PRIMARY ENERGY FACTOR FOR ELECTRICITY IN THE ENERGY EFFICIENCY DIRECTIVE

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AEBIOM EUROPEAN BIOMASS ASSOCIATION

EGEC GEOTHERMAL

ESTIF European Solar Thermal Industry Federation

KEY MESSAGES

The on-going revision of the EU-wide primary energy factor (PEF) for electricity under the Energy Efficiency Directive (EED) risks to undermine the energy efficiency first principle and to misguide consumers.

As warned by the experts hired by the European Commission, the calculation method for the PEF of electricity should be selected carefully and in line with the central goals of its application[1]. For this reason, and for the many inaccuracies of the methodology used, **EU-policy makers should avoid an artificial reduction of the PEF from 2.5 to 2.0 under the EED and its automatic application to other EU regulations without an accurate impact assessment.**

- **Application of the PEF determined under the EED should be limited to the EED**
- **The PEF to be used in the framework of the EED for the period post-2020 should not be lower than 2.2**

INTRODUCTION

We are the industry organisations representing the solar thermal, biomass, and geothermal sectors[2]; our technologies are crucial to decarbonising the heating sector, improving efficiency and security of supply, and reducing both system and consumers' life-cycle costs.

The purpose of the primary energy factors (PEFs) set out in Annex IV of the EED is to assist Member States to translate final energy savings into primary energy savings in the framework of Article 3 (energy efficiency targets) and Art.7 (energy efficiency obligation schemes).
The proposal to lower the PEF value – from 2.5 to 2.0 – and the intention to automatically apply this value to other EU legislation can create a dangerous spill over effect which risks deceiving the consumer, distorting competition, and promoting inefficient heating products mostly imported from non-European countries.

1. See p. 5 of Esser, a., Sensfuss, F., Review of the default primary energy factor (PEF) reflecting the estimated average EU generation efficiency referred to in Annex IV of Directive 2012/27/EU and possible extension of the approach to other energy carriers. Final report. Date: 13.05.2016. Available online: https://ec.europa.eu/energy/sites/ener/files/documents/final_report_pef_eed.pdf
2. Including the geothermal heat pump sector. Geothermal heat pumps are the most efficient heat pumps, and the only ones that are always renewable based on the methodology set out in Annex VII of Directive 2009/28/EC and Commission Decision 2013/114/EU.

PART 1: APPLICATION OF THE PEF DETERMINED UNDER THE EED SHOULD BE LIMITED TO THE EED

Today, a 2.5 PEF for electricity also applies in the framework of the implementation of:

> *Directive 2010/31/EU on the energy performance of buildings (EPBD); and of Regulations 811/2013, 812/2013, 813/2013, 814/2013 (eco-design) related to space and combination heaters (Lot1) and water heaters (Lot2).*

In the latter case, the PEF plays a key role in determining the efficiency of the electricity-using heating devices. This defines their compliance with minimum eco-design requirements and their position in the energy labelling system. Therefore, the PEF also has an impact in the comparison of the efficiency of devices using different energy carriers and sources (e.g. a solar thermal system vs electric boilers). A more detailed analysis of the interplay between the PEF of electricity, and the EU legislation on eco-design and energy labelling of space and water heating equipment is presented in annex.

Against this background, it is worth noting that Member States remain free to use a different value – provided they justify it - in the EED and EPBD, but NOT in eco-design and energy labelling, where there is no possibility to use different national values. The applicability of the PEF under the Energy Efficiency Directive is therefore of crucial importance.

How and where the PEF determined under the EED applies was one of the 51 options considered (see highlighted in table 13 on p. 162 of the EED Impact Assessment).

Table 13: Options for PEF calculation

Category	Option
Strategic and political considerations	
PEF purpose	Desired
	Calculated
Applicability	Abolish the use of a PEF
	No differentiation
	Different for different policies
	Different for different electric appliances
	Different for different policies and electric appliances
	Different for delivered and produced electricity
Adjustment and review process	Constant over time
	Regular review/adjustment

The consultants working on the PEF calculation methodology for the European Commission insist that no PEF calculation method can claim absoluteness' and that [ ], therefore, the calculation method for the PEF of electricity should be selected carefully and in line with the central goals of its application[3]. Nonetheless, and without the slightest impact assessment, the Commission has announced (see highlighted below from p. 164 of the EED Impact Assessment) its intention to apply the same PEF in all EU legislation where it is appropriate.

