	%
Portable Electric	365	7%	279	6%	273	6%
Fixed electric >250 W	2.267	44%	1.576	36%	1.552	37%
Fixed electric <250 W	179	3%	209	5%	207	5%
Electric storage heaters	133	3%	241	5%	239	6%
Electric underfloor	246	5%	287	7%	294	7%
Visibly glowing >1,2	10	0%	9	0%	8	0%
Visibly glowing <1,2	3	0%	2	0%	2	0%
Towel heaters	575	11%	520	12%	517	12%
Luminous local space heaters (commercial)	99	2%	83	2%	75	2%
Gas tube local space heaters (commercial)	124	2%	92	2%	81	2%
Gas open combustion/open fronted with exhaust restriction	172	3%	165	4%	145	3%
Gas open combustion/closed fronted	400	8%	382	9%	310	7%
Gas balanced flue	152	3%	170	4%	150	4%
Gas flueless heaters	9	0%	12	0%	9	0%
Gas open to Chimney heaters	58	1%	55	1%	54	1%
Liquid tube local space heaters (commercial)	96	2%	93	2%	92	2%
Liquid open combustion/open fronted with exhaust restriction	119	2%	117	3%	110	3%
Liquid open combustion/closed fronted	94	2%	96	2%	94	2%
Liquid balanced flue	1	0%	1	0%	1	0%

The majority of the annual consumer expenditure is related with electric heaters as 71% of combined consumer expenditure origins from this type of appliances. This is due to the large difference in stock of electric appliances and gas/liquid appliances.

6. Design options

According to the MEErP, Task 6 builds on the base case models described in Task 5 to identify design options and assess their costs and benefits in terms of Life Cycle Costs to indicate whether design solutions might negatively or positively impact the total EU consumer's expenditure over the total product life.

As noted in task 4, the technology of local space heaters is a mature product regime, and for gas and liquid domestic heaters even a declining market. The maturity of the technology means that there is little product development for the heating technology itself, whereas new control functions are still put on the market, especially for the electric heaters.

6.1 Automatic programming

Automatic programming is one of the most advanced types of control options, in which the control reads the end-users' behaviour and use patterns and based on these inputs auto-programs periods of high and low temperatures. This type of control can be used with any device (gas/liquid/electricity), but requires electronic control. However, stakeholders claim that in current assessment of safety of gas-fired local space, notified bodies do not allow auto on/off without the user being present in the property. Currently, the term automatic programming for local space heaters do not have a specific definition but include some characteristics.

The programming can be controlled locally or through wireless connection (WiFI, Bluetooth, z-wave, Zigbee etc.) possibly also over the internet or as a combination of both. Local inputs could be from sensors built in to the appliance such as presence detection, light sensors, outside temperature inputs, and a memory of when the end-users turn the heat up and down. Connected devices can build on a wider range of data, for example GPS position, weather forecasts, access to personal calendars, home automation systems[189]. The auto programming process power can either be a part of the physical control unit in the device or it can be an online connection only giving the required indoor temperature to the local unit.

The advantage of auto programming is that users will not have to take an active choice of when to turn the heat up and down, which can be beneficial for both comfort and energy efficiency. Especially for end-users who are not pre-occupied with constantly adjusting the heat according to outside temperature changes, night-time temperature reduction, or when leaving the house. The auto programming goes beyond a simple week timer, which is defined as:

[189] Such as Google Home, Amazon's Alexa, or Athom's Homey.

‘with electronic room temperature control plus week timer’ means the product is equipped with an electronic device, either integrated or external, that allows the product to automatically vary its heat output over a certain time period, in relation to a certain required level of indoor heating comfort and allows the setting of timing and temperature levels for a full week. During the 7-day period the settings must allow a variation on a day-to-day basis;

There are some similarities between the week timer and the automatic programming, for example that both are and *electronic device, either integrated or external,* and both *must allow a variation on a day-to-day basis*. However, there are two significant differences: The involvement and activity of the end-user and the time scale of planning.

With the week timer, the end-user needs to enter the desired *timing and temperature levels* for one week at the time (or repeat same pattern each week). An auto programming control has the potential to find more complex and long-term patterns in the use and can adapt to changing weeks and days by applying a mix of information from sensors and connected devices. The saving potential also depends on the assumption that the auto programming will be precise enough to avoid excessive heating by increasing temperature too early, when no one is present, when the windows are open, etc.

An appliance with the week timer might also adapt to some extent through e.g. presence detection or open window detection. The auto programming function thus has some overlap with other control options such, e.g. presence detection, distance control, adaptive start and the week timer itself. It is therefore also assumed that the price increase will be small compared to an appliance that already has electronic controls.

The specific energy saving potential related to auto programming depends highly on user behaviour and especially the difference in end-user behaviour with this control option compared to without. By this also follows that it can be very difficult to verify the effect of the auto programming control probably resulting in complex and expensive testing procedures for both manufacturers and market surveillance authorities. To test the auto programming function end-user behaviour profiles and a more specific definition of the required functionalities may likely be required. An equivalent auto programming function test exist for electric storage water heaters with smart controls (Commission Regulation (EU) 813/2013) for which the testing sequence to verify the effect last at least 14 days[190]. Based on the size of the other correction factors and the fact that the auto programming

[190] EN 50440:2015 Efficiency of domestic electrical storage water heaters and testing methods

build on top of other control functions and depends on these different sensors as well, the potential to add a maximum of 0,5% in bonus for this function will be investigated. This could further be restricted only to devices that are wireless connected[191], since these will inevitably have a better access to data on end-user behaviour.

6.2 Control accuracy

Efficient temperature control could improve comfort and energy efficiency. In case of the heating system not being able to maintain a constant temperature, users typically would increase the power or thermostat setting to ensure that the lowest of the temperatures reaches the desired level of comfort. This will result in a higher average temperature and the consequence is higher heat losses.

A study on heat loads for HVAC equipment also considers "Fluctuation and stratification losses"[192]. The study found that building codes in Germany, France and UK have efficiency-penalties for the heating system for losses as a result of the system not being capable of reaching the desired level due to temperature fluctuation and stratification.

On the controls side, there are various ways to evaluate this. For electric heaters, the standard EN 60675 specifies the stability of temperature by two parameters, the amplitude and the drift, which are determined by testing. The amplitude is the difference between maximum and minimum room temperatures for a specific setting of the room temperature controller and a specific energy ratio (load). The drift is the difference in average temperature at different energy ratios (loads) for the same setting of the room temperature controller. The amplitude and drift can be determined for electric local space heaters incorporating an integrated or external room temperature controller.

French certification scheme (NF Mark) for direct acting electric room heaters[193], combines the amplitude and drift parameters into another parameter, the aptitude coefficient (Le coefficient d'aptitude), which is a measure for the ability to deliver homogenous and stable heat to the room, the smaller the aptitude coefficient, the better. The aptitude coefficient is also used as input to French EPBD calculations.

The standard EN 15500-1 which is developed to support EPBD calculations is applicable for electronic individual zone controllers for heating, ventilation and air conditioning. In relation to heating this means hydronic and electric heating. The standard focuses on the performance of the controller only and do not incorporate a specific heater. The standard

[191] Does not have to be connected to the internet, as a local network can be enough, if you control form inside the home. If you need to control from outside the home, internet connection is required.
[192] Final report Average EU building heat load for HVAC equipment, René Kemna, VHK for the European Commission, DG ENER C.3: (2014)
[193] Specifications for the NF electricite performance mark No. LCIE 103-13/F, Direct-acting room heaters, CdC 103-13/F May 2018

operates with the term and parameter, control accuracy (CA), which in many ways takes into account the same aspects as the aptitude coefficient. The CA is discussed as a measure in the on-going BACS preparatory study.

According to stakeholders, there do not exist a similar standard framework to evaluate the performance of room temperature controllers for oil-fired and gas-fired local space heaters. Figure 30 illustrates how a less efficient thermostatic control and no day timer could influence indoor temperature levels compared to an ideal temperature curve. In this example the average temperature difference between the two controls is almost 4 °C.

The lower energy consumption typically comes with a more stable temperature and quicker response. This means the temperature set point can be lower since users do not need to add a "safety factor" to the setting. At the same time there would be fewer peaks with unintentional high temperatures and consequently higher heat loss.

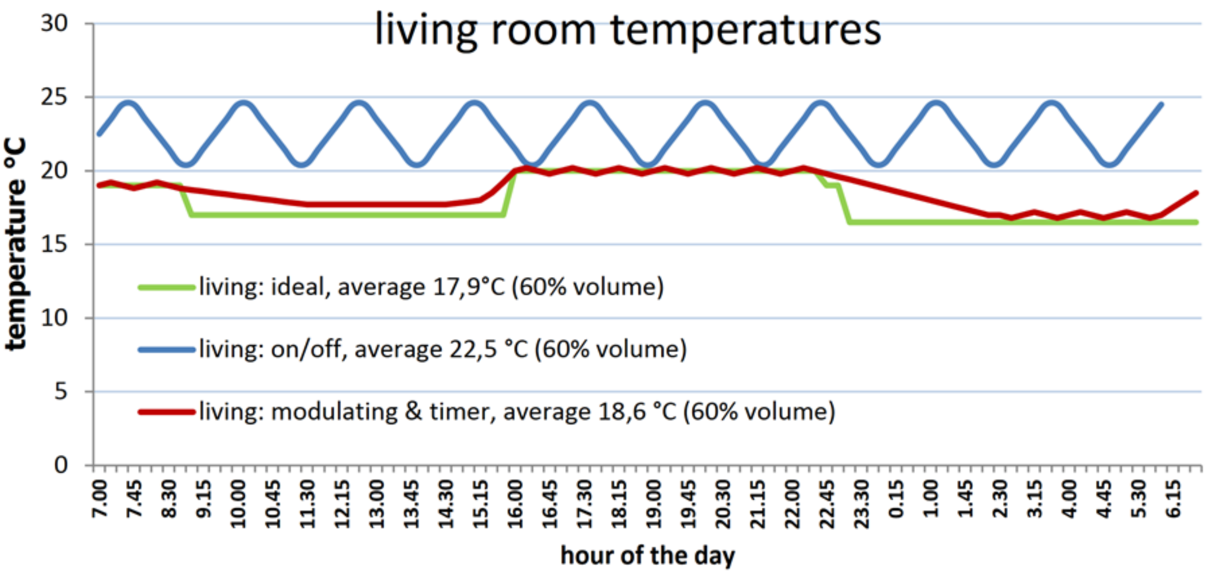


Figure 30: Typical indoor temperature lines for a low-efficiency on -off system, a high -efficiency modulation & timer system and the ideal temperature line. (illustrative)[194]

In general, higher control accuracy is achieved with electronic controls compared to mechanic thermostats (red line vs. the blue in Figure 30), which has already been taken into account in the current Regulation (EU) 2015/1188. However, even between electronic thermostats the accuracy can vary. What exact measure to be used for the performance

[194] Final report Average EU building heat load for HVAC equipment, René Kemna, VHK for the European Commission, DG ENER C.3: (2014)

of the controllers can be discussed: aptitude coefficient, control accuracy or something else, as long as it reflects the efficiency gain and is quantifiable.

In the following example is referred to typical control accuracies (CA) for different thermostats are[195]:

- Mechanical thermostat: CA = 1 K
- Electronic thermostat: CA = 0,5 K
- Good electronic thermostat: CA = 0,3 K

According to the correction factors in the regulation, an additional bonus of 2%-points can be achieved by going from a mechanic to an electronic control, corresponding to decreasing the average temperature with approximately 0,5 K according to the above (from at least 1K to at least 0,5K), or approximately 4%-points/K. This fits well with the general rule that the energy consumption for room heating decreases by 5-8% for degree lower room temperature.

The difference between the average and the good electronic thermostats is an additional average room temperature decrease of 0,2 K (0,5K – 0,3K), which would thus result in around 0,8% additional energy savings with the above assumptions. A threshold could thus be set for the accuracy of the thermostat, where the good electronic thermostats with CA below 0,3 K could achieve an additional 0,5%-point in bonus through the correction factors.

6.3 Improved useful efficiency

For the gas and liquid local space heaters, the useful efficiency in itself is important for the compliance with the ecodesign requirement, as opposed to electric appliances where there is a 100% conversion of electricity to heat. Therefore, there is also, as opposed to the electrical heaters, a potential to increase useful efficiency.

There is quite a large efficiency difference between products on the market today, as shown in task 4. For example, an open fronted heater with 52% useful efficiency (plus a two stage mechanical timer) can be compliant, whereas best types on market has thermal efficiencies around 71% or more (plus electronic controls). The difference in lifetime fuel costs for the end-user between these efficiencies is around one third lower costs for the high efficiency heater.

For the closed fronted local space heaters, the differences are smaller, with thermal efficiencies around 82% for the least efficient and 88% for the most efficient, which results in similar lower difference in the lifetime fuel costs of around 10%.

[195] Based on expert assessment based on inputs from the NF label and eubac.org.

However, this efficiency increase will also cause an additional purchase price, and in cases where the heater replaces one without electronic controls, the installation cost will also increase substantially due to the need for installing a power line. Hence, the fuel costs savings would likely be more than counteracted by increased purchase and installation costs, resulting in a higher total cost of ownership for the end-user.

Furthermore, the simple (and less efficient) gas appliances are often used in low income households, and are important in some member states to keep energy poverty rates from increasing, for example in the UK where these simple gas appliances are used to heat specific rooms above the average temperature provided by the central heating system.

It should also be noted, that the domestic gas and liquid products are in scope of the Energy Labelling Regulation (EU) 2015/1186, which helps users make an informed choice and buy the most energy efficient products within their budget. Since the ecodesign is a market-entry threshold and more advanced products do not necessarily result in lower life cycle costs for the consumer (depending on their living situation and available infrastructure), it is not recommended to set stricter ecodesign limits. Furthermore, the energy label will most likely pull the market towards higher efficiencies, but since both the regulations have been in force in less than one year, data of average energy levels for these products is still insufficient.

For the commercial gas and liquid local space heaters, i.e. the tube and luminous heaters the efficiency range is smaller and the average level higher, with products being above 80% thermal efficiency based on GCV. For these products, also the emission efficiency related to the radiant factor has important influence on the overall efficiency. An increase of for example 5%-points cause a decrease in fuel costs of around 5%. Due to the uncertainties in the calculations, especially due to uncertainties in the end-user behaviour and use pattern, as well the uncertainties regarding increases in purchase price, a lower LCC (Life Cycle Cost) is not certain, and it is therefore not sufficient to recommend a stricter ecodesign requirement.

Furthermore, it is unlikely that the thermal efficiencies will increase any further since it is already very high, and BAT can therefore be expected to be the same as any BNAT in terms of energy efficiency, and the far majority of commercial local space heaters are already sold with advanced controls, making improvement potentials small for additional controls as well.

Based on the above considerations it is thus not recommended to change the minimum efficiency requirement for any of the gas and liquid fuel local space heaters until the regulation has been into force for a long time period, in order to obtain better data on market response to the regulation.

6.4 Flueless heaters

For flueless heaters using gaseous or liquid fuel, no specific energy requirements exist in the current regulation. Thus, the requirements are limited to product information including the sentence 'This product is not suitable for primary heating purposes', presented in different ways, where the product is marketed. By definition the efficiency of flueless heaters is considered 100% as all flue gasses are released into the room where the heater is placed. This also means that pollutive substances as e.g. NO_x, are emitted to the room, and when the room is vented to the surroundings. Further, the water contained in the flue gas will require venting of the room. Flueless heaters are relatively cheap mobile products compared to products requiring a flue pipe. Concerning their use, flueless heaters are not necessarily inter-placeable with gaseous or liquid local space heaters of other types. When equipped with e.g. catalytic burners, very low NO_x-levels are achievable for flueless heaters (< 50 $mg/kWh_{input,GCV}$). Where setting a minimum requirement on the efficiency seems less meaningful, information of the NO_x could be relevant consumer information. It is therefore recommended to consider product information of NO_x-emissions to be included in the regulation.

6.5 Auxiliary electricity consumption for electric local space heaters

The auxiliary electricity consumption for electric local space heaters is based on the standby consumption and whether the product complies with the standby regulation (Regulation (EC) No 1275/2008) or not. The formula for calculating the correction factor F(4) for auxiliary electricity consumption for electric local space heaters is:

$$F(4) = CC * \frac{\alpha * el_{sb}}{P_{nom}} * 100\%$$

Where CC is the conversion to primary energy (or PEF factor), el_{sb} is the standby consumption (in kW), P_{nom} is the nominal heat output of the product (in kW) and α is a factor that depends on whether the product complies with the standby regulation or not. If it does comply with Regulation (EC) No 1275/2008 then α=0 (and thus F(4)=0), if not α=1,3.

