Brussels, 13 June 2022

Review of the Primary Energy Factor: an unmissable opportunity to contribute to the EU's climate targets and energy efficiency rules

The Primary Energy Factor (PEF) for electricity is set to be reviewed by December 2022, offering an unmissable opportunity to amend its methodology to redress the inconsistencies of the PEF framework and ensure it contributes to the objectives of the Climate Law[1] and REPowerEU initiative[2].

First, the methodology behind the PEF needs to be redesigned to be consistent with the reality of contemporary energy systems and political priorities at EU and national level, especially for climate neutrality, renewables and energy security. The PEF must also more accurately take into account the real impact of energy sources used for electricity generation.

Second, the revision process of the PEF methodology allows to re-evaluate its application across EU energy policies. The Energy Efficiency Directive (EED) introduced the PEF framework as it defined energy savings targets in primary energy, calling for a tool to accurately assess final energy savings. While this rationale may make sense for EED targets, the PEF has also been applied to other energy efficiency policies such as in Ecodesign, Energy Labelling and Energy Performance Certificates for buildings where its validity is questionable. In these cases, the PEF distorts efficiency ratings, leading to misinformation of consumers and misorientation of related energy policies.

The signatories of this paper call on the European Commission to adapt the methodology setting the PEF for electricity to ensure its coherence with the EU's new climate ambitions as well as with the aim of energy efficiency rules. The signatories believe the adaptation of the methodology can be based on the alternative options already present in the support study, which are also better geared towards reducing GHG emissions.

[1] Regulation (EU) 2021/1119
[2] COM(2022) 108 (REPowerEU: Joint European Action for more affordable, secure and sustainable energy)

The time has come for an overhaul of the PEF framework

The last review of the PEF (2018) was based on a support study[3] contracted by DG ENER, setting out the methodology to calculate the PEF for electricity. European policymakers have now set new objectives and aimed higher for the EU's climate ambition. Climate neutrality is now binding upon the EU[4], higher targets for renewables and energy efficiency are currently debated by the co-legislators[5], and electrification has made its way through the technology-neutral approach of the Commission to become a critical strategy for emissions abatement[6].

Yet, the current PEF for electricity incentivizes the consumption of fossil fuels in buildings instead of electricity (see Annex 1), does not value GHG reductions, overlooks the system efficiency of electricity consumption and distorts the efficiency rating of electric appliances. Further, electricity generation is already covered by the EU Emissions Trading System, already penalizing non-renewable generation with a carbon price.

More recently, high energy prices followed by the Russian invasion of Ukraine have prompted policymakers to urgently reduce our fossil fuel imports, especially from Russia. With REPowerEU, the Commission has yet again made electrification a priority action under the 'Electrify Europe' track[7].

Against this backdrop, the planned review of the Primary Energy Factor by the 25th of December 2022[8] must be carefully harnessed to ensure the achievement of EU climate and energy goals.

1. The PEF framework must contribute to the climate objectives of the EU

The current design of the PEF makes it a counterproductive tool to deliver on the binding objective of the EU to become climate neutral by 2050. While its initial aim is to account for primary energy consumption where needed, the methodological choices that led to the current PEF framework are completely decoupled from the main goal of climate policy, namely reducing GHG emissions to net-zero. A methodological redesign is needed to ensure the PEF does not work against the EU's climate neutrality target and to unlock the PEF's potential to better address GHG emissions and contribute to emissions reductions.

1.1 The PEF methodology must reflect the policy objectives of the EU

The PEF methodology is broken down into different 'categories' under which various options are available to decisionmakers and assessed in the support study. The first category is the "PEF purpose" which must be the starting point of this revision as it is reflective of the

[3] 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.
[4] Regulation (EU) 2021/1119 - "Climate Law"
[5] COM(2021) 557 (Renewable Energy Directive) & COM(2021) 558 (Energy Efficiency Directive)
[6] COM(2020) 299 (EU Strategy for Energy system integration)
[7] COM(2022) 108 (REPowerEU: Joint European Action for more affordable, secure and sustainable energy)
[8] This deadline was set out in the Directive 2018/2002 (Energy Efficiency Directive)

strategic and political considerations informing energy policy choices. It determines whether the PEF is based on what the support study calls either *desired* or *calculated* values.

The current PEF is based on the *calculated* value, which is more indicative of the actual status of the electricity sector. This choice is precise and fairly well adjusted to the reality of electricity generation in the EU at a given time. However, the slow revision process means that it quickly becomes out of touch with reality. While the PEF currently in use is still based on data available in 2018, the electricity sector has evolved significantly with new records for renewables being set every year[9]. In the last four years, the PEF has grown further out of touch with the reality of the electricity sector and misinformed stakeholders of the electricity value chain in the policy areas where it is applied.

