New generation of the Energy Performance Certificate

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Abstract
The revision of the EPBD is part of the whole package of new legislative acts of EU. Significant changes are made in the revised EPB Directive draft (December 2021) impacting the energy performance certificates. Energy performance certificates (EPC) are referenced for green finance in the EU Taxonomy and as a support for public funding in the Member States. The draft EPBD revision still allows different choices and possible interpretations.
In this article the changes are explained and the impact of possible interpretation on the energy performance indicator are analysed.
A table reporting the main possible choices has been developed in the EPC RECAST project. The aim of the EPC RECAST project is to support EPBD by indicators, tools and protocols for more reliable EPCs.

1. INTRODUCTION

Buildings are responsible for more than 40% of energy consumption and 36% of CO_2 emissions. Improvement of energy performance of buildings is key for achieving EU carbon neutrality by 2050. The Energy Performance Certificates (EPCs) are important instruments introduced by the EPBD **[1]**. The objective of the next generation of EPCs is to rely more on digital tools, to introduce new indicators, to be more reliable, transparent, linked to financial instruments for buildings renovation and triggering the improvement of energy performance of buildings.

2. ENERGY PERFORMANCE CERTIFICATE IN DRAFT EPBD REVISION

The next generation of energy certificates will be directed by the revised EPBD. The draft EPBD revision **[2]** defines, in article 16, that the energy performance certificate **shall** include:

- the **energy performance of a building** expressed by a numeric indicator of **primary energy use** in kWh/(m².y);
- reference values such as:
  - minimum energy performance **requirements**;
  - minimum energy performance **standards (MEPS)**;
  - nearly **zero-energy** building requirements;
  - zero-**emission** building requirements.

Minimum Energy Performance Standards (MEPS) will contribute to phasing out of the market 15% of the worst existing buildings (energy class G), for which the renovation obligation will apply in the years 2027-2033.

In addition, by **31 December 2025** the EPC shall comply with **the template for energy performance certificate** proposed in **Annex V**.
On its **front page**, the EPC shall display at least the following elements:

- the energy performance class;
- the **calculated annual primary energy use** - in kWh/(m² year) and in kWh or MWh;
- the **calculated annual final energy use** in kWh/(m² year) and in kWh or MWh;
- renewable energy production in kWh or MWh
- **renewable energy in % of energy use**;
- operational **greenhouse gas emissions** in kg CO_2/(m² year);
- the greenhouse gas emission class (if applicable).

The energy performance class of the building shall be based on a **closed scale using only letters from A to G.** The **letter A shall correspond to zero-emission buildings** and **the letter G shall correspond to the 15% worst-performing buildings in the national building stock.** The remaining classes (B to F) shall have an **even bandwidth distribution** of energy performance indicators among the energy performance classes.

The proposed changes show that there is a positive attempt of the EU legislation to increase the legal power of EPCs and to improve their quality, reliability and comparability. The draft EPBD revision:

- includes **more indicators**, especially new quantified indicators related to minimum energy performance standards (MEPs) and **zero-emission building**,
- is **more precise and push towards a harmonised scale** (A-G, even bandwidth distribution) and defines classes A and G.

The draft EPBD revision is a **game changer**.
For the **first time, quantified** thresholds are proposed to reach a comparable ambition level of requirements and energy classes between EU MSs.
As mentioned, the **strengthening of the requirements** is needed because buildings will be included in the EU **emission trading system (EU ETS). Dedicated EU funding** will be provided to Member States to finance investments in energy efficiency. Therefore, it is important that the energy performance assessment is "**reliable**" and not only **linked to administrative compliance** as it was before.

Among the financial instruments supporting the energy transition in the building sector is the EU taxonomy. The **EU taxonomy** is a framework for sustainable investment. Technical screening criteria in delegated regulation [3] are defining what is a sustainable investment and activity. The technical screening criteria in Chapter 7 "Construction and Real Estate" refer several times to primary energy demand in the EPC. For **new buildings,** the **primary energy demand should be at least 10% lower** than the requirement for a national near zero energy building (NZEB).
For building renovation, **30 % improvement** in primary energy compared to the actual state is required for **sustainable investment.** The reductions in net primary energy demand through renewable energy sources are not considered.

3. KEY PERFORMANCE INDICATORS IN ENERGY PERFORMANCE CERTIFICATE

The EPC RECAST project **[5]** deals with the key energy performance indicators (KPIs) in the residential sector. It is the follow up project of ALDREN **[6]**, dealing with similar topics in the non-residential sector. The KPIs, in line with CEN standards and EPBD, should support the EU harmonisation and provide understandable information to owners, tenants, public authorities and financial institutions.