The definition of the standby mode follows that of the Regulation (EC) No 1275/2008 and is also mentioned in the local space heater regulation:

'standby mode' means a condition where the product is connected to the mains power source, depends on energy input from the mains power source to work as intended and provides only the following functions, which may persist for an indefinite time: reactivation

function, or reactivation function and only an indication of enabled reactivation function, and/or information or status display;

According to stakeholders this definition does not fit electric local space heaters very well, since they work in duty cycles (e.g. 2 minutes on, 3 minutes off) to maintain a certain temperature level in the room. Hence, the heating element switches on and off when heating is needed, and in longer periods of time when heating is not needed, the heat elements are continuously off, but the heaters still monitors the room temperature all the time. This is therefore not qualified as a standby mode, but rather as an "on mode". Since many electric local space heaters are never in standby and do not have a standby mode, they can thus claim F(4) to be 0 for most products, according to one stakeholder.

All of the electricity used in this "on mode" is eventually transformed into heat. Hence, in the heating season it is all utilised. However, since there is no requirement for power consumption in this mode, there is no incentive for manufacturers to use efficient power supplies. This could result in excess power consumption when there are long periods without heat demand, where the appliance is still on. According to one stakeholder end users will turn of their appliances in the non-heating season. However, in the transitional period (e.g. spring and fall), the appliance might be left on for a long time without heating, or heating only in very short time intervals.

The following options for handling the auxiliary electricity consumption for electric local space heaters have been suggested by stakeholders:

- Include other low power modes such as:
  - Idle mode (when thermostat is not heating, but the appliance is on)
  - Off mode (When the user has switched of the appliance)
- Make the F(4) calculation independent of compliance with the standby regulation
- Set specific power consumption limits for off mode

For the first to options, the following formula was suggested by a stakeholder:

$$F(4) = CC * \frac{\left(t_{idle} * P_{idle} + t_{sb} * P_{sb} + t_{off} * P_{off}\right)}{P_{nom}} * 100\%$$

Where:

t_{idle} is the fraction of the year where the heater is on, but idle, and where auxiliary heating does not contribute to maintain thermal comfort because heating is not needed.

P_{idle} is the power in idle mode.

t_{sb} is the fraction of the year where the heater is in standby mode.

P_{sb} is the power in standby mode.

t_{off} is the fraction of the year where the heater is in off-mode.

P_{off} is the power in off-mode

P_{nom} nominal heat output of the product (in kW)

The different time fractions (t_{idle}, t_{sb}, t_{off}) would need to be defined and be the same for all heaters of the same type, taking into account the use times and heating season length. For example, the off time could be the entire heating season, and the idle and standby could be equally distributed from the rest of the time (minus the on-time). If the heater has no standby mode, the time in idle mode would be all that is not on or off.

Given that most electric heaters do not have a standby mode, the latter would most likely be the case for the majority of products. Whether the heat generated in the idle state is then useful or wasted, depends highly on consumer behaviour. If the user consequently turns off the appliance outside the heating season, the idle consumption (and heat produced) will contribute to indoor heating when it is need. If the end user does not turn off the appliance, the idle consumption can be considered wasted. Hence, the saving potential is thus also highly dependent on the end user behaviour.

For an end user who does not turn off the appliance, the potential saving for the (approximately) 6 months outside the heating season is around 4,4 kWh per watt consumed less in the idle mode[196]. However, for an end user turning the appliance off at the optimal time, the saving might be 0 kWh/year. For all end users, irrespective of the behaviour the consumption in the off mode is, however, important and has the same saving potential (4,4 kWh/year per watt decrease in off mode consumption).

The user behaviour is also important for the time fractions used in the formula suggested above. It should be taken into account that idle consumption (and thus the heat produced in the idle mode) is not considered waste heat in the heating season. And if the t_{off} is then the total time outside the heating season, the time in idle and standby outside the heating seasons would be 0 and the suggested formula would become redundant.

An alternative that would incentivise manufacturers to use high efficiency power supplies and not add functions that consumer unnecessary amounts of heat would be to change the formula to include all three low power modes:

$$F(4) = CC * \frac{\alpha * (el_{sb} + el_{idle} + el_{off})}{P_{nom}} * 100\%$$

[196] (8760 hours/year)/2 * 0,001 kW = 4,38 kWh/year

This would mean that all three of the identified low power modes are important for the calculated seasonal efficiency, and the fact that most heaters have no standby mode, would no longer mean that the idle and off modes are not considered.

In order to make the calculation independent of the standby regulation, it can also be changed so that the α factor depends the compliance with specific requirements for each of the low power modes (idle, standby and off mode) in the local space heater regulation itself. Hence, a limit value could be set for each of the low power modes, idle, standby and off mode, and if the consumption of the appliance is below all of these limits, α=0 and if not, α=1,3. This gives the advantages that the calculation is no longer dependent on the standby regulation and that the idle mode, which the appliance is in for large periods of time, is considered in the regulation, which it is not today.

In order to calculate the actual saving potential and set the limit values, however, average market data for energy consumption in off and idle modes of the electric heaters is needed. So far, only data for the idle mode and only for a few models is available. All of these, however, had idle consumptions below 0,5 W, even when they had an information display (for which the standby requirement is 1 W). It is not known, however, whether these are high-end or low-end products.

6.6 Improved efficiency for portable heaters

The energy efficiency requirements for portable heaters are lower than for fixed heaters. Some stakeholders have suggested to align the requirements/correction factors among portable and fixed heaters, so the efficiency of portable heaters is increased, as the portable category poses a loophole and portable heaters consume a considerable amount of energy in EU. However, other stakeholders are in favour of the current categories and efficiency requirements, as portable heaters are used differently (primarily for secondary heating), so more advanced controls (electronic controls) would not have any positive effect.

Whether alignment in requirements or correction factor would have an impact is currently not possible to quantify. Therefore, it is suggested to investigate the use patterns of portable heaters to quantify the share of heaters used for primary heating in the next review study. In addition, it is difficult to quantify the effect of the current regulation, due to the timing of the current review study.

6.7 Resource efficiency options

Resource efficiency requirements are increasingly important as energy levels are decreasing across different ecodesign regulations. These requirements often consist off all or some of the following options:

- Spare part availability for a period after putting on the market. The appropriate time would e.g. depend on the product lifetimes.
- Access to critical components during repair and maintenance operations
- Information like disassembly map and explosion view, diagnostic fault and error codes, wiring and connecting diagram etc.

However, these requirements may become counterproductive for local space heaters as the lifetime already is quite long compared to other regulated products. If spare parts have to be available for 20 years or more, manufacturers need to store a considerable amount of spare parts which may never be used. In general, it is assumed that all local space heaters are durable products with few moving parts, which means that there is very limited wear and tear of these product. Regarding repair it is assumed that no or only a few residential local space heaters currently are repaired. According to data available at restarters.net shows that out of 8000 attempts to repair appliances 35-40 were local space heaters. Half of these were fan-heaters, approximately a fourth were electrical local space heaters and a few were oil heaters, unspecified, one electrical stove and one towel rail.

Data from ifixit[197] indicates, that small heating appliances are not being repaired except for fan heaters. The reason is probably, that the heating element in electrical heaters are relatively resilient in contrary to the fan in a fan heater. In addition, it is the major component in the heater, so if it breaks it is more reasonable to change the whole heater.

The most common component failures were (electronic) timers, displays, thermostats, switches, wiring, switches, plugs and fuses. For the fan heaters heating elements were common but apparently this is not the case for radiators. These numbers are from non-professionals but according to The Repair Alliance the problems discovered here generally reflects what the professionals are observing as well. Since local space heaters are now per default equipped with controls and mostly electronical controls and displays, it must be expected that more of those breaks and that consumers consequently to a higher extend would want to repair local space heaters. The development where more and more products are equipped with more complex controls and control systems means it is even more important that the print boards for the controls are available. However, no data suggest reduced lifetimes due to the controls currently. In the future revision of the regulation it

[197] https://www.ifixit.com/Search?doctype=guide&query=heater

may be beneficial if products can be upgraded with new electronics and are designed with modularity in mind.

Therefore, it is assumed that there are no, or very few, repair operations undertaken for local space heaters. This could be caused by a lack of spare parts, or lack of repair information or simply because heaters are durable products which are replaced during construction work/redecoration rather than due to break downs. With lifetimes of 15-20 years or more, it becomes very difficult to predict the end-user behaviour.

Overall the design of local space heaters is fairly simple, and the material composition consists mostly of different types of metals. Metal are highly recyclable compared to other materials, which means that a high share of local space heaters is recycled End-of-Life. In Table 68 two examples of the recycling share are presented.

Table 68: Recycling rates for electric fixed heaters above 250 W and gas/liquid closed fronted heaters (values based on the recycling rates presented in section 3.5.4).

		Re-use	Recycling	Other	Total
Electric fixed heaters above 250 W	g	53	4569	654	5275
	%	1%	87%	12%	100%
Gas/liquid closed fronted heaters	g	199	18476	1178	19853
	%	1%	93%	6%	100%

For electric, gas and liquid heaters the recycling rate is 87% or above. This is a high recycling rate, which may be difficult to improve. The high recycling rate is a consequence of the design and material composition of space heaters. Hence, it only makes little or no sense to suggest any requirements which either improves the lifetime (including spare parts) or measures to ensure higher recyclability.

In the future, common standards and communications protocols may exist which makes it possible to build modular space heaters. Proper modular space heaters could potentially be built with upgradable controls, so consumers always are equipped with the best and most precise controls. This could potentially reduce the energy consumption from space heaters by continuously improving the controls as controls are essential to ensure lower energy consumption since the heating element alone are 100% efficient. However, with an upgradable design the product might become less durable or the products may become obsolete faster, as the products need frequent hardware updates. This may increase the overall resource consumption. With the small improvements for local space heaters products should be designed for a long lifetime. However, it is suggested that the lifetime of local space heaters shall be investigated in the next revision to see if the increase in complexity (more controls) has a negative impact on the lifetime and a requirement of upgradability and minimum lifetime would make sense.

At End-of-Life a modular design would potentially make it more affordable (and easy) to remove electronic modules for separate treatment. This could potentially save scarce resources as the majority of the scarce resources are located in the electronics. However, more electronics may be purchased, so it is difficult to quantify any benefits of a modular design currently.

7. Scenarios

This chapter provides scenario calculations and recommendations for amending and improving the regulations. In task 5 a baseline (or Business as Usual, BAU) scenario was established for the current energy consumption of products in scope of the local space heater regulation. In this task, this BAU scenario will be compared to the BAU scenario of the 2015 Impact assessment to determine the effect of the current regulation. Furthermore, the BAU scenario will be used to quantify the effect of the suggested improvements.

7.1 Policy analysis, policy options and scenario analysis

In this task 7 the policy options are defined, and the impacts of each policy option are modelled until 2030. The policy options have been identified based on the work in the previous tasks and based on the stakeholder consultation.

The stakeholder consultation has taken place through two stakeholder meeting held in June 2018 and February 2019 and through direct contacts and meetings with a broad range of manufacturers and manufacturer associations, including written comments.

Various measures have been considered and discussed with stakeholders and barriers and opportunities have been analysed.

This resulted in identifying three policy options:

- Policy option 1: Expanding and clarifying scope as discussed in task 1 of this report
- Policy option 2: Adjusting the correction factors to take into account accuracy and auto programming as discussed in task 6 of this report
- Policy option 3: Adjustment of formulas / expressions in the regulation

Furthermore, it has already been decided politically to introduce a revised PEF (or CC) factor of 2,1 instead of the current 2,5, and therefore all primary energy numbers in the following are based on a PEF of 2,1.

7.1.1 Policy Option 1: Scope clarifications

Policy option 1 follows the recommendations on scope and definitions suggested in section 1.5. Some of the changes affects the scope of the regulation, other are solely a question about wording, to make the regulation clearer. Those related solely to wording are:

- Re-phrasing the overall definition of local space heaters (section 1.5.1)
- Change the definition of air-heating appliances (section 1.5.1)
- Change the definition of "portable electric heaters" (section 1.5.2)

- Remove the "electric radiant heater" category (section 1.5.2)
- Change the definitions for commercial gas and liquid fuel heaters (section 1.5.3)

The changes that affects the scope and/or the requirements are the following:

- Include commercial gas and liquid heaters up to 300 kW according to reviewed standards (section 1.5.3)
- Remove the definition and exemption of slave heaters (section 1.5.1 and 1.5.2)
- Add information requirements to all heaters and controls sold unbundled (section 1.5.2)
- Include towel heaters in scope of the regulation (+/- 250 W) (section 1.5.2)
- Change the definitions for domestic gas and liquid fuel heaters (section 1.5.3)

Only the changes related to a scope change are assumed to have an influence on the annual energy consumption. These are explained below.

Include commercial heaters up to 300 kW

As discussed in section 1.5.3 it is recommended to include commercial heaters up to 300 kW. This will affect solely the tube heaters, since luminous heaters are maximum 40-50 kW. In order to calculate the effect on energy consumption, it is estimated that the tube heaters in the size rage 120-300 kW (not included in scope of the current regulation), will undergo the same increase in efficiency as the tube heaters <120 kW did from before to after the regulation was implemented. The sales of the commercial tube heaters in the size range 120-300 kW was stated by manufacturers to be around 8% of the sales of tube heaters below 120 kW. In Table 69and Table 70 the potential savings for including commercial heaters is calculated. Note that the assumed capacity is 200 kW, and the current efficiency is estimated to 83%.

Table 69: Assumption in connection with commercial tube heaters in the size range 120-300 kW

	Sales	Capacity Kw	Use hours - full load	Current efficiency	PO1 efficiency
Gaseous tube (commercial)	1.344	200	591	83%	85%
Liquid tube (commercial)	134	200	591	83%	85%

Table 70: Energy consumption commercial tube heaters in the size range 120-300 kW in BAU and in PO1.

	Annual energy consumption BAU – TWh	Annual energy consumption PO1 – TWh	Saving - PJ
Gaseous tube (commercial)	0,191	0,187	0,0162
Liquid tube (commercial)	0,019	0,019	0,0016
Total	**0,210**	**0,206**	**0,018**

If commercial tube heaters in the size range 120-300 kW are included in the scope of the regulation the annual saving in 2030 is calculated to 0.018 PJ.

Removing the slave heater definition and imposing information requirements on unbundled heaters and controls

The scenario has been modelled by assuming that the products sold without controls will now be installed with controls that makes them compliant with the ecodesign requirements for the specific products types. The percentages of products compliant and not compliant in the BAU and in this policy scenario are given in Table 71 and Table 72.

Table 71: Share of heaters installed non-compliantly expected in the BAU scenario for different product types, and the efficiency on the market overall, in 2020

BAU	Fixed >250W	Fixed <250W	Underfloor heaters
Share sold as slave heaters (not compliant)	30%	30%	90%
Average efficiency overall (no PEF)	91%	84%	80%

The energy consumption in the EU by these products are expected to decrease as a result of the information requirement, due to the slave heaters, now being in scope and underfloor heaters being no longer a grey area, and therefore installed with sufficient controls. Compliance with the requirements are therefore assumed for these product types in this policy option, giving the average efficiencies shown in Table 72.

Table 72: Share of heaters installed non-compliantly expected in the PO1 scenario for different product types, and the efficiency on the market overall, in 2020

PO1	Fixed >250W	Fixed <250W	Underfloor heaters
Share sold as slave heaters (not compliant)	0%	0%	0%
Average efficiency overall (no PEF)	96%	86%	95%

Include towel heaters in scope

Including towel heaters in scope will also lead to decreasing energy consumption. However, even in the BAU scenario already some towel heaters lived up to the fixed heater requirements. It is estimated that this share is around 10%[198]. The average efficiency (on the entire market) in the BAU scenario is 79%. In the PO1 scenario it is assumed that 100% of towel heaters are compliant with the requirements, and that the overall efficiency in the market increases to 95% as a consequence. The requirements for the towel heaters +/- 250 W suggested in PO1 are given in Table 73.