3. See note 1 above.

RESULTS

The following conclusions apply to all the four calculation methods:

- It appears appropriate for the approach of **single PEF value for electricity in the EU to be kept** (for use in the contexts where it is currently used) and the same PEF value for electricity to be used **in all EU legislation** where it is appropriate. This is to avoid distortions, take account of the interconnected European electricity system and be consistent with the EU Internal market vision. Where the same requirements or labels are applied to products using different fuels, a PEF is needed in order to obtain comparable information. In addition, since the Regulations published under the Ecodesign and the Energy Labelling Directives are directly applicable in all EEA countries (Norway, Liechtenstein and Iceland) and the free movements of goods needs to be maintained, a single European PEF value needs to be used.

Our preliminary analysis shows some catastrophic consequences of the automatic application of a PEF=2.0 in Eco-design/Energy Labelling. This would:

- Disproportionately benefit the worst performing electric heating devices, and result in keeping the most inefficient appliances[4], that are planned to be phased-out as of September 2017 (according to eco-design Regulation 813/2013), on the market. This **contradicts the energy efficiency first principle** (see annex for a more detailed example);

- **Mislead European citizens**, as it will push consumers to buy inefficient products, which benefitted from an artificial energy performance increase (for instance across energy labelling categories), resulting in increased energy bills. This might undermine trust in EU energy policies, notably eco-design and energy labelling.

In effect, to properly assess the efficiency of electric heaters, the PEF must reflect some crucial factors, including:

- **Time of use of energy.** Electric heaters are mostly used in winter and at night, e.g. when there is no or negligible photovoltaics in the system. To assess their efficiency, seasonal variability must be considered. Yet, in all the four proposed methods the Commission applies annual average values which do not reflect the actual efficiency of the power system when electric heaters are actually operating (again, in winter and at night). The EED Impact Assessment states (on p. 165) that seasonal values – the most relevant alternative option – are excluded because they would require complex calculations. Regrettably, this shows how the calculation methods proposed oversimplify reality.

- **Higher grid losses at distribution level.** Electric heaters are mainly used in buildings connected to medium and low voltage electricity grid, which has higher losses than high-voltage transmission grid. This is not reflected in the proposed options, as only high-voltage losses are considered.

The methodologies proposed are oversimplified, which make the PEF determined under the EED not suitable for eco-design and energy labelling (lots 1 and 2).

4. Most of which produced outside of the EU.

Key recommendation #1

The PEF for electricity determined under the EED should be limited to the EED and not apply to other EU regulations, especially if this is done without a proper impact assessment. In other EU legislation, the Commission should be mandated to develop and apply appropriate methodologies and specific PEFs in line with their central goals of application.

PART 2: THE PEF TO BE USED IN THE FRAMEWORK OF THE EED FOR THE PERIOD POST-2020 SHOULD NOT BE LOWER THAN 2.2

None of the four methods presented in the EED Impact Assessment reflects crucial factors determining the actual efficiency of electricity generation in Europe. On top of the time of use of energy and of grid losses (already discussed in the above section), other crucial parameters not properly considered are:

- **Geographical resolution:** The methodology used covers the EU28 and Norway; yet it does not include other countries integrated in the European grid, for instance Serbia. Whilst in Norway the electricity is mostly produced from hydro, in Serbia 73% of electricity is produced from coal[5]! And because the methodology used assumes full conversion efficiency (i.e. 100% efficiency) for non-combustible renewable sources, the inclusion of Norway instead of other countries such as Serbia manipulates the result by considerably decreasing the PEF.

- **Use of actual data:** Even though the purpose of the PEF under EED is to calculate real energy savings from the past (for Art. 3 and Art.7), the chosen methodology sometimes uses inaccurate PRIMES predictions instead of actual data provided by Eurostat. An alternative[6] would be to use an extrapolation of the power system efficiency (the factor) developed by Eurostat. This option is presented on p. 168 of the EED Impact Assessment and would increase the PEF to 2.2.