The revised EPBD will have to be implemented into Slovak regulation. Slovak calculation methodology refers to CEN standards.
But the CEN standards, and also the draft EPBD revision, still allows several options or interpretations. Therefore, several questions remain in draft proposal for EPBD revision [2] for an unambiguous EU approach:

- **primary energy use:** It is not defined if it is in **total** or **non-renewable** primary energy. The zero-emission building definition corresponding to class A is expressed in "**total**" primary energy. In the Slovak regulation the indicator is expressed in non-renewable primary energy. It is also important **to specify if on-site renewable (e.g. self-used PV) is included or not in the total primary energy use** because in some national methods it is withdrawn from the consumption and not in others;
- **final** energy **use:** in the CEN standards „energy use", is defined as an energy input into the technical building system. Again, it should be specified, if on-site renewable is included or not, because in some national methods it is withdrawn from the use (delivered energy). In some national methods (e.g. Slovakia) the on-site generation losses are not taken into account (use = energy output from generation system);
- **renewable energy production:** It should be specified if the energy taken from the environment (for example by the heat pump) is included or not. In the CEN standards it is, in some national methods it is not. In Slovakia the energy taken from the environment by a heat pump is not considered in the delivered energy. In the Slovak Regulation **[4]** the performance of the heat pumps is defined by an efficiency (transformation coefficient) similar to gas boiler or other generators.
- **renewable energy** in **% of energy use:** This indicator is related to the **ratio of renewables**. It is understood that the ratio is expressed in **delivered** energy. In the CEN standards the ratio is expressed in primary energy considering also the **exported** energy and potentially including renewable from nearby and distant. Therefore, also the perimeter, where the counted renewables are coming from (on-site, nearby or distant), must be clearly indicated.

To provide more transparency for the comparability between the national EPCs and for better understanding of indicators, the EPC RECAST project proposes to collect and report information as shown in Figure 1.

Information for understanding and basic comparability at EU level

EPC RECAST
ENERGY PERFORMANCE CERTIFICATE RECAST

Country: Slovakia

Aspect/Indicator	Choices					
Primary energy	Non-renewable primary energy			Other:		
Primary energy factors and CO_2 emissions coefficients	Primary energy factors			CO_2 emissions coefficient kg/kWh		
	electricity	gas	oil	electricity	gas	oil
	2.2	1.1	1.1	0.167	0.22	0.29
Services excluded	Cooling, ventilation, built-in lighting					
Final energy use	Including on-site produced renewable energy			On-site generation losses are excluded (use = energy output from generator)		
Renewable energy perimeter for ratio of renewable in %	Only on-site produced renewable is included			Energy from the environment (e.g. by heat pumps) is not counted as renewable		
Time step	Monthly for energy calculation			Annual for balance of self-used produced PV electricity		
NZEB is in energy class	Better class than A (e.g. A1, A0, A+)					
Reference floor area for kWh/(m^2.a)	Gross floor area, external dimenssions					
Climate for calculated energy	Standard national climate					
Type of use for calculated energy	Standard/typical use patterns for building category					

Figure 1: Information in the EPC on the main choices for energy performance indicator for basic comparability (EPC RECAST D1.10 draft)

4. IMPACT OF THE SELECTION OF INDICATORS AND BOUNDARY CONDITIONS ON ENERGY PERFORMANCE INDICATOR

As shown in the previous chapter the numeric indicators may differ **depending on the choices and assumptions in calculation**. The example presented in **Fig.2** shows different possible results for the same building in Slovakia. It is a well-insulated renovated family house, equipped with heat pump and PV panels. The numeric energy performance indicator is expressed in primary energy depending on possible national choices:

- for different types of primary energy (total, non-renewable)
- counting produced photovoltaic electricity (PV) only self-used in building or also exported into grid.

The PV panels covers 30 m^2 (33%) of the roof. The **PV production is 17 kWh/(m².y). 70% of the PV production is** assumed to be **self-used in building when the building is equipped by** a **heat pump**. Moreover, in Slovakia, as the next option, the renewable energy is subtracted from delivered energy [4].