Table 73: Requirements and average market efficiency of towel heaters (2020)

	BAU	PO1
Requirement for towel heaters <250 W	None	33%
Requirement for towel heaters >250 W	None	37%

[198] Estimation by stakeholders

Table 74: Suggestion for correction factors for towel heaters

F(2)	Towel
Single stage heat output, no room temperature control	0%
Two or more manual stages, no temperature control	2%
With mechanic thermostat room temperature control	2%
With electronic room temperature control	2%
With electronic room temperature control plus day timer	5%
With electronic room temperature control plus week timer	7%
F(3)	**Towel**
Room temperature control with presence detection	0%
Room temperature control with open window detection	1%
With distance control option	0%
With adaptive start control	1%
With working time limitation	1%
(total)	***10%***

Change the definitions for domestic gas and liquid fuel heaters

While the suggested definitions for domestic gas and liquid fuel heaters do not change the scope of the regulation, it does change the requirements slightly for the different types, which affects annual energy consumption. The suggestions for the categories and the corresponding requirements are shown in Table 75.

Table 75: suggested categories for domestic gas and liquid fuel heaters

Category	Criteria	Efficiency requirement	NOx requirement
Balanced flue	• Using gaseous or liquid fuel • Fire bed and combustion gasses completely sealed from the room • Sealed to a chimney or requires a flue duct • Air is taken from outside	72%	130 mg/kWh_{input} based on GCV
Open combustion / closed fronted	• Using gaseous or liquid fuel • Fire bed and combustion gasses are partly sealed from the room and air comes from the room with adjustable restriction • Sealed to a chimney or requires a flue duct	62%	130 mg/kWh_{input} based on GCV
Open fronted	• Using gaseous or liquid fuel • Fire bed and combustion gasses are not sealed from the room and air comes from the room with no restriction • Sealed to a chimney or requires a flue duct	42%	130 mg/kWh_{input} based on GCV
Open to chimney	• Using gaseous or liquid fuel • Fire bed and combustion gasses are not sealed from the room and air comes from the room with no restriction • Sit under a chimney without sealing, no restriction to products of combustion	none	Information requirements only
Flueless	• Using gaseous or liquid fuel • Fire bed and combustion gasses are not sealed from the room and air comes from the room with no restriction • Products of combustion released directly to the room	none	Information requirements only

Energy savings PO1

The above described changes yield the energy levels shown in Figure 31. For the sake of the scenario analysis (in order to be able to model the effect before the model ends in 2030 in accordance with the MEErP methodology), it is assumed that requirements are fully implemented by 2020, but this does not represent a suggested timing. With this modelled implementation date, the total 2030 energy savings amount to 28 PJ/year in primary energy, corresponding to 1,3 MT CO_2/year, approximately 3%. The approximate user expenditure saving is 7,9 million € per year in 2030, or 0,2%.

While these energy savings are not very large, the most important aspect of this policy option is to clarify the scope of the Regulation and ensure a level playing field, by eliminating the loophole that the exemption of slave heaters constitutes in the current Regulation.

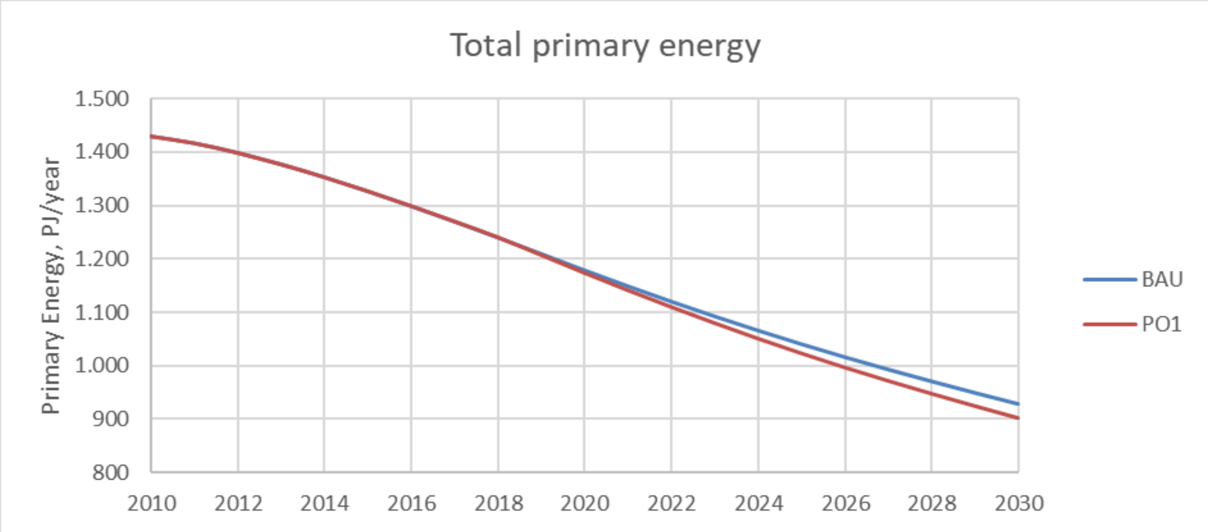


Figure 31: Primary energy consumption for all products in BAU and PO1 from 2010 to 2030 (with PEF 2.1)

7.1.2 Policy option 2: Additional correction factors

As discussed in task 6, the correction factors could be extended to include the most recent advancement in controls, by including a bonus for high accuracy and for automatic programming.

In order to not surpass the 10%-point in the formula, this means that other correction factors would need to be adjusted as well. In this policy scenario it is assumed that the accuracy and auto programming will each account for an additional 0,5%-points, which will in turn mean a lesser bonus for the week timer. The existing and the suggested correction factors can be seen in Table 76 and Table 77.

Table 76: Current correction factors in the existing Regulation (EU) 2015/1188

F(2)	Portable	Fixed	Storage	Underfloor	Radiant	Gas/ liquid
Single stage heat output. No room temperature control	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Two or more manual stages. No temperature control	1,0%	0,0%	0,0%	0,0%	2,0%	1,0%
With mechanic thermostat room temperature control	6,0%	1,0%	0,5%	1,0%	1,0%	2,0%
With electronic room temperature control	7,0%	3,0%	1,5%	3,0%	2,0%	4,0%
With electronic room temperature control plus day timer	8,0%	5,0%	2,5%	5,0%	3,0%	6,0%
With electronic room temperature control plus week timer	9,0%	7,0%	3,5%	7,0%	4,0%	7,0%
Contribution from F(1)			5%			
F(3)	**Portable**	**Fixed**	**Storage**	**Underfloor**	**Radiant**	**Gas/ liquid**
With presence detection	1,0%	0,0%	0,0%	0,0%	2,0%	1,0%
With open window detection	0,0%	1,0%	0,5%	1,0%	1,0%	1,0%
With distance control option	0,0%	1,0%	0,5%	1,0%	1,0%	1,0%
With adaptive start control	0,0%	1,0%	0,5%	1,0%	0,0%	0,0%
With working time limitation	0,0%	0,0%	0,0%	0,0%	1,0%	0,0%
With black bulb sensor	0,0%	0,0%	0,0%	0,0%	1,0%	0,0%
Total	10,0%	10,0%	10,0%	10,0%	10,0%	10,0%

Table 77: Policy Option 2: Correction factors updated with accuracy and auto programming. Coloured cells mark changed values.

F(2)	Portable	Fixed	Storage	Underfloor	Visibly glowing	Towel	Gas/ liquid
Single stage heat output, no room temperature control	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Two or more manual stages, no temperature control	1,0%	0,0%	0,0%	0,0%	2,0%	0,0%	1,0%
With mechanic thermostat room temperature control	6,0%	1,0%	0,5%	1,0%	1,0%	1,0%	2,0%
With electronic room temperature control	7,0%	3,0%	1,5%	3,0%	2,0%	3,0%	4,0%
With electronic room temperature control plus day timer	7,5%	4,5%	2,5%	4,5%	3,0%	4,5%	5,0%
With electronic room temperature control plus week timer	8,0%	6,0%	3,0%	6,0%	4,0%	6,0%	6,0%
Contribution from F(1)			5%				
F(3)	**Portable**	**Fixed**	**Storage**	**Under-floor**	**Visibly glowing**	**Towel**	**Gas/ liquid**
With presence detection	1,0%	0,0%	0,0%	0,0%	2,0%	0,0%	1,0%
With open window detection	0,0%	1,0%	0,5%	1,0%	1,0%	1,0%	1,0%
With distance control option	0,0%	1,0%	0,5%	1,0%	1,0%	1,0%	1,0%
With adaptive start control	0,0%	1,0%	0,5%	1,0%	0,0%	1,0%	0,0%
With working time limitation	0,0%	0,0%	0,0%	0,0%	1,0%	0,0%	0,0%
With black bulb sensor	0,0%	0,0%	0,0%	0,0%	1,0%	0,0%	0,0%
Automatic programming	0,5%	0,5%	0,5%	0,5%	0,0%	0,5%	0,5%
Accuracy	0,5%	0,5%	0,5%	0,5%	0,0%	0,5%	0,5%
Total	10,0%	10,0%	10,0%	10,0%	10,0%	10,0%	10,0%

The minimum requirements are expected to be kept unchanged, at the current levels, i.e. as shown in Table 78.

Table 78: Requirements in the existing Regulation and in Policy Option 2[199]

Fuel	Type	Seasonal space heating efficiency requirement
Electric	Fixed > 250 W	> 38 %
	Fixed ≤ 250 W	> 34 %
	Storage	> 38,5 %
	Portable	> 36 %
	Underfloor	> 38 %
	Radiant	> 35 %
	Visible glowing > 1,2 kW	> 35 %
	Visible glowing ≤ 1,2 kW	> 31 %
Gas/liquid	Open fronted	42 %
	Closed fronted	72%
	Luminous (gas only)	85 %
	Tube	74 %

The suggested changes in correction factors are thus not expected to significantly change the average seasonal efficiencies on the market (as calculated with the formula in the Regulation) when calculated theoretically, since all products are still assumed to be compliant with the minimum requirements in Table 78. However, it is assumed that the auto programming is used more than the manually set week-timers, because end-users do not have to take any deliberate actions or remember to change the timer according to changing behavioural patterns. Furthermore, the more detailed and data based automatic programming is expected to be able to run the appliances even more efficiently than the week timer.

By giving credit for the auto programming at the expense of the manual week timers, it creates an incentive for manufacturers to have the automatic function on their products, especially the heaters with strict requirements such as fixed electric heaters above 250 W, which account 40% of the total primary energy consumption of all local space heaters in scope of the Regulation.

The additional correction factor for high accuracy controls is suggested in order to differentiate between high and low quality electronic controls, and under the assumption that increased comfort leads to generally lower temperature settings.

Assuming that these products are run more efficiently with the automatic programming and better accuracy, the modelling of the energy savings are based on the assumption that

[199] Inclusion of towel heaters is part of Policy Option 1, and limits and requirements for towel heaters are therefore given in the description of policy option 1.

the average seasonal space heating efficiency of the following heater types will increase 0,5%-points:

- Fixed heaters >250W (including the towel heaters sold as fixed heaters today)
- Electric storage heaters
- Electric underfloor heaters (those not sold as slave heaters)
- Electric visibly glowing radiant heaters >1,2 kW
- Gas and liquid closed fronted heaters

This assumption yields an annual energy saving of 1,7 PJ primary energy in 2030 (0,075 Mt CO2-eq/year), corresponding to a 0,2% saving. The energy savings alone are thus not large enough to justify this change in correction factors. However, the change ensures that the Regulation is brought up to date and incentivises the use of the most technologically advanced controls.

7.1.3 Policy option 3: changes to formulas and expressions in the regulation

Policy option 3 includes the adjustments to formulas and expressions in the regulation that have been suggested by stakeholders in the study to clarify grey areas. These adjustments are primarily details that will make the regulation clearer, and none of them have any effect on the energy consumption or emissions.

Limits of factor F(1) for commercial heaters

As discussed in task 4 (section 4.2.2), the correction factor F(1) for commercial local space heaters requires some adjustments. In the regulation the F(1) correction factor for commercial heaters is calculated by the formulas:

If the heat output control type of the products is:	F(1) is calculated as:
Single stage	$F(1) = 5\ \%$
Two stage	$F(1) = 5\ \% - \left(2{,}5\ \% \cdot \frac{P_{nom} - P_{min}}{30\ \% \cdot P_{nom}}\right)$
Modulating	$F(1) = 5\ \% - \left(5{,}0\ \% \cdot \frac{P_{nom} - P_{min}}{40\ \% \cdot P_{nom}}\right)$

First of all, there is a confusion of percentages and percentage points in the formulas, according to stakeholders. The 5,0% and the 2,5% are percentage-points whereas the 30% and 40% are percentages. This can be solved quite easily by exchanging the latter with decimal numbers instead, i.e. 0,3 and 0,4, respectively. This would yield the formulas shown in Table 79.

Table 79: Suggested formulas and limits for the F(1) correction factor for commercial heaters.

If the heat output control type of the product is:	F(1) is calculated as:	With the following limits:
Single stage	$F(1) = 5\%$	
Two stage	$F(1) = 5\% - \left(2{,}5\% * \dfrac{P_{nom} - P_{min}}{0{,}3 * P_{nom}}\right)$	2,5% ≤ F(1) ≤ 5,0%
Modulating	$F(1) = 5\% - \left(5{,}0\% * \dfrac{P_{nom} - P_{min}}{0{,}4 * P_{nom}}\right)$	0 % ≤ F(1) ≤ 5,0%

Another issue is the limitations for the F(1) factors given in the regulation: "The minimum value of the correction factor F(1) for two stage commercial local space heaters is 2,5%, and for modulating commercial local space heaters is 5%". However, since the F(1) factor is subtracted from the 'seasonal space heating energy efficiency in active mode' in the formula for 'seasonal space heating energy efficiency' for commercial local space heaters, it is an advantage if the factor is as small as possible[200]. The formulas can result in large negative values, which is not realistic. The table should therefore be corrected to address the limits of the value of F(1) instead of the minimum value of F(1). The limits are for two stage burners (2,5% ≤ F(1) ≤ 5,0%) and for modulating burners (0 % ≤ F(1) ≤ 5,0%).

Change information requirements for commercial local space heaters from output to input
One stakeholder has requested that all information given for commercial local space heaters, should be given for nominal heat input instead of output, since the output is not measured but calculated form the input (which can be measured as the amount of fuel). This is because the measurement of heat output cannot be measured, and no standards or similar exists to measure the output. This would give no differences in values or relative efficiencies of commercial local space heaters, but would be a simpler way to calculate and state information, since it would be based on measurable values.

This would affect all formulas for calculating efficiencies of commercial local space heaters (page L 193/92 of the Regulation) and the information requirements in table 3 Annex II (Information requirements for commercial local space heaters). Hence the issue is not using either input or output (as heat output for commercial heaters is calculated based heat input), but all the formulas, correction factors and requirements that would be affected. For example the calculation of $\eta_{S,th}$ would need to be changed, since this formula includes the heat output minus the envelope loss, and the relation between input and

[200] This is the opposite of electric storage heaters, where a large F(1) value gives a higher seasonal space heating efficiency

losses would be different, albeit this is only by a factor (between heat input and output). This would therefore also affect the calculation of seasonal efficiency, which is currently based on these calculations. This suggestion will therefore require extensive changes to the regulation and is therefore not recommended, since it is only a matter of how the same results are expressed, even though expressing results for heat output is not considered conventional. That is also why transitional methods were developed for the calculation.

Change the calculation of the F(4) correction factor for electric local space heaters

As described in section 6.5 it is recommended to change the formula for calculating the F(4) correction factor for auxiliary electricity consumption for electric local space heaters.

The suggested formula includes also the electricity consumption in idle and off mode:

$$F(4) = CC * \frac{\alpha * (el_{sb} + el_{idle} + el_{off})}{P_{nom}} * 100\%$$

However, rather than being dependent on the compliance with the standby regulation, it is recommended to set limit values for each of the low power modes (idle, standby and off mode), and let the compliance with these values determine the α factor. If the consumption of the appliance is below all of these limits, α=0 and if not, α=1,3 (same values as today).

This would mean that the fact that most heaters have no standby mode, would no longer mean that the idle and off modes are not considered. However, in order to set adequate limits, additional market data for electricity consumption in the three low power modes. The only available data is indicative and shows that idle consumption below 0,5 is not unusual for new appliances. However, it is not known if this is true for both high-end and low-end products.

