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The Primary Energy Factors in the EPBD

How changes in an annex could flip the focus of EU energy efficiency policy

Summary

As an element in the proposed directive amending the Energy Performance of Buildings Directive (EPBD) the European Commission proposes to adjust the framework for the factors for calculating primary energy consumption – the so-called Primary Energy Factors (PEFs).

PEFs are in many countries used to calculate the total energy consumption in the national building regulation and hence a change to the PEFs and to the methodology for how they're used can have large impact on the incentives given in the national building regulation. This is both when it comes to the choice of heating technologies and for the choice of location for renewable energy generation – specifically whether this is on-site or off-site.

This position paper describes the function of the Primary Energy Factors and the implications of the Commission's proposal for amendment, as well as how the amended PEF will potentially inflict the choices for the energy supply for buildings.

A key finding of this paper is that the proposed amendments from the Commission will form a significant shift in policy objective of the EPBD. The new proposal entails solely focusing on reduction of fossil fuels in the energy supply instead of the present focus on reduction of end use energy (regardless of the origin of that energy).

The position paper elaborates on the problematic implications of such change and provides suggestions on how to react to the Commission's proposals for amendments in the annex of the EPBD.

The Danish Ecological Council strongly recommends to go for a solution which strongly promotes the further increase of energy efficiency and energy savings in the building stock on-site and off-site. This regardless of, but in parallel with the efforts to increase the share of renewable energy. Consequently, the Danish Ecological Council recommends to go for option setting $PEF = 1,0$ for all RES on-site and off-site 1, alternatively for the more moderate option of creating a hybrid model setting the PEF according to the characteristics of the on-site renewable source.

What are the “Primary Energy Factors” and how do they work today?

The Primary Energy Factors (PEFs) express the connection between a produced amount of heat or electricity and the amount of fuel that were needed to produce that heat or electricity. PEFs can include the needed fossil fuels only (PEF_{fossil}) or the total needed amount of fuels also from renewable sources (PEF_{total}).



To calculate how much primary energy a building uses, it is necessary to take every single energy carrier and multiply this amount of energy from that with the relevant PEF.

The PEFs are used in the calculation of the total energy use in buildings expressed in primary energy. Consequently, the PEFs are also part of the calculation of compliance with the energy requirements in the national building codes.

Every time the values of the PEFs are adjusted e.g. because the composition of fuels to produce electricity or district heating is changed, this will affect how much final energy that can be used in buildings if the building is to comply with the national total energy requirements.

Which type of primary energy factors to use and how to carry out the calculation regulated in the EPBD (Energy Performance of Buildings Directive) and its annexes and delegated acts.¹

The Total Primary Energy Factor consists of two partial factors: $PEF_{\text{renewables}} + PEF_{\text{fossil}} = PEF_{\text{total}}$

In the present EPBD it is up to the EU-member states to decide which of the three elements in the calculation of the PEF they want to use for national purposes. Many member states (including Denmark) have chosen to use the primary energy factors for the total energy use. (= PEF_{total}). In the treatment of renewables they typically use a $PEF_{\text{renewables}}$ of 1,0 for off-site production imported to the building and a $PEF_{\text{renewables}}$ of 0,0 for on-site production.

By doing so both the fossil based and the *imported* renewable based energy carriers will be included in the calculations when the amount of energy expressed in primary energy used in the building is determined (in the form and electricity and heat).

On the contrary renewables (i.e. solar or wind) produced on or adjacent to the building is defined as *energy savings* in the EPBD and the EED. Therefore, it shall be calculated as *energy savings* and not as *energy production*. This implies that the amount of renewables produced on-site shall be deducted in the calculation of the buildings total energy need. Consequently, the $PEF_{\text{renewables}}$ for all renewable production on-site shall be 0,0.

What changes are suggested in the proposed EPBD?

The proposal from the Commission for an amendment directive of the existing EPBD contains a proposal for amending the existing Annex 1. Paragraph 2 is proposed to be replaced by a new paragraph 2 which includes the wording:

¹ The primary energy factors are also used to determine energy demands in the ECO-design directive and the Renewable Energy directive.



“Primary energy factors shall discount the share of renewable energy in energy carriers so that calculations equally treat: (a) the energy from renewable source that is generated on-site (behind the individual meter, i.e. not accounted as supplied), and (b) the energy from renewable energy sources supplied through the energy carrier.”