- **The consumption of primary energy in the upstream chain of fossil fuels.** Incredibly, the methodology chosen by the Commission does not consider the primary energy used for extraction and transportation and the losses during distribution of fossil fuels before they are converted into electricity. The absence of any life-cycle approach confirms the oversimplifications applied in this process.

Regarding the **primary energy factor applied to electricity from non-combustible renewable sources for electricity** (PV, wind, and hydro), the choice to apply a PEF=1 is already quite generous[7].
In this respect, the methodological choice of the Commission is no doubt the most appropriate (the alternative being applying a PEF of 0). As rightly stated in the EED Impact Assessment (on p. 168), a PEF as 1 for RES recognises that it makes sense to place a value on, and save where possible, all types of energy, including renewable energy.

5. In 2013. Source: OECD/IEA.
6. The option to use real data to calculate the efficiency of the power system is already applied in the calculation of the share of renewables from heat pumps in Annex VII of Directive 2009/28/EC.
7. The methodology assumes a 100% conversion efficiency (despite the actual low conversion efficiency - rarely higher than 20% for PV) and disregard the fossil primary energy used in the upstream chain.

Key recommendation #2

Given the many inaccuracies of the applied methodology and the need to use real data as much as possible, the PEF to be used in the framework of the EED for the period post-2020 should NOT be lower than 2.2, as indicated in the last paragraph of p. 168 of the EED Impact Assessment.

ANNEX: ENERGY EFFICIENCY FIRST? IMPACT OF A REDUCED PEF IN ECO-DESIGN AND ENERGY LABELLING

The interplay between Eco-design, Energy Labelling and PEF works as such:

1. Regulation 813/2013 applying Eco-design to Lot 1 (space heaters) determines requirements for a certain level of energy efficiency (η) that space heaters shall achieve to be placed on the market (Annex II - Eco-design requirements), and introduces two tiers of increase of η per category of systems, from September 2015, and from September 2017 (see table below).
2. The Energy Labelling Regulation 811/2013 for space heaters sets the criteria to determine the conversion of the energy efficiency resulting from the Eco-design into the energy labelling classes (see table overleaf from Annex II – Energy Efficiency Classes):

Table 1

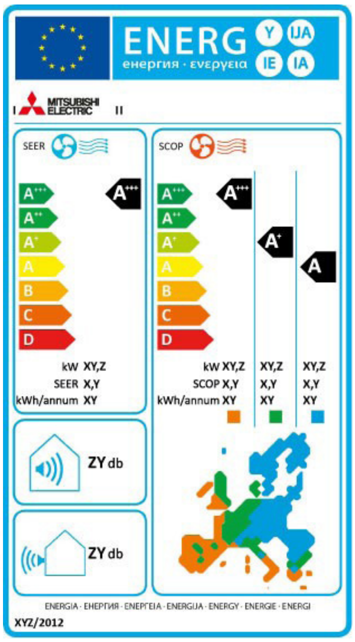
Seasonal space heating energy efficiency classes of heaters, with the exception of low-temperature heat pumps and heat pump space heaters for low-temperature application

Seasonal space heating energy efficiency class	Seasonal space heating energy efficiency η_s in %
A+++	$\eta_s \geq 150$
A++	$125 \leq \eta_s < 150$
A+	$98 \leq \eta_s < 125$
A	$90 \leq \eta_s < 98$
B	$82 \leq \eta_s < 90$
C	$75 \leq \eta_s < 82$
D	$36 \leq \eta_s < 75$
E	$34 \leq \eta_s < 36$
F	$30 \leq \eta_s < 34$
G	$\eta_s < 30$

Table 2

Seasonal space heating energy efficiency classes of low-temperature heat pumps and heat pump space heaters for low-temperature application

Seasonal space heating energy efficiency class	Seasonal space heating energy efficiency η_s in %
A+++	$\eta_s \geq 175$
A++	$150 \leq \eta_s < 175$
A+	$123 \leq \eta_s < 150$
A	$115 \leq \eta_s < 123$
B	$107 \leq \eta_s < 115$
C	$100 \leq \eta_s < 107$
D	$61 \leq \eta_s < 100$
E	$59 \leq \eta_s < 61$
F	$55 \leq \eta_s < 59$
G	$\eta_s < 55$



Thus, as an example, from the Eco-design Regulation we can see that a low-temperature heat pump has to achieve a minimum efficiency of 115% from 2015, and 125% from September 2017. From the Labelling Regulation point of view, this means that as of 2015, only heat pumps from class A or above can be sold in the market, while from September 2017, only heat pumps from class A+ or above will be allowed to be sold.