Add information requirements on NOx for flueless heaters

There are currently no requirements for either efficiency or NOx emmissions for flueless heaters, but the requirements are limited to product information including the sentence 'This product is not suitable for primary heating purposes'. In order to provide end users with health related information, it is recommended to consider product information of NO_x-emissions to be included in the regulation for flueless heaters. The information should be displayed in the same places as the sentence required.

7.1.4 Long-term saving potentials

According to the MEErP methodology, the scenario modelling should only be conducted until 2030 (as in the above sections), however, because of this short time span and the long lifetimes of the local space heaters, the full potential of new requirements is not achieved by 2030. In this section the saving potentials for Policy Option 1 and 2 as well as a combined scenario "Policy option 1+2", are therefore presented for 2030, 2040 and 2050. It should be noted that these scenario models do not take into account the effect of e.g. fossil fuel restricting regulation in member states, but assumes a continuation of the sales and efficiency trends presented in this report.

Annual saving potentials

The annual primary energy savings for all local space heaters can be seen in Table 80 for the years 2030, 2040 and 2050. By 2050 it is assumed that close to the whole stock has been replaced with more efficient products.

Table 80: Annual primary energy savings in 2030, 2040 and 2050, respectively, for each policy scenario

	Consumption, PJ/year			Savings, PJ/year			Savings, %		
	2030	2040	2050	2030	2040	2050	2030	2040	2050
BAU	929,1	765,9	654,6	0,0	0,0	0,0	0,0%	0,0%	0,0%
PO1	901,1	732,8	621,9	28,0	33,1	32,7	3,0%	4,3%	5,0%
PO2	927,5	764,4	653,3	1,6	1,4	1,3	0,2%	0,2%	0,2%

As shown in the sections above, none of the policy options leads to extensive energy savings and the savings from PO2 are very small. However, the policy options update the regulation to close loopholes and clarify grey areas, and to take into account the new technology development. The largest savings are obtained by a combination of PO1 and PO2. The corresponding CO_2 savings and user expenditure savings can be seen in Table 77 and Table 78.

Table 81: Annual CO2 savings in 2030, 2040 and 2050, respectively, for each policy scenario

	Emissions, MT CO_2-eq/year			Savings, MT CO_2-eq/year			Savings, %		
	2030	2040	2050	2030	2040	2050	2030	2040	2050
BAU	43,1	33,4	26,9	0,0	0,0	0,0	0,0%	0,0%	0,0%
PO1	41,8	32,0	25,6	1,3	1,4	1,3	2,9%	4,2%	4,8%
PO2	43,0	33,4	26,9	0,1	0,1	0,0	0,2%	0,2%	0,2%

Table 82: Annual user expenditure savings in 2030, 2040 and 2050, respectively, for each policy scenario

	Expenditure, mill. €/year			Savings, mill. €/year			Savings, %		
	2030	2040	2050	2030	2040	2050	2030	2040	2050
BAU	4235,0	4196,7	4161,6	0,0	0,0	0,0	0,0%	0,0%	0,0%
PO1	4227,1	4187,3	4152,6	7,9	9,4	9,0	0,2%	0,2%	0,2%
PO2	4234,5	4196,3	4161,3	0,4	0,4	0,3	0,0%	0,0%	0,0%

It should be noted, that the largest savings are obtained by a combination of PO1 and PO2, and the savings may be larger than just the individual savings combined. Synergies can occur, so the effect is even larger.

Cumulative saving potentials, from 2020

As prescribed in the MEErP methodology the cumulative energy savings for each policy options are presented in the following tables. The percentage savings are similar to the annual savings shown above, however the absolute savings gives an overview of the total potential of the policy scenario over time, compared to the current Regulation (BAU).

Table 83: Cumulative energy savings from 2020 to 2030, 2040 and 2050, respectively, for each policy scenario

	Consumption, PJ			Savings, PJ			Savings, %		
	2030	2040	2050	2030	2040	2050	2030	2040	2050
BAU	11.512	19.835	26.860	-	-	-	-	-	-
PO1	11.316	19.317	26.013	196	518	846	1,7%	2,6%	3,2%
PO2	11.498	19.806	26.817	14	29	43	0,1%	0,1%	0,2%

Table 84: Cumulative CO2 savings from 2020 to 2030, 2040 and 2050, respectively, for each policy scenario

	Emissions, MT CO_2-eq			Savings, MT CO_2-eq			Savings, %		
	2030	2040	2050	2030	2040	2050	2030	2040	2050
BAU	565	938	1.235	-	-	-	-	-	-
PO1	555	915	1.199	9	23	37	1,6%	2,5%	3,0%
PO2	564	937	1.233	1	1	2	0,1%	0,1%	0,2%

Table 85: Cumulative user expenditure savings from 2020 to 2030, 2040 and 2050, respectively, for each policy scenario

	Expenditure, mill. €			Savings, mill. €			Savings, %		
	2030	2040	2050	2030	2040	2050	2030	2040	2050
BAU	47.573	89.715	131.477	-	-	-	-	-	-
PO1	47.519	89.569	131.240	54	146	238	0,1%	0,2%	0,2%
PO2	47.570	89.707	131.465	4	8	12	0,0%	0,0%	0,0%

7.2 Conclusions and recommendations

Based on the outcomes of the analyses in this report, it is recommended to change the scope in the regulation to avoid loopholes and grey areas, and especially to set information requirements for heaters sold without controls, in order to increase the overall energy efficiency of local space heaters installed in European homes. In other words, it is recommended to follow Policy Option 1, as modelled in the above section, with the scope and definition changes recommended in task 1.

Furthermore, the changes in expressions in Policy Option 3 are recommended in order to clarify the regulation where there are grey areas related to the calculations, except for changing the calculation and information for commercial heaters given according to the output.

It is not, however, recommended to implement the additional control factors from Policy Option 2, since the saving potential is quite small, and it is highly uncertain whether the suggested control function will actually lead to real-life energy savings.

7.2.1 Policy option 1

The suggested changes to the scope and definitions in Policy Option 1 were recognised by the far majority of stakeholders to be improvements to the regulation and to be necessary. Only one stakeholder expressed concerned regarding the timing, since adding for example the new category of closed fronted / open combustion gas and liquid fuel heaters might require additional testing by manufacturers. However, additional time can be given by setting an implementation date sometime in the future, giving the manufacturers time to adapt.

7.2.2 Policy option 2

Regarding policy option 2, stakeholders generally opposed the idea of introducing the new correction factors accuracy and automation. For gas and liquid fuel local space heaters, the concern is primarily that controls offering higher accuracy and automation are not available, especially for the type of heaters that are not sold with advanced electronic controls. Especially when the F(3) factors are added at the expense of F(2) factor for week timer (which is actually possible for gas appliances), the suggestion reinforces the requirements for gas heater to an extend where many products would not linger be able to fulfil the requirements.

For all heater types, it is also argued by multiple stakeholders that the changes in correction factors is premature, in the sense that the market has not yet fully adjusted to the existing ecodesign regulation. Any addition of correction factors implies decreasing the percentage-points given to existing correction factors, and is de facto a reinforcement of the regulation. This is also the case in policy option 2, where the addition of the new F(3) factors mean a subsequent decrease of the F(2) factor for the week timer. The early review of the regulation (the review study began before the regulation entered into force), also means that any reinforcement of the regulation will be early compared to other regulations.

According to several manufacturers and organisations, they are still only getting up to date with the current regulation.

Furthermore, the saving potentials related to the suggested new F(3) factors are highly uncertain. It depends on whether the end users actually use these functions as intended and adjusts the set point accordingly (e.g. a lower set point due to higher control accuracy) and not just increase the comfort for the same amount of energy consumed. It is therefore also uncertain that the additional costs of more advanced controls will actually be counteracted by the energy savings. Hence, there is a higher certainty that energy savings will be obtained with a week timer F(2) than with the new suggested functions, and it can therefore be argued that the current level of F(2) should be maintained. The high uncertainty of the energy savings related to the automatic programming is related to the possible overlaps with other control options, such as presence detection or week timer.

Besides the low energy saving potentials and the early reinforcement of requirements, it is also stated that the reinforcement is not equally distributed for all the local space heater types. For example, policy option 2 will not change the fact that portable electric local space heaters can still obtain ecodesign compliance with a mechanical control only. Since these appliances are already significantly cheaper than most fixed appliances, it is therefore not recommended to further divide the market by reinforcing the requirements for fixed electrical heaters without a simultaneous reinforcement of the requirements for portable electric heaters.

In order to avoid legislative confusion disrupting the market further, it is thus not suggested to follow Policy Option 2.

7.2.3 Policy option 3

Of the suggestions in policy option 3 it is recommended to clarify the formulas for calculating the correction factor F(1) for commercial local space heaters by replacing 30% and 40% with 0,3 and 0,4 for two-stage and modulating controls, respectively. It is also recommended to clarify the limits to avoid any risk of negative numbers resulting from the calculation.

It is not recommended to change that emissions and efficiency is calculated for commercial local space eaters expressed by heat output. This would require changes throughout the calculations related to emissions and efficiency for commercial local space heaters as well as for the information requirements.

Furthermore, it is suggested to change the formula and threshold values for the low power modes for electric local space heaters in order to include idle, off and standby modes and to make the calculation independent of the compliance with the standby regulation.

8. Annex A – Existing legislation

Regulation (EU) No 305/2011 – Construction Products Regulation

The Construction Products, Regulation (CPR) lays down harmonised rules for the marketing of construction products in the EU, including heating products. The conformity assessment and verification used in the CPR is fundamentally different from that in the Ecodesign Regulation. The CPR requires that the testing shall be accomplished by a Notified Body from the EU NANDO (New Approach Notified and Designated Organisations Information System) list of officially appointed Notified Bodies[201]. This means that the manufacturer cannot self-declare or perform the conformity assessment by themselves but need to have the product tested (initial type testing) by a Notified Body before putting the product on the market. There are 693 Notified bodies in the EU related to CPR[202], of which around 45-50 are notified for solid fuel heaters[203].

EU Regulation 1907/2006/EC - REACH Regulation [204]

The Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) addresses chemicals, and their safe use, and aims to improve the protection of human health and the environment through a system of Registration, Evaluation, Authorisation and Restriction of Chemicals. The REACH Regulation places greater responsibility on industry to manage the risks from the chemicals they manufacture, import and market in the EU. Companies are required to demonstrate how substances can be used safely and risk management measures must be reported to users. The REACH Regulation also establishes procedures for collecting and assessing information on the properties and hazards of substances and requires that companies register their substances in a central database. The entries in the database are then assessed to determine whether the risks of the substances can be managed. The REACH Regulation allows for some chemicals to be determined "substances of very high concern (SVHC)" due to their large potential negative impacts on human health or the environment. The European Chemicals Agency must be notified of the presence of SVHCs in certain products and the use of SVHCs may then be subject to prior authorisation. Substances can also be banned were risks are deemed to be unmanageable. As such, REACH encourages substitution of the most dangerous chemicals when suitable alternatives have been identified.

[201] http://ec.europa.eu/growth/tools-databases/nando/index.cfm?fuseaction=directive.notifiedbody&dir_id=33
[202] http://ec.europa.eu/growth/tools-databases/nando/index.cfm?fuseaction=directive.notifiedbody&dir_id=33
[203] http://ec.europa.eu/growth/tools-databases/nando/index.cfm?fuseaction=directive.notifiedbody&dir_id=33
[204] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006R1907-20140410&from=EN

As REACH applies to all chemical substances, which implies that it also covers the chemicals that are used in local space heaters that are within scope of this review project.

EU Directive 2011/65/EU - RoHS Directive[205]

The Restriction of Hazardous Substances (RoHS) Directive aims to reduce hazardous substances from electrical and electronic equipment (EEE) that is placed on the EU market. A number of hazardous substances are listed in the Directive along with maximum concentration values that must be met. The RoHS Directive does contain some exemptions where it has been decided that it may not be possible to manufacture some products without the use of one or more of the banned substances.

EU Directive 2006/42/EC - Machinery Directive[206]

The Directive has the dual aim of harmonising the health and safety requirements applicable to machinery on the basis of a high level of protection of health and safety, while ensuring the free circulation of machinery on the EU market. The revised Machinery Directive does not introduce radical changes compared with the previous versions. It clarifies and consolidates the provisions of the Directive with the aim of improving its practical application. This directive applies to products which are not residential

EU Directive 2006/95/EC - Low Voltage Directive [207]

The Low Voltage Directive (LVD) ensures that electrical equipment that operates within certain voltage limits, provides a high level of protection. The LVD Directive covers all health and safety risks of electrical equipment operating with a voltage of between 50 and 1000 volts for alternating current and between 75 and 1500 volts for direct current. Consumer goods with a voltage below 50 for alternating current or 75 for direct current are covered by the General Product Safety Directive (GPSD) (2001/95/EC).

The new Low Voltage Directive (2014/35/EU) will come into force on the 20th April 2016.208

Most local space heaters that are within scope of this review study would fall under the scope of the LVD Directive.

EU Directive 2012/19/EU - WEEE Directive [209]

The Waste Electrical and Electronic Equipment (WEEE) Directive implements the principle of "extended producer responsibility" where producers of EEE are expected to take responsibility for the environmental impact of their products at the end of life. As such, the WEEE Directive aims to reduce environmental impacts through setting targets for the

[205] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011L0065&from=EN
[206] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006L0042-20160420&from=EN
[207] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:374:0010:0019:en:PDF
[208] http://ec.europa.eu/growth/sectors/electrical-engineering/directives/index_en.htm
[209] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0019&from=EN

separate collection, reuse, recovery, recycling and environmentally sound disposal of WEEE.

As EEE (Electrical and Electronic Equipment), electric local space heaters fall under the scope of the WEEE Directive. Ecodesign requirements for local space heaters could therefore be used to assist the WEEE Directive aims via the introduction of product design requirements that enhance reuse, material recovery and effective recycling.

EU Regulation 1275/2008/EU - Ecodesign Requirements for standby and off mode, and networked standby, electric power consumption of electrical and electronic household and office equipment[210]

EU ecodesign requirements are mandatory for all manufacturers and suppliers wishing to sell products consuming electric power in standby and off mode in the EU. A wide range of equipment – computers, TVs, audio and video equipment, dishwashers, microwave ovens, and electric toys – can have standby modes so the regulation covers a wide range of products. The complete list of products is presented in annex 1 in the regulation. The requirements for products listed in annex 1 is:

- Standby and off mode ≤ 0,5 Watts
- Standby with display ≤ 1 Watts
- Networked standby ≤ 3 Watts
- HiNA (High Network Availability) equipment ≤ 8 Watts

It should be noted that local space heaters are not included in the standby regulation but the requirements for standby and off modes are indirectly included in Regulation 2015/1188 as the factor α. If the product complies with the limit values set in Regulation 1275/2008 the α factor is by default 0.

Note that Regulation (EU) 2015/1188 considers off mode and standby mode which have the limits shown in Table 86, but that network standby is not included in the Regulation.

The Regulation for standby is under review and will normally be adopted in November 2018. The review of Regulation (EU) 2015/1188 will take into account the new provisions if anything relevant.

[210] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008R1275-20170109&from=EN

Table 86: Limit values for off mode and standby mode in Regulation 1275/2008

	Description	Limit values
Off mode	Power consumption of equipment in any off-mode condition	0,5 W
Standby mode	Power consumption of equipment in any condition providing only a reactivation function, or providing only a reactivation function and a mere indication of enabled reactivation function	0,5 W
	Power consumption of equipment in any condition providing only information or status display, or providing only a combination of a reactivation function and information or status display	1 W

EU Directive 2010/31 – Energy Performance of Buildings[211]

Buildings are responsible for 40% of energy consumption and 36% of CO_2 emissions in the EU. The Energy Performance of Buildings Directive sets minimum efficiency standards for residential and commercial buildings that should be implemented through national legislation in all Member States. It also proposes a general framework for a methodology for calculating the integrated energy performance for buildings which includes HVAC and hot water systems, lighting, building shell, outdoor climate, etc. The local space heaters are not directly mentioned in the scope, but butter insulation of buildings will also have a positive impact on the energy consumption of local space heaters.