The other option, to base the PEF on a forward-looking or *desired* value, is much more in tune with the current political priorities of the EU. With the Fit for 55 Package, further supplemented by the REPowerEU initiative, EU policymakers have set an ambitiously transformative roadmap for the EU energy sector counting on electrification as cornerstone of our future energy system. Such a pioneering transformation calls for coherent energy policies and cannot be hampered by a backwards PEF. Indeed, the *desired* value "puts a strong focus on the impact of the PEF"[10] and can ensure impacted areas are led towards the objectives of the EU, which is precisely what was missing.

➔ Amend the "PEF purpose" from *calculated* to *desired* to allow for a more forward-looking and future-proof PEF

- The new PEF can become a 'carrot' that leads impacted policy areas towards an increasingly cleaner (and soon fully decarbonised) energy carrier[11]
- The PEF must already now be consistent with the share of renewables in electricity production that will be necessary to achieve these heightened targets
    - Achieving our climate neutrality by 2050 implies a 100% renewable electricity mix by 2035 and 83% of renewables by 2030[12]

1.2. The PEF must accurately reflect the impact of energy sources

The current PEF values lack accuracy. The default PEF for grid electricity is based on an EU average which can already be extremely misleading at national level, especially where the electricity mix is different than the EU average.

Grid electricity is already offsetting its carbon impact

[9] EMBER (2021): EU Power Sector in 2020 and EMBER (2021): European Electricity Review: H1-2021
[10] 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
[11] EMBER (2022): European Electricity Review 2022
[12] EMBER (2021): Zero-Carbon Power

While electricity is not yet always carbon neutral, it is already covered by the EU Emission Trading System which has 2 effects. First, power producers pay a price per ton of carbon they release. This price contributes to offsetting the climate impact of the CO2 released and already provides a significant incentive to reduce the carbon-intensity of the electricity produced by increasing the share of renewables. Second, the ETS 'cap & trade' principle entails a set limit on the CO2 that will be emitted and any extra demand for electricity will not lead to extra CO2 emissions. Thus, electric appliances newly added could be seen as zero-emission.

On the other hand, fossil fuels are not carbon-neutral and, when consumed locally, are not regulated by such a system and its emissions are not offset by any carbon pricing. While this may change in the future, this currently leads to unfair competition between electricity and fossil fuels in end-uses, on top of an indirect incentive for the use of fossil fuels in buildings and appliances. Additionally, there is no mechanism to internalise the negative externalities stemming from the local emissions linked to burning fossil in cities, such as air pollution.

The PEF must place more value on savings in fossil fuels

The worst discrepancy centers on the PEFs for fossil fuels and for non-combustible renewable energy sources. In both cases, the PEFs for each energy source, or in this case *"fuel"*, are set at 1. This means that each unit of fuel consumed is counted as 1, for fossil fuels this could be a unit of gas or oil, and for renewables this could be a unit of solar radiation or wind blowing. In the case of electricity generation, this unit is then divided by the conversion efficiency of the device using it to work out the final PEF (see figure 1). This value is wrong for 2 reasons.

Figure 1: calculation process of the PEF for electricity[13]

$$PEF\ Electricity = \frac{PEF\ of\ Fuel}{Conversion\ efficiency}$$

First, this is not in-line with the EU's ambition to phase out fossil fuels as it puts them on equal footing with renewable energy. The Commission argues the PEF of 1 for renewables "makes sense to place value on, and save where possible, all types of energy"[14]. It is unacceptable to place the same value on savings of renewable electricity and fossil fuels. A reasonable differentiation is needed between the two to ensure that the PEF framework is consistent with the EU's objectives. Indeed, the EU Parliament lead rapporteur on the EED recast called to ensure "energy efficiency solutions lead to GHG reductions"[15]. Similarly, the EU Parliament lead rapporteur on the EPBD recast is consistently linking energy performance with the reduction of GHG emissions[16].

[13] SWD(2016) 405
[14] ibid
[15] 2021/0203(COD)
[16] 2021/0426(COD)

Second, setting the PEF for fossil fuels at 1 does not take into account the heavily polluting life cycle of fossil fuels and the significant methane leakage occurring in their value chain[17]. A life-cycle approach is direly needed to accurately measure the impact of fuels and avoid increasing emissions.