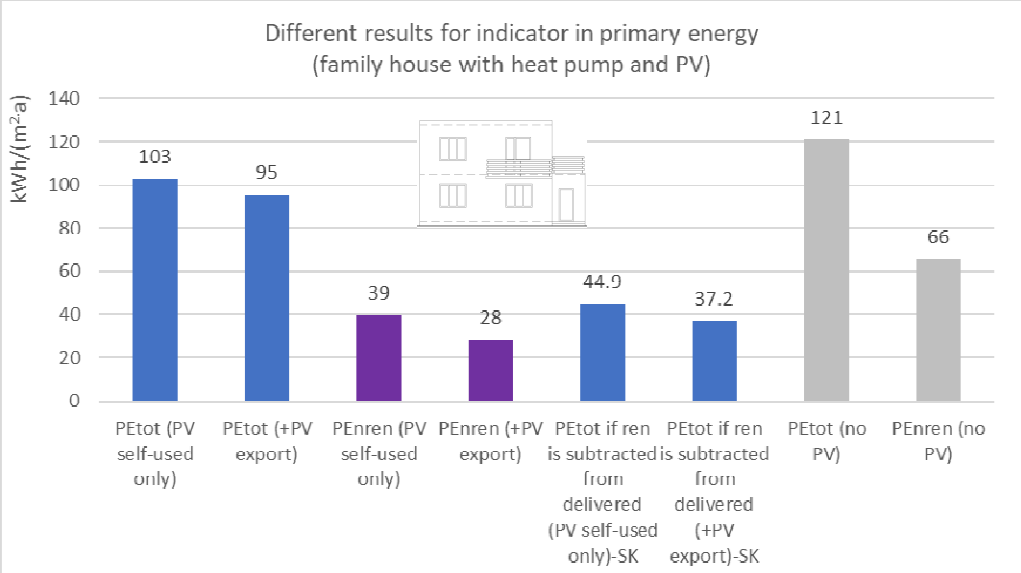
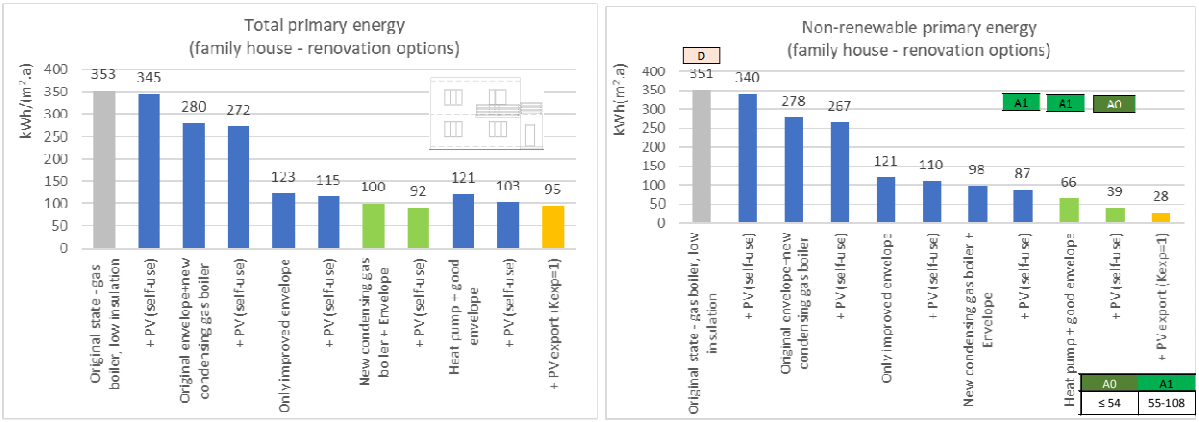


Figure 2: Different results, for the same building, where the numeric indicator is expressed in different primary energy (total and non-renewable) and with different possible choices for PV

Figure 2 and **Figure 3** underlines that if the "**total** primary energy" is **calculated according to physical definitions and CEN standards** (including the ambient heat recovered by the heat pump), the heat pumps will have very high total primary energy use. The valorisation of on-site renewables will be less and the **best solution will be different** from the best solution when the performance is expressed in non-renewable primary energy:

- expressed in **total primary energy**, the best solution, **without export,** will be a **well insulated building with a condensing gas boiler (Fig. 3a).** Using CEN standards for calculation, no solution will reach the maximum threshold of 65 kWh/(m².a) requested for class A in the draft EPBD revision [2],
- **expressed in non-renewable primary** energy, the best solution will be the **heat pump with PV self-used (Fig. 3b)**. This solution will reach the Slovak energy class A0 (<54 kWh/(m².a) expressed in non-renewable primary energy [4]. A well insulated building equipped with heat pump but without PV or a new condensing boiler without PV will reach the Slovak energy class A1 (55 -108 kWh/(m². y)) [4].



a) *b)*

Figure 3 Example of EP indicator for different alternatives of family house renovation
a) in total primary energy b) in non-renewable primary energy

Figure 4 shows that it is easier to achieve higher energy savings in % when the energy performance indicator is expresses in non-renewable primary energy than in total primary energy, because the solutions with more renewable energy produced on-site can be better valorised.