Directive 2009/28 – Promotion of renewable energy[212]

The Renewable Energy Directive establishes an overall policy for the production and promotion of energy from renewable sources in the EU. It requires the EU to fulfil at least 20% of its total energy needs with renewables by 2020 – to be achieved through the attainment of individual national targets. Each Member State shall adopt a national renewable energy action plan. The national renewable energy action plans shall set out Member States' national targets for the share of energy from renewable sources consumed in transport, electricity and heating and cooling in 2020, taking into account the effects of other policy measures relating to energy efficiency on final consumption of energy. The electricity mix is of great importance for electric local space heaters. As more energy is renewable the primary energy factor needs to be updated at some point. The effect of more renewable energy is less impacts of electric local space heaters.

EU Directive 2018/2001 – The revised Renewable Energy EU Directive[213]

The revised Renewable Energy EU Directive 2018/2001 establishes a binding EU target of at least 32% for 2030 with a review for increasing this figure in 2023. The rules serve also

[211] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&from=EN
[212] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=EN
[213] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

to create an enabling environment to accelerate public and private investment in innovation and modernisation in all key sectors. It aims to provide guiding principles on financial support schemes for RES, renewable energy self-consumption, energy communities and district heating. It seeks to enhance mechanisms for cross-border cooperation, simplify administrative processes, strengthen the sustainability and greenhouse gas emissions-savings criteria for biofuels, and mainstream the use of RES in the transport sector and in the heating and cooling sector.

EU Directive 2018/2002[214] amending EU Directive 2012/27 on energy efficiency

The revised Energy Efficiency Directive (EU) 2018/2002 sets a 2030 target of 32.5%, with a possible upward revision in 2023. This means that EU countries must put measures in place to save on average 4.4% of their annual energy consumption between now and 2030. The aim of the revised directive will ensure more efficient use of energy and lead to:

- reduced energy consumption for households and businesses
- lower consumption, making Europe less reliance on energy imports
- incentives for producers/manufacturers to use new technologies and innovate
- more investment, for example in the building sector, thereby creating jobs
- clearer information in household bills

The new Governance Regulation (EU) 2018/1999 includes the requirement for Member States to draw up integrated National Energy and Climate Plans for 2021 to 2030 outlining how to achieve the targets and submit the draft to the European Commission by the end of 2018. The overall goals of the new regulation are:

- to implement strategies and measures which ensure that the objectives of the energy union, in particular the EU's 2030 energy and climate targets, and the long-term EU greenhouse gas emissions commitments are consistent with the Paris agreement.
- to stimulate cooperation between Member States in order to achieve the objectives and targets of the energy union
- to promote long-term certainty and predictability for investors across the EU and foster jobs, growth and social cohesion
- to reduce administrative burdens, in line with the principle of better regulation. This was done by integrating and streamlining most of the current energy and climate planning and reporting requirements of EU countries as well as the Commission's monitoring obligations

[214] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2002&from=EN

- to ensure consistent reporting by the EU and its Member States under the UN Framework Convention on Climate Change and the Paris agreement, replacing the existing monitoring and reporting system from 2021 onwards.

9. Annex B – Existing standards

9.1 Standards for gas heaters

EN 1266:2002 Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases

This standard covers independent convection heaters, burning gas having a fan to assist the transportation of combustion air and/or flue gases. Requirements and test methods relates to the construction, safety, fitness for purpose, rational use of energy, classification and marking

EN 449:2002+A1:2007: Specification for dedicated liquefied petroleum gas appliances - Domestic flueless space heaters (including diffusive catalytic combustion heaters)

This standard covers domestic flueless space heaters, including diffusive catalytic combustion heaters, having a nominal heat input (Hs), not exceeding 4,2 kW burning 3rd family gases at nominal operating pressures not exceeding 50 mbar.

Other standards covering flueless dedicated liquefied petroleum heaters are EN 461:2004 and EN 1596:2004. EN 461:2004 covers non-domestic space heaters not exceeding 10 kW and EN 1596:2004 covers mobile and portable non-domestic forced convection direct fired air heaters.

EN 14829:2007 Independent gas-fired flueless space heaters for nominal heat input not exceeding 6 kW

This standard covers domestic flueless space heating appliances having a nominal input not exceeding 6 kW (based on net calorific value). It does not cover mobile heaters, portable flueless heaters or diffusive catalytic combustion heaters. All the heat produced by the combustion process is released into the space to be heated.

9.2 Existing standards for liquid heaters

EN 13842:2004 Oil fired forced convection air heaters - Stationary and transportable for space heating

This standard covers stationary and portable oil-fired air heaters using only forced draught oil burners. It also applies to appliances intended for outdoor installation. Provision of the heated air may be by means of ducting or may be directly into the heated space. This standard does not apply to appliances intended for use in a single unit residential dwelling, appliances of the condensing type, appliances with atmospheric burners without a fan to assist the transportation of combustion air, dual purpose air conditioning appliances (heating and cooling), appliances where the air is heated by an intermediate fluid, appliances fitted with manual or automatic flue dampers, appliances having multiple heating units with a single flue, appliances fitted with more than one flue outlet.

9.3 Other existing standards

EN 15456:2008-06 Heating boilers - Electrical power consumption for heat generators - System boundaries - Measurements

This standard applies to heating boilers (e.g. with forced-draught burners (unit)) and burners equipped with a fan including all components specified by the manufacturer to be required for the designed boiler operation. The standard covers the required definitions, the system boundaries, the measurements for the determination of the electrical power consumption and, where applicable, the water side resistance in order to establish the electric auxiliary energy.

The standard refers to flued oil stoves with vaporizing burners in accordance with EN 1 which are in scope of Regulation (EU) 1188/2015, but the standard is also referred to in the transitional methods (2017/C 076/02) for the gaseous fired local space heaters.

10. Annex C – Modules of Decision 768/2008/EC

Several options exist for conformity assessment, both with and without third party involvement, as defined by Decision 768/2008/EC. Figure 32 outlines the modules and combination of modules that can be required for the manufacturer to obtain CE marking of their product.

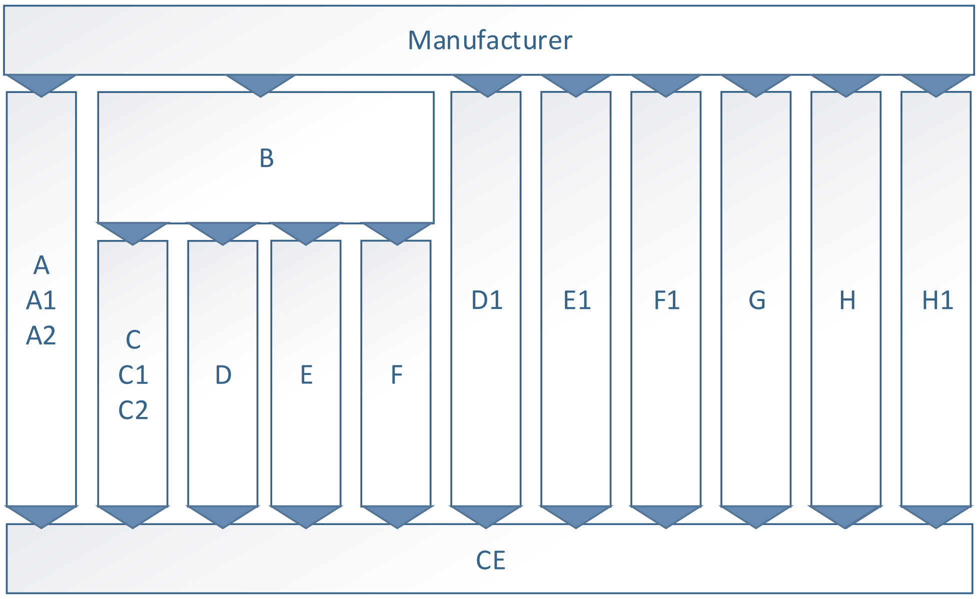


Figure 32: Possible modules and combination of modules for conformity assessment

Module A – Internal production control

- Covers both design and production
- The manufacturer ensures conformity of the products to the legislative requirements
- The manufacturer affixes required conformity marking (CE mark)

Module A1 – Internal production control + supervised product testing

- Covers both design and production
- Module A + tests on specific aspects of the product carried out by an accredited in-house body or notified body
- Possible to require the use of an accredited third party where this is felt necessary

Module A2 – Internal production control + supervised product checks at random intervals

- Covers both design and production
- Module A + product checks at random intervals carried out by an accredited in-house body or notified body
- Possible to require the use of an accredited third party where this is felt necessary

Module B – EU-type examination

- Covers design and is always followed by other modules

- The manufacturer submits technical documentation, supporting evidence for the adequacy of the technical design solution and a specimen (if required) of the product to a Notified Body
- The Notified Body examines the technical design and/or the specimen of a type and verifies and attests that it meets the legislative requirements
- The Notified Body issues an EU-type examination certificate
- The EU-type examination can be carried out in three ways:
    - Production type
    - Combination of production type and design type
    - Design type

The three ways to carry out type examination allows for flexibility by including the options of examining only the technical documentation and/or critical parts of the specimen. This concept is designed to provide sufficient flexibility and to recognise relevant practice where the examination of the complete specimen "representative of the production envisaged" is either not economically viable or not necessary[215].

Module C – Conformity to type

- Covers production and follows module B
- The manufacturer ensures conformity of the products to the approved EU-type

Module C1 – Conformity to type + supervised product testing

- Covers production and follows module B
- Module C + tests on specific aspects of the product carried out by an accredited in-house body or notified body
- Possible to require the use of an accredited third party where this is felt necessary

Module C2 – Conformity to type + supervised product checks at random intervals

- Covers production and follows module B
- C + product checks at random intervals carried out by an accredited in-house body or notified body
- Possible to require the use of an accredited third party where this is felt necessary

Module D – Conformity to EU-type based on quality assurance of the production process

- Covers production and follows module B
- The manufacturer operates and approved quality system for production, final inspection and testing (E.g. EN ISO 9001)

[215] CERTIF doc. 2008-002 https://ec.europa.eu/docsroom/documents/6296/attachments/1/translations/en/renditions/pdf

- The manufacturer declares conformity with the EU-type
- The manufacturer affixes required conformity marking (CE mark)
- The notified body carries out surveillance and approves the quality system

Module E – Conformity to EU-type based on product quality assurance

- Covers production and follows module B
- The manufacturer operates and approved quality system final inspection and testing (E.g. EN ISO 9001)
- The manufacturer declares conformity with the EU-type
- The manufacturer affixes required conformity marking (CE mark)
- The notified body carries out surveillance and approves the quality system

The idea behind module E is similar to the one under module D: both are based on a quality system and follow module B. Their difference is that the quality system under module E aims to ensure the quality of the final product, while the quality system under module D (and D1 too) aims to ensure the quality of the whole production process (that includes the manufacturing part and the test of final product). E is thus similar to module D without the provisions relating to the manufacturing process.

Module F – Conformity to EU-type based on product verification

- Covers production and follows module B
- The manufacturer declares conformity with the EU-type
- The manufacturer affixes required conformity marking (CE mark)
- The Notified Body carries out product examinations (testing of every product or statistical checks) in order to control product conformity to EU-type
- The Notified Body issues a certificate of conformity
- Note: Module F is like C2 but the notified body carries out more systematic product checks

Module D1 – Quality assurance of the production process

- Covers both design and production
- Used like D without module B
- The manufacturer operates and approved quality system for production, final inspection and testing (E.g. EN ISO 9001)
- The manufacturer declares conformity with the legislative requirements
- The manufacturer affixes required conformity marking (CE mark)
- The notified body carries out surveillance and approves the quality system

Module E1 – Quality assurance of final product inspection and testing

- Covers both design and production
- Used like E without module B
- The manufacturer operates and approved quality system final inspection and testing (E.g. EN ISO 9001)
- The manufacturer declares conformity with the legislative requirements
- The manufacturer affixes required conformity marking (CE mark)
- The notified body carries out surveillance and approves the quality system

Module F1 – Conformity based on product verification

- Covers both design and production
- Used like F without module B
- The manufacturer ensures compliance of the manufactured products to the legislative requirements.
- The manufacturer affixes required conformity marking (CE mark)
- The Notified Body carries out product examinations (testing of every product or statistical checks) in order to control product conformity to EU-type
- The Notified Body issues a certificate of conformity
- Note: Module F1 is like A2 but the notified body carries out more detailed product checks

Module G – Conformity based on unit verification

- Covers both design and production
- The manufacturer submits technical documentation and product
- The manufacturer declares conformity with legislative requirements
- The manufacturer affixes required conformity marking (CE mark)
- The Notified Body The notified body verifies every individual product in order to ensure conformity to legislative requirements
- The Notified Body issues a certificate of conformity

Module H – Conformity based on full quality assurance

- Covers both design and production
- The manufacturer operates a full quality assurance system for design (EN ISO 9001) in order to ensure conformity to legislative requirements
- The manufacturer submits technical documentation
- The Notified Body carries out surveillance of the quality system

Module H1 – Conformity based on full quality assurance + design examination

- Covers both design and production
- The manufacturer operates a full quality assurance system for design (EN ISO 9001) in order to ensure conformity to legislative requirements
- The manufacturer submits technical documentation
- The Notified Body carries out surveillance of the quality system
- The Notified Body verifies conformity of the product design
- The Notified Body issues an EU-design examination certificate
- Note: Module H1 in comparison to module H provides in addition that the notified body carries out a more detailed examination of the product design

In the discussion preceding the current regulations, the terms "third party certification" and "third party verification" were used, but all the nuances of the different modules in Decision 768/2008 are not reflected in these terms. However, according to several of the stakeholders involved in these discussions, the primary difference between verification and certification, is that *verification* is a one-time type approval of the product type by a Notified Body, whereas *certification* is a continuous surveillance and approval of the product type.

11. Annex D – Sales of fixed electric local space heaters per person

Sales of fixed electric local space heaters per person in different countries. Based on Figure 13 in task 2.

Table 87: Sales of fixed electric local space heaters per person in different countries

Country	Population	Fixed electric local space heaters	Fixed electric local space heaters/person
Norway	5361039	357000	0,0666
France	65233271	4000000	0,0613
Sweden	9982709	150000	0,0150
Finland	5542517	80000	0,0144
Estonia	1306788	18000	0,0138
Latvia	1929938	21000	0,0109
Denmark	5754356	50000	0,0087
Czech Republic	10625250	80000	0,0075
Slovenia	2081260	15000	0,0072
Spain	46397452	245000	0,0053
U.K.	66573504	330000	0,0050
Lithuania	2876475	12000	0,0042
Austria	8751820	33000	0,0038
Croatia	4164783	15000	0,0036
Belgium	11498519	38000	0,0033
Poland	38104832	121000	0,0032
Portugal	10291196	32000	0,0031
Hungary	9688847	23000	0,0024
Bulgaria	7036848	15000	0,0021
Slovakia	5449816	8000	0,0015
Greece	11142161	15000	0,0013
Netherlands	17084459	20000	0,0012
Germany	82293457	60000	0,0007
Romania	19580634	12000	0,0006
Italy	59290969	7000	0,0001

12. Annex E – Development of heating degree days and assumptions on use regarding secondary and primary heating

In Table 88 the assumed development in heating degree days is presented.

Assumptions on use regarding secondary/primary heating and the full load hours are presented in Table 89.

Table 88: Development of heating degree days

	1990	2000	2010	2020	2030	2040	2050
Heating season (days)	265	229	198	171	148	128	110

Table 89: Assumptions on use regarding secondary/primary heating and the full load use hours

	Secondary heating	Primary Heating	Use hours	Use hours full load
Portable Electric	85%	15%	436	218
Fixed electric >250	0%	100%	1408	704
Fixed electric <250	0%	100%	1408	704
Electric storage heaters	0%	100%	469	235
Electric underfloor	50%	50%	836	418
Visibly glowing >1,2	50%	50%	836	418
Visibly glowing <1,2	50%	50%	836	418
Towel heaters	50%	50%	836	418
Gas luminous	0%	100%	1408	704
Gas tube	0%	100%	1408	704
Gas open fronted	50%	50%	836	418
Gas closed fronted open combustion	50%	50%	836	418
Gas balanced	50%	50%	264	418
Gas flueless	100%	0%	264	132
Gas open to chimney	100%	0%	1408	132
Liquid luminous	0%	100%	1408	704
Liquid tube	0%	100%	836	704
Liquid open fronted	50%	50%	836	418
Liquid closed fronted open combustion	50%	50%	836	418
Liquid balanced	50%	50%	836	418
Liquid flueless	100%	0%	264	132
Liquid open to chimney	100%	0%	264	132

13. Annex F - Impacts over a lifetime of local space heaters calculated in the EcoReport Tool

All the impacts over a lifetime of local space heaters calculated in the EcoReport Tool in connection with Task 5 are presented in Table 90 to Table 104 below.