This means that the calculation of the energy efficiency η (using a PEF) in eco-design **impacts both the possibility for a product to retain access to European markets, and its specific positioning in an energy labelling class, thus also affecting its marketing competitiveness vis-á-vis competing technologies.**

The same reasoning is to be applied for the Lot 2 for water heating devices, with Regulation 814/2013 on Eco-design, setting specific energy efficiency requirements for water heaters, and 812/2013 for Energy Labelling, transforming those requirements into energy labelling classes.

3. The calculation of the energy efficiency (η) of products is specified in the Regulations, in the case of space heaters in Annex III of Regulation 813/2013, and varies according to different technologies. In the case of an electricity-using heating device, the PEF plays a crucial role in the definition of the η, thus contributing to the determination of the energy labelling class of the device.

For electrical devices such as heat pumps, η is calculated as the seasonal coefficient of performance (SCOP[8]) divided by the PEF (in this case called conversion coefficient CC[9]), with specific corrections[10]. In order to clarify the role of the PEF in this calculation, the rule can be simplified as follows:

$$\frac{SCOP}{PEF} = \eta$$

Therefore, (again, considering a simplification of the formula for explanatory purposes) the η of electrical heating devices such as heat pumps is affected by two main factors, the seasonal coefficient of performance SCOP, and the PEF. To increase η , it is therefore possible to act on one, or both elements.

8. SCOP 'is the overall coefficient of performance of a heat pump space heater or heat pump combination heater using electricity or the overall primary energy ratio of a heat pump space heater or heat pump combination heater using fuels, representative of the designated heating season, calculated as the reference annual heating demand divided by the annual energy consumption'. The coefficient of performance indicates, therefore, the number of outputs produced with one input.
9. Conversion coefficient is used as a synonym to PEF.
10. 'Contributions accounting for temperature controls and, for water-/brine-to-water heat pump space heaters and heat pump combination heaters, the electricity consumption of one or more ground water pumps'. See Annex III, point 4 of Regulation 813/2013.

To increase η, an electrical heating devices manufacturer has two choices:

They could act on the numerator, by increasing the coefficient of performance of its products. This means technological improvements on the product itself, which would then be able to deliver a higher output from the same level of input. For instance, with the current PEF, a SCOP 2.5 heat pump will have a η of (2.5/2.5=1) 100%[11]. By raising the SCOP to 3.0, the heat pump will increase its efficiency to (3.0/2.5=1.2) 120%. Increasing the SCOP of an appliance means producing a more efficient product, as well as introducing changes in the production process to deliver such improvements, thus having a considerable impact on the industry business model.

Or it can instead act on the denominator. In fact, just by lowering the PEF to 2.0 the very same electrical heating device will have an efficiency of (2.5/2=1.25) 125% without any actual technical improvement.

A change in the PEF can be the trick to change the perceived efficiency, improve the label class and market competitiveness of an electrical heating device, without any actual technical improvement (see box below for concrete examples).

Case study on worst performing electric heating devices

The Eco-design Regulation 813/2013 stipulates that as from 2015, electric boiler space heaters must achieve a seasonal energy efficiency (η) of at least 30%, to be increased to at least 36% as from September 2017. The Energy Labelling Regulation 811/2013 translates those figures into energy classes (see table below): from 2015, class G is already banned from the market, from September 2017, classes E and F will be banned too.

REQUIREMENTS FOR SEASONAL SPACE HEATING ENERGY EFFICIENCY	seasonal space heating energy efficiency (2015)	seasonal space heating energy efficiency (2017)
Electric boiler space heaters and electric boiler combination heaters	**30%**	**36%**

D	36%≤ η <75%
E	34%≤ η <36%
F	30%≤ η <34%
G	η <30%

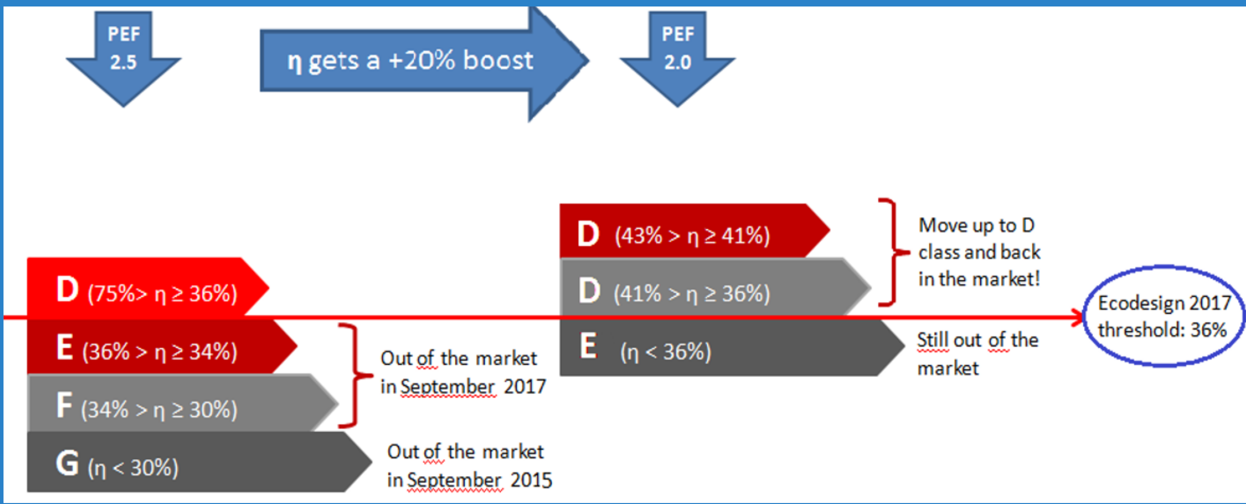
As things stand now, an ordinary consumer entering a shop would not be able to find G class electrical space heaters. As of September 2017, our consumer will not even find devices in E and F classes, which are being phased-out of the market.

However, by lowering the PEF from 2.5 to 2.0, such devices would get the equivalent of a 20% increase in the calculation of their energy efficiency value. Therefore, items in the F class would jump from having an energy efficiency of between 34% and 30% inclusive (see table above), to 41%> η ≥36%, while E group items would jump from a η between 36% and 34% inclusive, to 43%> η ≥41%.

11. The numbers are not to be taken literally, since as stated before the formula is a simplification, but are intended to show a trend between numerator and denominator, and the interaction between COP, PEF and η.

This means that all the devices previously catalogued under E and F classes, which used to be below the 36% Eco-design requirements for September 2017, would jump to class D and suddenly comply with the 2017 Eco-design threshold and remain in the market (see picture below).

The consumer entering a shop in search of an efficient heating device after September 2017, under a scenario PEF=2.0, might still find appliances originally supposed to be phased-out of the market, because of their inefficiency, and labelled under the D class, while the very same devices were labelled E or F just a few months before (under a PEF=2.5).



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The European Biomass Association (AEBIOM) is the common voice of the bioenergy sector with the aim to develop a sustainable bioenergy market based on fair business conditions. AEBIOM is a non profit Brussels based international organisation founded in 1990 that brings together around 30 national associations and 90 companies from across Europe.

More than 120 members from 28 countries, including private companies, national associations, consultants, research centres, geological surveys, and public authorities, make EGEC the strongest and most powerful geothermal network in Europe, uniting and representing the entire sector.

The European Solar Thermal Industry Federation (ESTIF) is the voice of the solar thermal industry, actively promoting the use of solar thermal technology for renewable heating and cooling in Europe. With around 80 members from 17 European countries, ESTIF represents the entire value chain.