A life cycle analysis (LCA) can be implemented by adapting the "system boundaries" category in the methodology. This approach is supported by the conclusion of the support study: "*Having in mind that the PEF of electricity should indicate a sound competition between electricity and other fuels for energy services our recommendation is to base the calculation on a life cycle perspective of the consumption of non-renewable resources"*[18]. The benefits of the LCA have also been upheld in the EU Strategy for System Integration[19], including the benefits of demand-side solutions.

Finally, the PEF for fuels set at 1 for solar, wind and hydro is based on the premise that a unit of sun, wind and water is *consumed* when it actuates a renewable electricity generation device. This is a rather controversial position as it could be argued that the wind blowing through a windmill and the water flowing through a dam is not actually *consumed*. If no fuel is consumed, the PEF for the fuel should be 0.

The support study presents four calculation methodologies for evaluation. The second method uses the option of the '*zero equivalent*' method under the category "accounting method for power (and heat) generation using non-combustible RES" (in combination with a LCA). The support study argues this is done precisely because this method "*is designed to put an emphasis on climate change issues and a sound representation regarding heat and electricity, especially regarding electricity as competitor to other sources of heat generation*"[20].

➔ The system boundaries category in PEF methodology must be amended to include a life cycle analysis, especially for fossil fuels

- This will ensure that negative externalities such as methane leakage are taken into account

➔ The accounting method for power generation using non-combustible renewables should be revised to ensure it is coherent with the EU's objectives

- Using the 'zero equivalent' method would provide a clear incentive for renewables and support the EU's goals to phase out fossil fuels and increase energy independence

[17] COM(2020) 663 (Methane Strategy): In the EU, 19% of methane comes from the energy sector, among which 54% form oil and gas and 11% in residential.

[18] 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.

[19] COM(2020) 299: "*Further measures are needed to ensure that customers' decisions to save, switch or share energy properly reflect the life cycle energy use and footprint of the different energy carriers, including extraction, production and reuse or recycling of raw materials, conversion, transformation, transportation and storage of energy, and the growing share of renewables in electricity supply*."

[20] 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.

- The combination of an LCA and the 'zero equivalent' method would ensure that both renewables and fossil fuels are weighed according to their actual consumption of primary energy sources

2. Buildings and products must be labelled according to their own energy performance

Using a PEF can be justified to calculate system-wide energy savings in primary energy. It is, however, not indicative of the energy performance of a single building or product and unfairly distorts their efficiency rating. More flexibility is needed to adapt the PEF framework and value according to the policy area, enabling buildings and products to be rated according to their intrinsic energy performance. To this end, the option chosen under the 'applicability' category in the methodology should allow for this differentiation between legislations. In the case of Ecodesign and Energy Labelling Regulations as well as Energy Performance of Buildings Directive, the PEF should be abolished. As abolishing the PEF would require amending the concerned legislative acts, the review process of the PEF can set the PEF at 1 for all energy carriers, effectively canceling its distorting effect.

Consumer information and actual efficiency

The primary energy factor for grid electricity is determined upstream of the point of consumption, before it enters a building or before it is consumed by an appliance. Using the PEF to alter the rated performance of an appliance or to express the energy performance of a building will not steer consumers towards the most efficient option.

An electric heater with a class D can use just as much energy as a fossil heater with a class A as far as the consumer is concerned (see Annex 1). Similarly, a house that does not use fossil fuels anymore (switching to full electric) could be penalized in its Energy Performance Certificate even though its final energy performance is similar, and the consumer does not pay for any more kWh of energy.

In order for products to compete on equal grounds on the basis of their conversion efficiency, Ecodesign requirements and energy labels should not use the PEF to alter their efficiency rating. This will allow consumers to understand the true efficiency of what is installed in their home without blurring their understanding with what occurs upstream in the energy system and on which they have no control.

Further misleading environmentally-minded consumers, the PEF applied to energy labels and Ecodesign requirements can lead to increased GHG emissions, especially in Member States where the share of renewables in electricity is higher than the EU average or when electric appliances are directly connected to onsite or nearby renewable generation (see Annex 1).

Applicability

The support study for the 2018 EED included an '*applicability'* category, evaluating whether the same PEF should be used across all relevant policy areas. This is a key variable that needs

to evolve to remove the PEF from building and product policies and ensure that the orientation of consumers towards the most efficient appliances and buildings is not hampered by the needs of other policy areas.

In the Impact Assessment for the 2018 EED, the Commission does not offer conclusive arguments as to its choice in the applicability category, citing only the interconnectedness of the EU energy system, the internal market and avoiding distortions. This is deeply flawed as:

- The interconnectedness of energy systems is not relevant in differentiating the use of the PEF between legislations. Further, many Member States set their own PEF where possible, showing how electricity can be assessed nationally. Additionally, energy systems inextricably linked with the intrinsic (conversion) efficiency of products or buildings.
- Distortions are only created by the use of a single PEF for all policy areas. As explained above, the use of an EU average PEF leads to highly discrepant energy labels.
- The internal market calls for territorial homogeneity of energy labels and ecodesign requirements across the EU. Removing the PEF from product policy would not hamper the internal market in any way.

While the rationale behind removing the PEF from product policy is sensible for energy-consuming devices, it should not be applied to electricity transmission and distribution equipment which serves mainly to convey electrical energy.

Finally, abolishing the PEF would enhance the use of electrically-driven equipment and discourage fossil fuel-based devices, yet, appliances with the highest energy efficiency rating (e.g. heat pumps) should still be promoted when suitable. Similarly, when electrifying industrial processes, the highest energy efficiency classes for electric motors systems should be incentivized. This may require accompanying measures.

➔ The applicability category in PEF methodology should be amended to allow for a differentiation between policies
➔ For Ecodesign and Energy Labelling Regulations as well as Energy Performance of Buildings Directive, the PEF should be abolished

- Alternatively, the PEF could be set at 1 for all energy carriers as this would have the same effect as abolishing it.
- This will avoid distorted and misrepresentative energy labels and EPCs while changing the current situation which unfairly penalizes electricity consumption and serves as an incentive for fossil fuels
- The highest efficiency should remain encouraged for electrically driven equipment. Specific measures might be needed when the PEF is abolished.

Annex 1: Case Study on the PEF in Energy Labelling

Energy classes are attributed by determining the rate at which an appliance converts energy into heat (e.g. how many kWh of electricity are needed for 1kWh of heat). In the case of electric appliances, this conversion efficiency is divided by the EU average PEF to take into account conversion processes taking place upstream in the energy system. This means the energy label displays an efficiency rating that is 2.1 times lower than the actual appliance's efficiency, independent of the electricity mix that is powering the appliance and thus of the resulting CO2 emissions. Table 1 shows the CO2 emissions of gas and electric appliances based on different electricity mixes.

Results in gCO2/kWh	Gas boiler A+	Electric heating D	Heat pump A+
Sweden	202	9	4
Germany	202	317	121
EU average 2020	202	234	90
EU average 2030	202	95	35
ETS perspective	202	0	0

Table 1: CO2 intensity of different heating appliances[21][22][23]

Let's imagine a consumer in the market for a heating appliance who is conscious about her/his impact on climate. She/he knows heaters can work on either gas or electricity but is unsure about the most climate friendly option and thus counts on the energy label as information. If this consumer reviews the options:

- A gas boiler can be marked with an A+ grade, which will seem like a climate-friendly option
- An electric heater can mathematically only achieve a D grade because of the PEF, and will seem like a much less climate-friendly option even though it converts electricity into heat with the same efficiency as the gas boiler (see Table 1)
- A heat pump can be marked with an A+ grade, which will seem equally as climate friendly as the gas boiler even though it converts electricity into heat with an efficiency 2.5 times higher than the gas boiler and can be powered by renewables. However, the higher price tag and installation cost of the heat pump will in many cases deter the consumer.

As a consequence, this consumer will most likely buy a gas heater, even though:

[21] Gas CO2 intensity for an A+ device with 98% efficiency. CO2 emission intensity retrieved from: https://www.energuide.be/en/questions-answers/how-much-co2-does-my-home-emit/68/

[22] CO2 values for Sweden, Germany and EU in 2020: https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-9/#tab-googlechartid_googlechartid_googlechartid_chart_1111

[23] CO2 values for EU in 2030: https://ember-climate.org/insights/research/zero-carbon-power/

- An electric heater can be up to 15 times cleaner than gas depending on the national power mix
- An electric heater can be zero emission if this particular consumer has direct access to on-site or nearby renewable power generation (e.g. rooftop solar)
- Heat pumps are the most efficient of the options in Table 1 and can be powered by renewable electricity, but, according to the energy label, an A+ heat pump is no better than a gas heater with the same label
- By 2030, even with the EU average power mix all electric heaters in table 1 will be less than half as carbon intensive as gas boilers, which will still not be taken into account at the end of their life cycle if installed today
- The gas heater will emit twice as much CO2 than what is allowed for gas-fired power plants under the EU taxonomy
- Thanks to the EU ETS, emissions are capped and extra demand for electricity cannot lead to extra emissions. This means that newly installed electric appliances do not directly cause emissions and could be considered zero-emission devices.