Electric heaters

Table 90: All impact categories for portable heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	274	37	146	16.759	7	-61	17.161
of which. electricity (MJ)	129	22	0	16.757	0	-27	16.882
Water – process (litre)	40	0	0	0	0	-8	32
Water – cooling (litre)	177	10	0	746	0	-36	899
Waste. non-haz./landfill (g)	366	119	124	8.639	16	-94	9.169
Waste. hazardous/ incinerated (g)	21	0	2	265	0	-4	283
Emissions (Air)							
GWP100 (kg CO_2.eq)	16	2	11	715	0	-4	741
Acidification (g SO_2-eq.)	129	9	32	3.166	0	-33	3.303
VOC (g)	0	0	1	374	0	0	375
Persistent Organic Pollutants (ng i-Teq)	3	0	1	39	0	-1	42
Heavy Metals (mg Ni eq.)	34	1	6	170	0	-8	203
PAHs (mg Ni eq.)	14	0	4	39	0	-5	53
Particulate Matter (g)	62	1	103	68	2	-14	223
Emissions (Water)							
Heavy Metals (mg Hg/20)	52	0	0	73	0	-14	111
Eutrophication (g PO_4)	1	0	0	3	0	0	5

Table 91: All impact categories for fixed heaters above 250W. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	475	38	192	90.847	8	-137	91.424
of which. electricity (MJ)	162	23	0	90.844	0	-37	90.993
Water – process (litre)	50	0	0	1	0	-12	39
Water – cooling (litre)	251	11	0	4.040	0	-68	4.234
Waste. non-haz./landfill (g)	1.687	131	147	46.831	29	-601	48.223
Waste. hazardous/ incinerated (g)	23	0	3	1.434	0	-5	1.454
Emissions (Air)							
GWP100 (kg CO_2.eq)	28	2	14	3.878	0	-8	3.913
Acidification (g SO_2-eq.)	234	9	41	17.162	0	-73	17.373
VOC (g)	1	0	2	2.029	0	0	2.031
Persistent Organic Pollutants (ng i-Teq)	26	1	1	212	0	-10	230
Heavy Metals (mg Ni eq.)	58	2	7	919	0	-17	970
PAHs (mg Ni eq.)	36	0	6	212	0	-13	241
Particulate Matter (g)	127	1	233	365	3	-37	692
Emissions (Water)							
Heavy Metals (mg Hg/20)	58	0	0	783	0	-20	821
Eutrophication (g PO_4)	4	0	0	34	0	-1	37

Table 92: All impact categories for fixed heaters below 250W. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	77	10	131	48.513	1	-25	48.705
of which. electricity (MJ)	7	6	0	48.512	0	-2	48.523
Water – process (litre)	5	0	0	0	0	-1	3
Water – cooling (litre)	62	3	0	2.157	0	-17	2.205
Waste. non-haz./landfill (g)	383	33	116	25.004	5	-142	25.399
Waste. hazardous/ incinerated (g)	4	0	2	765	0	-1	771
Emissions (Air)							
GWP100 (kg CO_2.eq)	14	1	10	1.036	0	-4	1.056
Acidification (g SO_2-eq.)	114	2	29	4.583	0	-30	4.699
VOC (g)	0	0	0	542	0	0	543
Persistent Organic Pollutants (ng i-Teq)	7	0	1	57	0	-3	62
Heavy Metals (mg Ni eq.)	39	0	6	246	0	-9	282
PAHs (mg Ni eq.)	12	0	3	57	0	-4	68
Particulate Matter (g)	78	0	59	98	3	-19	219
Emissions (Water)							
Heavy Metals (mg Hg/20)	23	0	0	105	0	-7	121
Eutrophication (g PO_4)	1	0	0	5	0	0	5

Table 93: All impact categories for storage heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	2.401	75	278	86.689	50	-673	88.821
of which. electricity (MJ)	1.602	45	0	86.681	0	-417	87.911
Water – process (litre)	983	1	0	10	0	-264	729
Water – cooling (litre)	174	21	0	3.853	0	-63	3.985
Waste. non-haz./landfill (g)	11.319	247	190	44.774	215	-4.129	52.617
Waste. hazardous/ incinerated (g)	43	0	4	1.368	0	-11	1.404
Emissions (Air)							
GWP100 (kg CO_2.eq)	141	4	19	3.701	0	-41	3.824
Acidification (g SO_2-eq.)	576	18	58	16.376	2	-165	16.865
VOC (g)	5	0	3	1.936	0	-2	1.941
Persistent Organic Pollutants (ng i-Teq)	191	1	1	204	0	-72	325
Heavy Metals (mg Ni eq.)	127	2	10	878	1	-39	978
PAHs (mg Ni eq.)	35	0	9	203	0	-13	234
Particulate Matter (g)	516	3	479	352	6	-183	1.173
Emissions (Water)							
Heavy Metals (mg Hg/20)	65	0	0	374	0	-22	417
Eutrophication (g PO_4)	2	0	0	16	0	-1	18

Table 94: All impact categories for underfloor heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	444	130	146	160.492	8	-108	161.113
of which. electricity (MJ)	46	78	0	160.488	0	-10	160.602
Water – process (litre)	48	1	0	0	0	-10	39
Water – cooling (litre)	641	37	0	7.139	0	-134	7.683

Waste. non-haz./landfill (g)	617	418	124	82.711	35	-155	83.750
Waste. hazardous/ incinerated (g)	53	0	2	2.533	0	-12	2.577
Emissions (Air)							
GWP100 (kg CO_2-eq)	28	7	11	6.851	0	-7	6.890
Acidification (g SO_2-eq.)	209	31	32	30.316	0	-63	30.527
VOC (g)	0	0	1	3.584	0	0	3.585
Persistent Organic Pollutants (ng i-Teq)	3	1	1	374	0	-1	378
Heavy Metals (mg Ni eq.)	17	2	6	1.623	0	-6	1.641
PAHs (mg Ni eq.)	31	0	4	375	0	-11	398
Particulate Matter (g)	21	5	103	642	0	-6	766
Emissions (Water)							
Heavy Metals (mg Hg/20)	160	0	0	692	0	-44	809
Eutrophication (g PO_4)	5	0	0	30	0	-1	35

Table 95: All impact categories for visible glowing heaters above 1.2kW. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	548	73	182	61.538	14	-123	62.233
of which. electricity (MJ)	258	44	0	61.535	0	-54	61.784
Water – process (litre)	80	1	0	1	0	-17	65
Water – cooling (litre)	355	21	0	2.738	0	-71	3.043
Waste. non-haz./landfill (g)	731	237	142	31.717	32	-187	32.673
Waste. hazardous/ incinerated (g)	41	0	3	971	0	-9	1.007
Emissions (Air)							
GWP100 (kg CO_2-eq)	32	4	13	2.627	0	-7	2.669
Acidification (g SO_2-eq.)	258	18	39	11.625	1	-67	11.875
VOC (g)	1	0	1	1.374	0	0	1.376
Persistent Organic Pollutants (ng i-Teq)	5	1	1	144	0	-2	149
Heavy Metals (mg Ni eq.)	68	1	7	623	1	-16	683
PAHs (mg Ni eq.)	28	0	5	144	0	-9	168
Particulate Matter (g)	124	3	206	247	5	-27	557
Emissions (Water)							
Heavy Metals (mg Hg/20)	104	0	0	266	0	-28	342
Eutrophication (g PO_4)	3	0	0	12	0	-1	14

Table 96: All impact categories for visible glowing heaters below 1.2kW. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	274	37	146	36.823	7	-61	37.225
of which. electricity (MJ)	129	22	0	36.821	0	-27	36.946
Water – process (litre)	40	0	0	0	0	-8	32
Water – cooling (litre)	177	10	0	1.638	0	-36	1.791
Waste. non-haz./landfill (g)	366	119	124	18.978	16	-94	19.509
Waste. hazardous/ incinerated (g)	21	0	2	581	0	-4	600
Emissions (Air)							
GWP100 (kg CO_2-eq)	16	2	11	1.572	0	-4	1.597
Acidification (g SO_2-eq.)	129	9	32	6.956	0	-33	7.093
VOC (g)	0	0	1	822	0	0	823
Persistent Organic Pollutants (ng i-Teq)	3	0	1	86	0	-1	89
Heavy Metals (mg Ni eq.)	34	1	6	373	0	-8	406

PAHs (mg Ni eq.)	14	0	4	86	0	-5	99
Particulate Matter (g)	62	1	103	148	2	-14	303
			Emissions (Water)				
Heavy Metals (mg Hg/20)	52	0	0	159	0	-14	197
Eutrophication (g PO_4)	1	0	0	7	0	0	8

Table 97: All impact categories for towel heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
			Other Resources & Waste				
Total Energy (MJ)	475	38	192	36.448	8	-137	37.024
of which. electricity (MJ)	162	23	0	36.444	0	-37	36.593
Water – process (litre)	50	0	0	1	0	-12	39
Water – cooling (litre)	251	11	0	1.622	0	-68	1.816
Waste. non-haz./landfill (g)	1.687	131	147	18.797	29	-601	20.189
Waste. hazardous/ incinerated (g)	23	0	3	575	0	-5	595
			Emissions (Air)				
GWP100 (kg CO_2.eq)	28	2	14	1.556	0	-8	1.591
Acidification (g SO_2-eq.)	234	9	41	6.886	0	-73	7.097
VOC (g)	1	0	2	814	0	0	816
Persistent Organic Pollutants (ng i-Teq)	26	1	1	85	0	-10	103
Heavy Metals (mg Ni eq.)	58	2	7	369	0	-17	420
PAHs (mg Ni eq.)	36	0	6	85	0	-13	114
Particulate Matter (g)	127	1	233	147	3	-37	474
			Emissions (Water)				
Heavy Metals (mg Hg/20)	66	0	0	158	0	-22	203
Eutrophication (g PO_4)	4	0	0	7	0	-1	10

Gas/liquid heaters

Table 98: All impact categories for open combustion/open fronted with exhaust restriction heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
			Other Resources & Waste				
Total Energy (MJ)	626	48	152	307.740	4	-228	308.343
of which. electricity (MJ)	98	29	0	1	0	-29	99
Water – process (litre)	51	0	0	-4.351	0	-17	-4.317
Water – cooling (litre)	357	13	0	4	0	-134	239
Waste. non-haz./landfill (g)	6.190	166	127	62	72	-2.363	4.254
Waste. hazardous/ incinerated (g)	18	0	3	0	0	-6	15
			Emissions (Air)				
GWP100 (kg CO_2.eq)	42	3	11	17.014	0	-16	17.055
Acidification (g SO_2-eq.)	273	12	33	4.958	0	-100	5.176
VOC (g)	2	0	1	224	0	-1	226
Persistent Organic Pollutants (ng i-Teq)	111	1	1	1	0	-43	71
Heavy Metals (mg Ni eq.)	70	2	6	1	0	-25	55
PAHs (mg Ni eq.)	42	0	4	9	0	-16	40
Particulate Matter (g)	289	2	120	89	2	-107	395
			Emissions (Water)				
Heavy Metals (mg Hg/20)	72	0	0	1	0	-27	46
Eutrophication (g PO_4)	8	0	0	0	0	-3	5

Table 99: All impact categories for open combustion/closed fronted heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	626	48	152	229.162	4	-228	229.764
of which. electricity (MJ)	98	29	0	1	0	-29	99
Water – process (litre)	51	0	0	-3.240	0	-17	-3.205
Water – cooling (litre)	357	13	0	4	0	-134	239
Waste. non-haz./landfill (g)	6.190	166	127	62	72	-2.363	4.254
Waste. hazardous/ incinerated (g)	18	0	3	0	0	-6	15
Emissions (Air)							
GWP100 (kg CO_2.eq)	42	3	11	12.670	0	-16	12.710
Acidification (g SO_2-eq.)	273	12	33	3.693	0	-100	3.911
VOC (g)	2	0	1	167	0	-1	169
Persistent Organic Pollutants (ng i-Teq)	111	1	1	1	0	-43	71
Heavy Metals (mg Ni eq.)	70	2	6	1	0	-25	55
PAHs (mg Ni eq.)	42	0	4	7	0	-16	37
Particulate Matter (g)	289	2	120	67	2	-107	373
Emissions (Water)							
Heavy Metals (mg Hg/20)	72	0	0	1	0	-27	46
Eutrophication (g PO_4)	8	0	0	0	0	-3	5

Table 100: All impact categories for balanced flue heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	626	48	152	185.808	4	-228	186.410
of which. electricity (MJ)	98	29	0	1	0	-29	99
Water – process (litre)	51	0	0	-2.627	0	-17	-2.592
Water – cooling (litre)	357	13	0	4	0	-134	239
Waste. non-haz./landfill (g)	6.190	166	127	62	72	-2.363	4.254
Waste. hazardous/ incinerated (g)	18	0	3	0	0	-6	15
Emissions (Air)							
GWP100 (kg CO_2.eq)	42	3	11	10.273	0	-16	10.314
Acidification (g SO_2-eq.)	273	12	33	2.995	0	-100	3.213
VOC (g)	2	0	1	135	0	-1	138
Persistent Organic Pollutants (ng i-Teq)	111	1	1	1	0	-43	71
Heavy Metals (mg Ni eq.)	70	2	6	1	0	-25	55
PAHs (mg Ni eq.)	42	0	4	6	0	-16	36
Particulate Matter (g)	289	2	120	55	2	-107	361
Emissions (Water)							
Heavy Metals (mg Hg/20)	72	0	0	1	0	-27	46
Eutrophication (g PO_4)	8	0	0	0	0	-3	5

Table 101: All impact categories for flueless heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	313	24	131	50.351	2	-114	50.708
of which. electricity (MJ)	49	14	0	0	0	-14	49
Water – process (litre)	26	0	0	-712	0	-9	-695
Water – cooling (litre)	178	7	0	2	0	-67	120

Waste. non-haz./landfill (g)	3.095	83	117	31	36	-1.181	2.180
Waste. hazardous/ incinerated (g)	9	0	2	0	0	-3	8
Emissions (Air)							
GWP100 (kg CO_2-eq)	21	1	10	2.784	0	-8	2.808
Acidification (g SO_2-eq.)	137	6	29	812	0	-50	934
VOC (g)	1	0	0	37	0	0	38
Persistent Organic Pollutants (ng i-Teq)	56	1	1	1	0	-21	36
Heavy Metals (mg Ni eq.)	35	1	6	0	0	-13	30
PAHs (mg Ni eq.)	21	0	3	2	0	-8	18
Particulate Matter (g)	145	1	60	16	1	-54	169
Emissions (Water)							
Heavy Metals (mg Hg/20)	36	0	0	0	0	-13	23
Eutrophication (g PO_4)	4	0	0	0	0	-1	3

Table 102: All impact categories for open to chimney heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	314	25	131	34.204	2	-114	34.563
of which. electricity (MJ)	49	15	0	0	0	-14	50
Water – process (litre)	26	0	0	-483	0	-9	-466
Water – cooling (litre)	180	7	0	2	0	-67	122
Waste. non-haz./landfill (g)	3.096	84	117	31	36	-1.181	2.183
Waste. hazardous/ incinerated (g)	9	0	2	0	0	-3	9
Emissions (Air)							
GWP100 (kg CO_2-eq)	21	1	10	1.891	0	-8	1.916
Acidification (g SO_2-eq.)	137	6	29	552	0	-50	674
VOC (g)	1	0	0	25	0	0	26
Persistent Organic Pollutants (ng i-Teq)	56	1	1	1	0	-21	36
Heavy Metals (mg Ni eq.)	35	1	6	0	0	-13	30
PAHs (mg Ni eq.)	21	0	3	1	0	-8	18
Particulate Matter (g)	145	1	60	11	1	-54	164
Emissions (Water)							
Heavy Metals (mg Hg/20)	36	0	0	0	0	-13	23
Eutrophication (g PO_4)	4	0	0	0	0	-1	3

Commercial heaters

Table 103: All impact categories for luminous heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	1.378	37	350	921.085	32	-367	922.515
of which. electricity (MJ)	800	22	1	8	0	-176	655
Water – process (litre)	221	0	0	-13.022	0	-53	-12.854
Water – cooling (litre)	383	11	0	4	0	-145	253
Waste. non-haz./landfill (g)	6.612	117	226	66	102	-2.386	4.738
Waste. hazardous/ incinerated (g)	56	0	4	1	0	-15	47
Emissions (Air)							
GWP100 (kg CO_2-eq)	84	2	24	50.925	0	-23	51.011
Acidification (g SO_2-eq.)	508	9	72	14.837	2	-124	15.303
VOC (g)	4	0	4	671	0	-1	678
Persistent Organic Pollutants (ng i-Teq)	107	0	1	1	0	-40	69

Heavy Metals (mg Ni eq.)	206	0	11	2	2	-49	172
PAHs (mg Ni eq.)	21	0	12	26	0	-4	54
Particulate Matter (g)	579	1	684	263	15	-164	1.379
Emissions (Water)							
Heavy Metals (mg Hg/20)	58	0	0	1	0	-15	45
Eutrophication (g PO_4)	9	0	0	0	0	-3	6

Table 104: All impact categories for tube heaters. The life cycle phase with the highest impact for each of the categories is highlighted with red text.