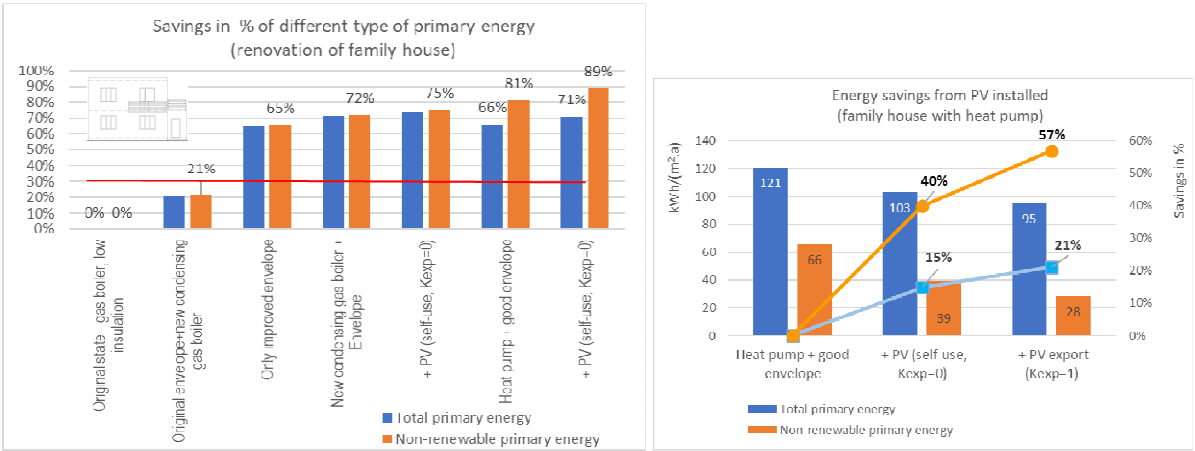
If the performance indicator is expressed in non-renewable primary energy, a well-insulated building equipped with heat pump would reach the 30% savings (required for green financing by the EU Taxonomy) only by PV panels installation (Fig. 4b).

If the performance indicator is expressed in total primary energy, the 30 % level will not be reached (15%, 21% Fig. 4b).

The relative difference is higher for high performing buildings (e.g. 40% savings for non-renewable compared to 15 % for total, Fig. 4b).

Member States EPC's, using non-renewable primary energy, should not be used to justify the 30 % savings requested for green financing in the taxonomy, because renewable energy is taken into account.

The original building is from 1984-1992 with porous concrete walls, changed windows in quality of 2000-2012 and with gas boiler (energy class D for primary energy [4]).



a) % to initial state (old building class D) b) % to renovated building without PV

Figure 4. Energy savings in % for indicator in total and non-renewable primary energy

5. CONCLUSION

In the EPBD revision there is a clear move from **a general framework**, towards **more comparability and reliability.** This move is needed because the targets were not reached.
The draft EPBD revision is a step forward towards EPCs of next generation with better quality, reliability and comparability. Additional indicators, and for the first-time, quantified thresholds are set. Quantified values for key performance indicators are needed for green financing, the emission trading system and for dedicated EU funding. Otherwise, comparison and fair and efficient distribution of funding is not possible.
The level of ambiguities in the current KPIs was quantified and described in this article. The draft EPBD revision should limit them by clear boundary conditions and unambiguous assessment methods.
Energy policy is a **shared competence** between Europe and the Member States based on the **subsidiarity principle**. Member States shall set the requirements level considering the heterogeneity of their building stock.
But for the reasons mentioned before, there **must be EU common technical rules** to create a **level playing field for comparable assessment and requirements**. This target is not reached yet. T**he technical quality must still be upgraded in the draft EPBD revision.**
The EPC RECAST project will contribute to reach this target and provide recommendations for comparability and better understanding of EPCs at EU level.

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[3] Commission delegated regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives

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