This amendment establishes two basic principles for the application of the primary energy factors and the calculation of total energy demands of which especially this is of utmost importance:

1. In the calculations, renewable energy production shall be treated equally regardless of whether it is produced in front or behind the individual meter (e.g. on-site or off-site for example in a district heating system)

Establishing of this principle intuitively seems rather reasonable, as it aims to ensure that renewable production is treated equally regardless of where the production takes places i.e. using the same energy performance factor for renewable production on-site and off-site.

What does that mean? Why a mandatory requirement to use of PEF_{fossil} is so much more than a technical annex discussion

It is important to bear in mind that renewables produced on-site are still in the proposed renewed EPBD considered as *energy savings* thus meaning that the PEF_{renewables} for on-site production must be set to 0,0. To avoid discriminating between renewables produced on-site and off-site the Commission hence chose to put the off -site PEF_{renewables} to 0,0 as well. In this way, the understanding of on-site renewables production as *energy savings* could remain unchanged.

However, the proposal from the Commission will – if adopted - imply that all member states will be mandated to set the PEF_{renewables} to 0,0 for all renewable production, and hence that they in practice will be obliged to use the PEF_{fossil} as the basic principle for PEF calculating the energy use of buildings from 2020 and onwards.

When analyzing the wider implications of this proposal it occurs that even though the Commission seems to solve some practical problems with discrimination between on- and off-site renewable generation the proposal has more far-reaching problematic implications. The problems can be grouped in two areas: 1) Shift of policy focus away from reduction of total energy use over to decarbonization (only reduction of fossil fuels use) and 2) Incentivizing problematic choices of heating technology for buildings.



Change in policy-focus and coherence with the other Energy Efficiency legislation

By changing the focus to fossil-based energy consumption only via the application of PEF_{fossil} , there will be a massive policy shift from the current focus on reducing the overall energy use of the buildings (regardless how the energy was produced). Following this shift, the usage of renewable energy for heating purposes “disappear” from the calculation because only the fossil part (plus possible grid and conversion losses for renewables) will count in the calculation of how buildings fulfil the national energy requirements about a maximal energy consumption.

Such a shift in the focus of the policy is very problematic when considering how the requirements of the EPBD are to interact and underpin the focus on reducing total end-use energy consumption in the EED (Energy Efficiency Directive).

The EED constitutes the overall framework for the EU and its member states' efforts to increase energy efficiency and the overarching focus on reducing the amount of end-use energy needed in the EU. With buildings still accounting for about 40 % of the Unions energy consumption the rules in the EPBD are absolutely essential for the likelihood of the EU and its member states to deliver on the overall reduction requirements of the EED.

Consequently, a shift in the EPBD to solely focus on the part of the energy use that comes from fossil sources is unhelpful for reaching the common EU energy efficiency target and directly contradictory to the aim of reducing the amount of end-use energy in the EED.

Also, the suggested change seems to introduce some sort of “substitutions principle” between two independent and so far, supplementing policy objectives of the 2030-framework and the Energy Union, namely 1) to reduce the energy consumption and 2) to promote renewable energy. The practical consequence of a mandatory application of a PEF of 0,0 for all renewables will be, that building regulations in the future could be complied with by what could harshly be categorized as “tents with PVs or biomass boilers”. Hence basically the policy objective for RES has somehow substituted the policy objective on EE instead of the two policy objectives being *closely interrelated and mutually reinforcing*².

On the more administrative side, a change in the PEF methodology in the EPBD would create a large technical difference in how the energy use of buildings in the EPBD and the energy efficiency in end-use energy in the EED were to be calculated. Likewise, the proposed amendment by the Commission of the PEF in the EPBD will be in contradiction to the use of PEF in the Eco-design directive. Here the focus is on reduction of the total final energy consumption of the products – and obviously not only the part of the energy consumption that originates from fossil based energy carriers.

² European Council wording on the nature and relationship between the different aspects of the Energi Union <http://www.consilium.europa.eu/en/press/press-releases/2015/03/conclusions-energy-european-council-march-2015/>



Influencing choices of technology: incentivizing the use of individual biomass installations

The proposed shift to mandatory use of PEF_{fossil} will massively influence the incentives provided for choice of different heating technologies. It should be noted that this will affect both new buildings and buildings undergoing renovation. Several unfortunate dynamics can be pointed out, but the far most severe is, that a change to PEF_{fossil} will create very strong incentives to installation of individual biomass-based heating systems in buildings. Such an incentive for individual combustion of biomass is problematic for several reasons:

- Biomass is a high-quality fuel that must be prioritised in areas where there seems to be no other obvious solutions such as heavy transport, shipping and aviation. There is not sufficient sustainable biomass to cover the foreseen global need for electricity and heat. For individual heating purposes, there are several alternative possibilities based on solar, wind and ambient heat available.
- Combustion of biomass in small individual burners is a very inefficient use of the resource. It is simply not appropriate to utilize a high-quality energy such as biomass using an old-fashioned ineffective technology.
- Finally, there is no or little cleaning of the smoke from individual combustion of biomass. The massive pollution with small particles from individual combustion of biomass in boilers and stoves is one of the major cause of health problems in cities all over the world, as it causes premature deaths, allergies, asthma and other respiratory problems. In Denmark alone The Economical Council estimates that combustion of biomass in individual stoves inflict health costs for the Danish population of around 4 billion DKK/535 million Euros each year.

Possible solutions to the PEF-dilemma

To avoid the described negative consequences of the current Commission proposal several models could be further explored. The first and second model provide real alternatives to the Commission approach, which in our opinion is misguided. The third model basically proves as “damage control” and provides suggestion for how member states can handle the perverse incentives of the current proposals in a way that efforts for continuous EE improvements in the building stock stay on track.

1. Production *is* production (also on-site)

A model to pursue could be to be more strict and realistic on the fact that renewables production is in fact production regardless of where the production takes place and that this should not inflict on the performance demands of the building it-self. This with the core argument that the quality of the building is (to a large degree) constant over its lifetime, whereas the energy supply systems are likely to change/ be replaced during the lifetime of the building. At the same time



this model would solve the discrimination issue by changing the current definition of on-site RES as *energy savings* with a PEF of 0,0 by giving all RES a PEF of 1.

2. A hybrid approach with realistic definitions of on-site renewables

If one take a closer look at the various technologies and forms of renewable energy which can be produced on-site, it is clear that their nature, alternative use and ability to interact with and affect with the rest of the energy system is very different. Hence, this could call for differentiation in the definition of each as either *production* with a PEF set to 1,0 or *savings* with a PEF set to 0,0.

- PEF shall be set at 1,0 for biomass in any form imported to the building to be converted to heat by being combusted there. The main argument here being, that the biomass is not “generated” on-site (only burned) and could have alternative use other places in the energy system (or in some cases for other functions in the economy).
- PEF should be set at 1,0 for electricity produced on-site by PV or micro wind. It will in practice be a mixture of production and savings, since electricity in hours with much sunshine or wind and/or little consumption in the building will be exported to the grid and hence substituting electricity production other places in the energy system. Still also imports to the building from the grid will occur in periods/seasons with no sun and less wind.
- Finally, PEF could be set at 0,0 for active or passive solar thermal and for the use of ambient heat since the heat generated to the building based on these energy resources is really on-site and since the potential heat surplus based on these resources will not be exported out of the site where it is produced.

To tackle the issue on discrimination between off-site and on-site RES, the PEFs outlined above should be mirrored in the setting of the off-site PEF's for similar energy carriers. An added value to this would be an increased incentive for solar thermal and ambient heat in district heating, where those technologies can also be used by obtaining a lower PEF for district heating.

3. Building codes must ensure energy efficient buildings bottom up (if RES =0,0)

In a regrettable situation where co-legislators decide to endorse the proposed changes to the PEF, member states should be strongly encouraged to apply alternative means to ensure that efforts to a continuous improvement of the energy efficiency of buildings is not derailed by on-site RES-technology. Such a substitution between RES and EE that will be the result of setting the PEF for all RES to 0,0 is not in line with the overall energy policy objectives of the EU and it is not acceptable.

If the PEF methodology dilutes the overall energy performance requirements by omitting all RES-based energy, there is a need to ensure the “real” energy



performance of the building itself by a more bottom up approach. The situation requires a very strong national focus (political and administrative) on setting requirements for maximum energy use for components, maximum energy transmission losses for non-transparent parts of the building envelope, strict energy requirements for windows, maximum requirements for ventilation systems and maximum requirements for cooling system etc.

Recommendations:

The Danish Ecological Council strongly recommends to go for a solution which strongly promotes the further increase of energy efficiency and energy savings in the building stock on-site and off-site. This regardless of, but in parallel with the efforts to increase the share of renewable energy. Consequently, the Danish Ecological Council recommends to go for option 1, alternatively for the more moderate option 2 of the above. Obviously, there will in such cases be a need to align the relevant provisions not only in the EPBD, but also in the EED and the RED to underpin that renewables (or parts thereof) on-site should be considered as production and to avoid double counting of on-site renewables in other parts of the energy policy framework.