	Material	Manufacturing	Distribution	Use	Disposal	Recycling	Total
Other Resources & Waste							
Total Energy (MJ)	6.294	174	1.310	1.992.072	144	-1.689	1.998.305
of which. electricity (MJ)	3.601	104	3	36	0	-794	2.950
Water – process (litre)	994	2	0	-28.157	0	-240	-27.401
Water – cooling (litre)	1.724	49	0	17	0	-650	1.140
Waste. non-haz./landfill (g)	29.870	555	706	299	462	-10.782	21.109
Waste. hazardous/ incinerated (g)	252	0	14	3	0	-66	203
Emissions (Air)							
GWP100 (kg CO_2-eq)	383	10	85	110.138	1	-106	110.509
Acidification (g SO_2-eq.)	2.398	42	259	32.100	9	-602	34.205
VOC (g)	17	0	21	1.451	0	-5	1.484
Persistent Organic Pollutants (ng i-Teq)	484	1	4	5	0	-182	312
Heavy Metals (mg Ni eq.)	945	2	36	9	7	-227	773
PAHs (mg Ni eq.)	125	0	47	57	0	-32	198
Particulate Matter (g)	2.611	6	3.419	583	68	-741	5.947
Emissions (Water)							
Heavy Metals (mg Hg/20)	303	0	1	3	1	-82	225
Eutrophication (g PO_4)	40	0	0	0	1	-15	27

14. Annex G – Preliminary Better Regulation evaluation

The purpose of this section is to evaluate the effect of the current Ecodesign Regulation for local space heaters, and compare the results obtained so far with the expectations in the impact assessment. In addition, it is analysed how well the regulations have been able to solve the market failures identified in the impact assessment.

The evaluation will focus on answering questions based on the official template[216] and the Better Regulation Toolbox[217] under the following headlines:

- Effectiveness of the regulations. What has been the impact of the regulations so far and have the objectives of the policy measures been achieved?
- Efficiency of the regulations. Has the regulation been cost effective and are the costs justified?
- Relevance of the regulation. Are the regulations still relevant and have the original objectives been appropriate?

Since the Regulation entered into force less than one year before this review study (in 1 January 2018), the effect on the market is not reflected in the accessible data yet. Therefore this a full evaluation cannot be performed at this point in time and this preliminary evaluation builds on a number of important assumptions. Most important it is assumed that all products in scope Regulation EU 2015/1188 are compliant from 2018, but that efficiencies do not exceed the minimum requirements. This is based on information form stakeholders stating that all of their products will be compliant by 2018. Products sold as slave heaters are not assumed to be compliant but to follow the BAU energy efficiency development.

The regulation evaluated is the Ecodesign Regulation for local space heaters, Regulation EU 2015/1188. The aim of the regulation was to accelerate market transformation towards energy-efficient technologies, as it was found that there was a lack of Community incentives to reduce the energy consumption and the emissions to air of local space heaters during use[218]. The ecodesign requirements were intended to harmonise energy consumption and nitrogen oxides emission requirements for local space heaters throughout the Union, for the internal market to operate better and in order to improve the environmental performance of those products[219].

[216] https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-47_en_0.pdf
[217] https://ec.europa.eu/info/files/better-regulation-toolbox-47_en
[218] Commission Staff Working Document, Impact Assessment with regard to ecodesign requirements for local space heaters, SWD(2015) 91 final http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/swd_2015_0091_en.pdf
[219] Regulation 2015/188, OJ L 193, 21.7.2015, p. 76–99, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015R1188

According to the current Ecodesign Regulation the annual electricity consumption of local space heaters covered by the regulation was 1673 PJ in the Union in 2010 corresponding to 75,3 Mt of CO_2 emissions. Without the regulation the annual electricity consumption was predicted to be 1630 PJ in 2020 corresponding to 71,6 Mt of CO_2 emissions.

Furthermore, the annual emissions of nitrogen oxides (NOx) from local space heaters were estimated to correspond to 5,6 kton of SO2 equivalents in acidification potential in 2010. As a result of specific measures adopted by Member States and technological development, these emissions are expected to be 4,9 kton of SO2 equivalents in 2020 without the regulation.

The Ecodesign Regulation was implemented to remove the least efficient local space heaters from the market, thus pushing the market towards higher energy efficiency and lower emissions. The Ecodesign Regulation for local space heaters entered into force in 2013 and sets requirements on seasonal energy efficiency based on control functionalities. In addition, the regulation includes requirements on NOx emissions of gas and liquid fuelled local space heaters.

The objectives of the current regulation are:

- Correcting the market failure identified in the impact assessment: lack of Community incentives to reduce energy consumption and emissions to air.
- Reducing energy consumption and related CO_2 and NO_x emissions due to local space heaters following community environmental priorities, such as those set out in decision 1600/2002/EC or in the commissions European climate change programme (ECCP) and Air Quality Framework Directive 96/62/EC and its daughter Directives.
- Promoting energy efficiency hence contribute to security of supply in the framework of the community objective of saving 20% of the EU's energy consumption by 2020.

More specifically, the objectives were to reduce the energy consumption of local space heaters with around 10% (from 1630 to 1470 PJ/year in 2020), and CO_2 emissions from 71,6 to 64,9 Mt/year in 2020. The objective regarding NO_x emissions was to reduce them by 12% from 7 kton NO_2 equivalents to 6,1 kton NO_2 equivalents per year in 2020[220].

In the Regulation the NO_x emission savings are reported in SO_2 equivalents to represent the acidification potential, however, NO_x gives rise to other important environmental

[220] Reported in the Regulation as SO_2 equivalents, which only reflects the acidification potential, however seeing that NO_x has a number of other environmental impacts, it is reported here as NO_2 equivalents.

impacts such as eutrophication (measured as PO_4 equivalents), formation of fine particles (PM) and ground level ozone, giving rise to smog and related health issues[221].

According to the Impact Assessment[222], the main market failure related to local space heaters was the lack of Community incentives to reduce the energy consumption and the emissions to air of local space heaters during use. Only some Member States addressed these issues, but their national approaches were not harmonised, hampering the internal market for these products.

14.1 Effectiveness

14.1.1 Evaluation question 1: What have been the effects of the regulation?

In order to quantify the effect of the regulation, the observed savings in the market are compared with those expected in the impact assessment. The policy option closest to the one adopted in the Regulation is policy option E from the impact assessment, with one tier of implementing the ecodesign requirements and no energy label for the electric heaters. The only difference is an earlier expected implementation date in policy option E (2016) than in the approved Regulation (2018).

The regulation has been able to transform the market towards a higher energy efficiency and has resulted in fuel savings and reduction of CO_2 emissions. Compared to the expectations in the Impact Assessment, the assumed market development in this study gives only around half of the savings anticipated in the impact assessment, as seen in Table 105. Some of this could be due to the delay in implementation year (2016 in the impact assessment, 2018 in the approved regulation) affecting especially the 2020 impacts. However, for 2030 this should not have such a large influence. It must therefore be assumed that the difference is either due to difference in calculation methods and assumptions or that the Regulation has not been as effective as anticipated. While the review study was built in the information from the impact assessment for calculations, the product categories in the regulation are different than what was proposed in the impact assessment, giving different conditions and baselines for the calculations.

The impact assessment included also solid fuel local space heaters and the greenhouse gas emissions savings and consumer expenditure savings were reported as a sum of all appliances, not for the gas, liquid and electric heaters separately. The savings related to the scope of the regulation can therefore not be found directly in the impact assessment. However, the solid fuel local space heaters are assumed to be a minor part of the total

[221] http://www.icopal-noxite.co.uk/nox-problem/nox-pollution.aspx
[222] Commission Staff Working Document, Impact Assessment with regard to ecodesign requirements for local space heaters, SWD(2015) 91 final http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/swd_2015_0091_en.pdf

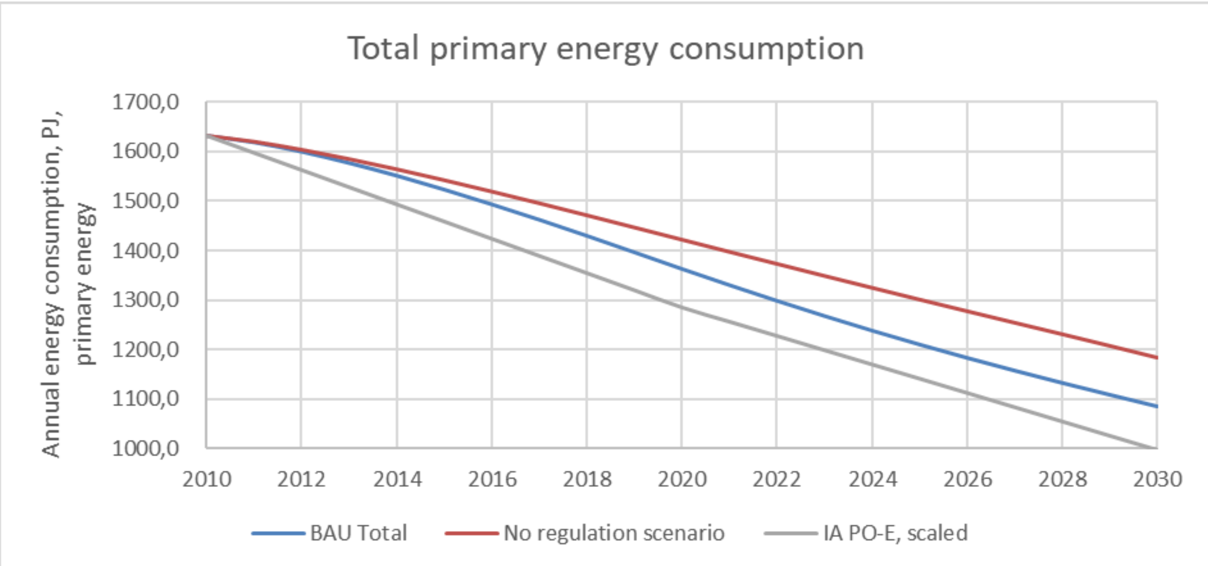
savings, and the numbers therefore still gives a good indication of the trend. The same trends and differences apply for GHG emission savings.

For the cost savings, which are close to zero in the review study, they were clearly expected to be higher in the impact assessment. This is due to a change in calculations method, where the more realistic development in fuel and electricity prices are now used[223] instead of the 4% p.a. price increase prescribed in the MEErP methodology. However, the regulation has not increased the cost for the end-users.

Table 105: Comparison of results of this study to results from the 2013 Impact Assessment regarding cumulative savings of key parameters

Study	Parameter	Annual savings, absolute			Annual savings, %	
		2010	2020	2030	2020	2030
This review study	Energy savings [PJ/year]	0	59	98	4%	8%
	GHG emissions [Mt CO_2-eq/year]	0	2.50	3.72	4%	8%
	User expenditure [bln. €/year]	0	0.45	0.52	0.01%	0.01%
	NOX [kton/year]	0	No data	No data	No data	No data
Impact assessment Option E	Energy savings [PJ/year]	0	157	251	10%	16%
	GHG emissions [Mt CO_2-eq/year]*	0	6.9	11.0	9%	14%
	User expenditure [bln. €/year]*	0	4.1	9.1	4%	10%
	NOX [kton/year]	0	No data	No data	No data	No data

*Numbers in the impact assessment includes solid fuel local space heaters



[223] Data from PRIMES database is now used in pre-regulatory studies for Ecodesign and Energy Labelling Regulations.

Figure 33: Annual primary energy consumption – comparison of the current BAU, to the PO E[224] from the impact assessment and the no-policy scenario.

Evaluation question 2: To what extent do the observed effects link to the regulations?

The observed market change towards more energy efficient local space heaters is likely to be largely linked to the Regulation, since it removed the most energy consuming models from the market. It is unlikely that the effects are in part due to other factors such as general innovation and market trends towards more energy efficient local space heaters as this is not line with the development for local space heaters seen during the last decades.

Evaluation question 3: To what extent can factors influencing the observed achievements be linked to the EU intervention?

Some factors have reduced the achievements of the Regulation. An important factor that could have reduced the effect of the Regulation is the unclear definitions and scope, especially the exemption of slave heaters, which has been difficult to define for industry and market surveillance authorities. The general diversity of the product group and the national differences in how the products are used and which products are preferred, has made it difficult to make univocal definitions that can easily be applied to the different products on the market.

Hence, the scope of the current Regulation has reduced the achievements because not all types of local space heaters are included in the scope, such as slave heaters and towel heaters. Extension of the scope to cover these types are considered in this review study.

Conclusion effectiveness

The current Regulation seems to be effective in reducing the electricity and fuel consumption, and GHG emission of local space heaters, but not yet as effective as expected in the POE in the impact assessment as shown in Table 105 above. The Regulation has not led and will not lead to the expected monetary savings for end-users, due to the change in the underlying methodology for calculating electricity price development[225] following the recently provided energy price data from the Commission, which are lower than the MEErP. However, since this is due to a methodology change in calculation of energy prices the real life difference in consumer expenditure is probably not as significant as seen by the results in Table 105. Even with the new calculation method the consumer expenditure has still decreased compared to the baseline in the impact assessment, showing that there have not been additional costs for end users.

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[224] The PO E scenario from the impact assessment was scaled to the stock used in this review study, to make the scenarios comparable.

[225] Data from the PRIMES database is now used in pre-regulatory studies for Ecodesign and Energy Labelling Regulations. Previous the energy rate was assumed to increase by 4%/year. Based in PRIMES data the annual increase is approximately 1%.

The effectiveness of the regulation is set back by the scope exemptions and the loopholes they create, but except form that it is not clear how such high savings were calculated in the impact assessment compared to the review study.

14.1.2 Efficiency

Evaluation question 1: To what extent has the intervention been cost-effective?

It is not possible to compare the prices in the impact assessment and preparatory study directly with those provided by stakeholders for this study. The main reason is that the product categories and scope are not the same. For the categories that are the same in the impact assessment and the regulation, the prices in this study were based on the prices from the impact assessment, but adjusted according to stakeholder inputs. For the categories that were defined differently stakeholders provided additional price data.

Especially for the gas and liquid appliances, the categories in the regulation differ significantly from the preparatory study and impact assessment, and the price change does not reflect an actual development in prices, but rather a correction based on changed categories and scope.

Table 106 shows the (assumed) prices for each product category in 2012 (based on preparatory study data) and 2018 (new data and updated impact assessment data). All prices are shown in 2018 values. The 2012 values are adjusted based on an approximate product fit between the preparatory study and the regulation. Due to the shift in product categories and the different prices reported by stakeholders for this study, there are large uncertainties in the price data, and it is not possible to draw a conclusion regarding actual price development for the product categories defined in Regulation 2015/1188.

Table 106: Product prices used in 2012 (based on preparatory study) and in 2018 (amended Impact Assessment prices[226])

Product category	2018 prices, €		Difference	
	2012	2018	€	%
Portable Electric	42	32	-10	-24%
Fixed electric >250	396	270	-126	-32%
Fixed electric <250	127	150	23	18%
Electric storage heaters	396	820	424	107%
Electric underfloor	158	181	23	14%
Visibly glowing >1,2	42	36	-6	-15%
Visibly glowing <1,2	32	24	-8	-24%
Gas luminous	1.372	1800	428	31%
Gas tube	2.005	1476	-529	-26%
Gas open fronted	633	1174	541	85%

[226] Data from 2012 is based on the preparatory study while data from 2018 is based on the impact assessment. However, the 2018 data have been corrected according to inputs from stakeholders.

Product category	2018 prices, €		Difference	
	2012	2018	€	%
Gas closed fronted	633	1663	1.030	163%
Gas flueless	633	1000	367	58%
Gas open to chimney	633	1000	367	58%
Liquid tube	1.372	1476	104	8%
Liquid open fronted	2.005	850	-1.155	-58%
Liquid closed fronted	633	1589	956	151%
Liquid flueless	633	1000	367	58%
Liquid open to chimney	633	1000	367	58%

The large price jumps for especially gas and liquid fuel appliances also results in increasing LCC for these products. LCC is calculated as the sum of purchase price, repair and maintenance and fuel costs over the lifetime of one product. The 2010 and 2018 LCC for each product type can be seen in Table 107.

For all the electrical appliances a decrease in the LCC is seen, even though some products have an increased purchase price. However, for the gas and liquid appliances, only the tube heaters have lower LCC, while all other types have higher LCC due to increased purchase price and increasing fuel costs, despite the lower energy consumption. This change is not caused by the Regulation, but rather the change in categories and stakeholder inputs regarding prices for these categories. As mentioned above the purchase prices and re-categorisation happened primarily for the gas and liquid heaters, which are also the ones where the LCC seems to have increased. In the preparatory study there was a lot of uncertainty regarding the specific product types covered by each category, but with the clearer definitions in the regulation, it has been possible to give more reliable price, and according many stakeholders the purchases prices were set unrealistically low for gas and liquid heaters in the preparatory study. It cannot be precluded that the price is partly affected by the regulation causing an increase in purchase prices, especially just around the point of implementation, when manufacturers have to make an effort to ensure compliance, however it has not been possible to quantify the size of the Regulation's impact.

Table 107: LCC for products purchased in 2010 and 2018. LCC for the end-user in € per product over a lifetime

Product category	LCC 2010, €	LCC 2018, €	Difference
Portable Electric	45	32	-13
Fixed electric >250	419	270	-149
Fixed electric <250	134	150	16
Ekectric storage heaters	419	820	401

Product category	LCC 2010, €	LCC 2018, €	Difference
Electric underfloor	168	181	13
Visbily glowing >1,2	45	36	-9
Visibly glowing <1,2	34	24	-10
Gas luminous	1,452	1300	-152
Gas tube	2,122	1500	-622
Gas open fronted/open combustion	670	1175	505
Gas Closed fronted/open combustion	1,340	2375	1,035
gas balanced	670	1663	993
Gas flueless	670	1000	330
Gas open to chimney	670	1000	330
Liquid tube	2,122	1500	-622
Liquid open fronted/open combustion	670	850	180
Liquid closed fronted/open combustion	1,340	2375	1,035
Liquid balanced	670	1589	919
Liquid flueless	670	1000	330
Liquid open to chimney	670	1000	330
Liquid open to chimney	1.355	1.739	384

The Regulation applies some extra costs for testing on the manufacturers. However, as it is based on self-declaration, no excessive testing costs are assumed to be put on the manufacturers. Furthermore, EU-wide legislation will be more cost effective from a manufacturer perspective compared to national legislation, because the costs of conformity assessment tests are only needed once instead of for each individual member state regulation.

Member States need to bear the costs for market surveillance, but they will also benefit from the energy savings and the reduction of emissions. In addition, the EU-wide legislation means that member states will not have the costs of developing their own legislation.

The costs for market surveillance vary between Member States. Some carrying out almost no activities while others undertake both shop inspections, inspection of documentation, and testing. No EU-wide data regarding Member States costs for market surveillance with regard to local space heaters is available.

Evaluation question 2: To what extent are the costs of the intervention justified, given the changes/effects it has achieved?

The current Regulation seems to have resulted in savings for end-users and society, without excessive costs for manufacturers, other market actors or Member States. In total the Regulation will in 2020 have avoided fuel consumption of 254 PJ corresponding to 11 Mt CO_2-eq, 2,4 bln. EUR (total consumer expenditure)[227].

Based on the indicative purchase prices, it seems that manufacturers have been able to pass on the extra cost for development of better performing local space heaters to end-uses, and both manufacturer and retailers have benefitted from increased turnover compared to the situation without the regulation. However, it should be noted that the increase in purchase price, especially for gas and liquid fuel appliances cannot be attributed to the Ecodesign Regulation alone, due to the change in product categories, leading manufacturers to state new (higher) prices, as explained above. Therefore, the development in turnover for manufacturers and retailers cannot be calculated. However, both with and without the regulation, the turnover is foreseen to decrease due to the expected decrease in overall sales.

Member States need to bear the costs for market surveillance, but they will also benefit from the energy savings and reduced emissions due to the Regulations.

Evaluation question 3: To what extent are the costs associated with the intervention proportionate to the benefits it has generated? What factors are influencing any particular discrepancies? How do these factors link to the intervention?

Even though the local space heater purchase price seems to have increased for some product types, the total consumer expenditure (i.e. total costs paid by all users each year) has decreased overall with the regulation compared to if there had been no regulation. Figure 34 shows the development in the total consumer expenditure for all local space heaters in the BAU (current regulation) and the BAU 0 (No-regulation) scenarios.

Based on the total consumer expenditure, it seems that the additional purchase costs are outweighed by the fuel savings for the regulation overall.

[227] NOx savings cannot be quantified due to lack of data

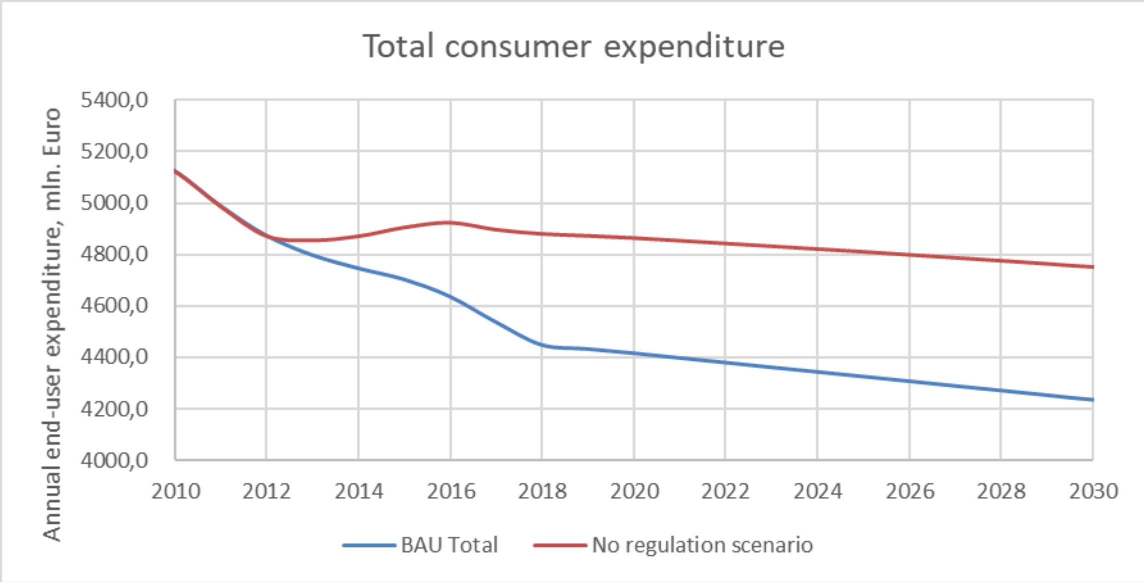

Figure 34: Total consumer expenditure for all local space heaters in BAU (current regulation) and BAU 0 (no regulation)

It can be assumed that additional costs for manufacturers can be passed on to end-users, however it has not been possible to obtain any data regarding manufacturer costs.

Furthermore, this should also be seen in a broader perspective regarding the environmental benefits in terms of avoided climate change potential.

No particular discrepancy has been identified so far.

Evaluation question 4: How proportionate were the costs of the intervention borne by different stakeholder groups taking into account the distribution of the associated costs?
Manufacturers of local space heaters bear the largest share of the costs, but as mentioned above it can be assumed that they have been able to pass the extra costs on to the end-users. However, as shown above it is unclear for the gas and liquid fuel appliances whether the total costs for end-users over the life time of the local space heaters has increased or decreased.

The end-users bear the costs for more expensive local space heaters, but it is anticipated that they will be compensated by saved fuel costs over the lifetime of the local space heaters and by an increased comfort. However, due to the uncertainty of price data (especially for gas and liquid heaters) as well as uncertainty of how the efficiency of heaters will develop due to the short time since implementation, this cannot be verified presently. For electric heaters the prices data is more certain, because categories in the regulation are better aligned with the preparatory study and impact assessment, but the effect on efficiency is still not clear.

Member States bear the costs for market surveillance for energy related products and local space heaters constitute only a small part of that but will still cause an additional administrative cost for market surveillance authorities and thus for Member States. Also, Member States who have electricity and fuel taxes, the higher energy efficacy leading to lower energy consumption might also cause a corresponding decrease in tax income.

Evaluation question 5: Are there opportunities to simplify the legislation or reduce unnecessary regulatory costs without undermining the intended objectives of the intervention?

One opportunity for reduction of the regulatory costs is establishment of a product registration database requiring the manufacturers to enter the data they are obliged to provide in the Regulation's information requirements. This is already decided for products covered by Energy Labelling Regulations and implemented via the Energy Labelling Framework Regulation (EU) 2017/1369. However, further reduction of the administrative costs for Member States could be achieved if the database is extended to cover also ecodesign regulations (i.e. the manufacturers should have an obligation to enter technical documentation and other relevant documents proving compliance with relevant ecodesign regulations in the product registration database). This is relevant for products like electric local space heaters, which are not covered by an Energy Labelling Regulation. However, this would require an amendment of the Energy Label Framework Regulation. Furthermore, the Ecodesign Regulation might include various requirements that are not included in the Energy Labelling Regulation, and the technical documentation for proving compliance with Energy Labelling not is sufficient to prove compliance with ecodesign.

If all the necessary documentation is available in a database the burden for Member States' MSAs to obtain the documentation will be reduced, and the burden for manufacturers to send documentation to each MSA, likewise.

As the Commission is already obliged to set up the database for energy-related products covered by Energy Labelling Regulations, the extra costs for inclusion of products covered by ecodesign regulations will be marginal. Decision on such a database can only be discussed in the framework of a possible revision of the Ecodesign Framework Directive.

Furthermore, a number of scope clarifications and changes could lead to a clearer definition of different product types, close loopholes and increase the effect of the regulation, as described in Task 1 of the review study.

Evaluation question 6: If there are significant differences in costs (or benefits) between Member States, what is causing them? How do these differences link to the intervention?
Member State costs associated with the current regulations are primarily related to market surveillance.

Even though all Member States have the same the obligation to perform market surveillance according to the Regulation, the actual level of market surveillance varies between Member States and not necessarily according the national market size. Furthermore, since local space heaters is a very fragmented market, where the market penetration of different product types varies highly between Member States, some Member States will most likely prioritise market surveillance of some product types higher than others.

The differences in market surveillance costs are not linked to the interventions rather to the Member States' priorities and limited budget for market surveillance.

Conclusions on efficiency
The evaluation assessment has shown that the benefits of the Regulation seem to outweigh its costs, overall, but might not do so for each product type individually.

The manufacturers have invested in improvements of the products, but it seems they have been able to pass the costs on to the end-users. In addition, the manufacturers would then have benefitted from an increased turnover compared to the situation without the regulations.

It is not possible to say clearly whether the increased performance has resulted in increased purchase prices for end-users and whether this is offset by the energy savings to result in lower total costs of ownership. This is due to the change in product categories and thus available data from the preparatory study over the impact assessment to the final regulation.

Member State costs associated with the Regulation are primarily related to market surveillance. The market surveillance costs could be reduced by establishing of the product registration database for energy related products covered by ecodesign regulations[228]. However, in order to keep a high quality of the market surveillance, costs saved on technical documentation checks should instead be used for product testing.

14.1.3 Relevance

Evaluation question 1: To what extent is the intervention still relevant?

[228] The EPREL database

The objective of the regulation was to reduce the energy consumption and NOx emissions of local space heaters. In addition, the objective was to address the identified market failure i.e. that the identified lack of Community incentives to reduce the energy consumption and the emissions to air of local space heaters during use[229].

The objectives have to a large extent been met and the Regulation is still considered relevant. Since the Regulation only entered into force recently, the market is still adjusting to the requirements, but the overall goal of the Regulation of reducing CO_2 and NO_x emissions remains highly relevant for the protection of the environment and human health, and the preliminary indication of emission reductions show that it is also relevant for local space heaters.

If one or more of the product groups are phased out due to national energy and climate policies in multiple Member States, it could minimise the relevance for those specific product groups, however, as long as the products in scope continues to be sold, the Regulation remains relevant.

Evaluation question 2: To what extent have the (original) objectives proven to have been appropriate for the intervention in question?

The original objectives have been appropriate and have resulted in better designed products with better control options to ensure decreased energy consumption on the market. The market failure has to some extent been corrected for local space heater types included in the scope of the regulations, however, due to the loopholes, especially for heaters sold without controls (slave heaters), the objective of decreasing energy consumption has not been met for these products.

Evaluation question 3: How well do the (original) objectives of the intervention (still) correspond to the needs within the EU?

The objectives regarding energy savings and increased energy efficiency are in line with European policies such as the 2030 Climate and Energy Policy Framework, that sets targets for greenhouse gas emissions and improvement of energy efficiency at European level for the year 2030 (at least 40% cuts in greenhouse gas emissions, and at least 27% improvement in energy efficiency)[230].

Also for the NOx emissions the objective of decreasing air pollution is still relevant in the context of the Clean Air Programme[231] to protect human health.

[229] Commission Staff Working Document, Impact Assessment with regard to ecodesign requirements for local space heaters, SWD(2015) 91 final http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/swd_2015_0091_en.pdf

[230] 2030 Climate and energy policy framework. Conclusion – 23/24 October 2014. EUCO 169/14. https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf

[231] http://ec.europa.eu/environment/air/clean_air/index.htm

Evaluation question 4: How well adapted is the intervention to subsequent technological or scientific advances?

The technology of local space heaters is very mature and no or very slow change is seen in the market. The majority of the development in e.g. energy efficiency happens by development of control functions to better regulate the heat emitted without decreasing comfort. A significant market trend for local space heaters is thus more advanced control options, which is especially seen for the electric local space heaters.

While not all advancements are included specifically in the Regulation, advanced technology such as internet connectivity (distance control) is included. However, technologies leaning on new development in AI technology, for example self-learning auto programmable controls are not explicitly addressed in the Regulation.

The fact that slave heaters are not in the scope of the current Regulations means that there is no requirement to install them with controls that can increase their energy efficiency.

Evaluation question 5: How relevant is the EU intervention to EU citizens

The Regulation is highly relevant for EU citizens in terms of reducing greenhouse gas emissions to minimize the severe effects of climate change on both humans and environment. According to a report by the UN Intergovernmental Panel on Climate Change (IPCC)[232] published in 2018, states that there is only limited time to keep global warming to a maximum of 1,5 °C, and that changes to slow the temperature rise, including regulation, needs to accelerate. The Regulation thus remains highly relevant for all EU citizens.

The same is the case for the requirements for NOx emissions, since NOx contributes to acid deposition and eutrophication of soil and water which has adverse effects on ecosystems. Furthermore, NOx is associated with severe human health effects including respiratory diseases[233]. It is thus of the interest of all EU citizens to reduce these impacts.

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[232] IPCC, 2018: *Global Warming of 1.5°C, an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. http://www.ipcc.ch/report/sr15/

[233] https://www.eea.europa.eu/data-and-maps/indicators/eea-32-nitrogen-oxides-nox-emissions-1/assessment.2010-08-19.0140149032-3

Conclusion on relevance

The regulation continues to be relevant for reducing the energy consumption and GHG emissions of local space heaters and contributes to achieve the targets in the EU 2030 Climate and Energy Policy Framework[234] and mitigate climate change and air pollution.

The Ecodesign Regulation prevents placing on the market of local space heaters with insufficient controls, making the products ineffective in use. Furthermore, it creates an increased incentive for manufacturers of gas and liquid fuel local space heaters to increase the combustion efficiency of the appliances.

[234] 2030 Climate and energy policy framework. Conclusion – 23/24 October 2014. EUCO 169/14. https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf