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ANNEX 7

ANNEX

to the

COMMUNICATION TO THE COMMISSION

Approval of the content of the draft Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Zero Emission Buildings (Articles 7 and 11)

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to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Zero Emission Buildings (Articles 7 and 11)

1. ZERO EMISSION BUILDINGS (ZEB): DEFINITION AND RELATED PROVISIONS

Buildings are a major source of direct and indirect greenhouse gas (GHG) emissions and one of the hardest sectors to decarbonise. To meet the Union's longer-term climate neutrality goals, it is necessary to significantly reduce the operational energy consumption of buildings, while starting to consider buildings' full life cycle GHG emissions. Although improving the energy and climate performance of the existing building stock is key for this process, it is also important that new buildings being constructed have very low energy consumption and operational emissions from the start, avoiding the need for further intervention.

Therefore, the recast Energy Performance of Buildings Directive ('the recast EPBD')[1] introduces the requirement that all new buildings must be zero-emission buildings. Article 2(2) of the Directive defines a zero-emission building (ZEB) as a building:

- with a very high energy performance, as determined in accordance with Annex I,
- requiring zero or a very low amount of energy,
- producing zero on-site carbon emissions from fossil fuels,
- producing zero or a very low amount of operational greenhouse gas emissions
- in accordance with Article 11

Article 11 of the Directive sets out the detailed requirements for a ZEB, both new and existing.

Article 7 of the Directive indicates the timeline for the application of ZEB requirements to new buildings. In addition, it provides that several issues must also be addressed for new buildings, namely: optimal indoor environmental quality, adaptation to climate change, fire safety, risks related to intense seismic activity, accessibility for persons with disabilities and carbon removals associated to carbon storage in or on buildings.

Annex I to the Directive updates the calculation methodology for the energy performance of buildings.

2. ARTICLE 11(1) - ZERO ON-SITE EMISSIONS FROM FOSSIL FUELS

Article 11(1) states that a ZEB must "not cause any on-site carbon emissions from fossil fuels".

This means that the combustion of fossil fuels to generate energy on-site to supply the building needs within the recast EPBD scope[2] is not allowed. 'Fossil fuels' are defined in

[1] Directive (EU) 2024/1275

[2] The recast EPBD scope is defined in Annex I of the Directive and comprises the energy use for space heating, space cooling, domestic hot water, ventilation, built-in lighting and other technical building systems.

Article 2(62) of Regulation (EU) 2018/1999[3] as 'non-renewable carbon-based energy sources such as solid fuels, natural gas and oil'. This definition is in line with the Eurostat definition[4]: 'non-renewable energy sources such as coal, coal products, natural gas, derived gas, crude oil, petroleum products and non-renewable wastes'.

Examples:

- The use of on-site heating systems powered by natural gas, oil and petroleum products, or coal and coal products is not compliant with Article 11(1).
- The use of heat pumps, solar-thermal and bioenergy-based[5,6] heating systems is compliant with Article 11(1).

3. ARTICLE 11(7) - SOURCES OF ENERGY SUPPLY

Total primary energy use of a ZEB must be fully covered on an annual basis by one or a combination of the following options:

(a) energy from renewable sources generated on-site or nearby, fulfilling the criteria laid down in Article 7 of Directive (EU)2018/2001[7];

(b) energy from renewable sources provided from a renewable energy community within the meaning of Article 22 of Directive (EU)2018/2001;

(c) energy from an efficient district heating and cooling system in accordance with Article 26(1) of Directive (EU)/2023/1791[8]; or

(d) energy from carbon-free sources.

3.1. Renewable energy

The meaning of 'energy from renewable sources' is as defined in Article 2(14) of the Directive, mirroring the definition of Directive (EU) 2018/2001, i.e. 'energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogases.

Furthermore, for the purpose of Article 11(7), the scope of energy from renewable sources must be narrowed to the eligible renewable sources defined by Article 7 of Directive EU/2018/2001. Notably, biofuels, bioliquids and biomass fuels that do not fulfil the

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3 Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action Regulation - 2018/1999 - EN - EUR-Lex (europa.eu)

4 Eurostat, Glossary:Fossil fuel - Statistics Explained (europa.eu)

5 The negative impact of bioenergy on indoor and outdoor air quality is regulated by the Directive (EU) 2024/2881 of the European Parliament and of the Council of 23 October 2024 on ambient air quality and cleaner air for Europe (recast)

6 Sustainable use of bioenergy is stringent since "carbon removals [in the land use, land-use change, and forestry (LULUCF) sector] have and continue to decline at a worrying speed in recent years" and "there are many indications that, because of climate change, the future robustness of EU forest removals is far from guaranteed" as found by the Climate Action Progress Report 2024.

7 Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast). Directive - 2018/2001 - EN - EUR-Lex (europa.eu)

8 Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast). Directive - 2023/1791 - EN - EUR-Lex (europa.eu)

sustainability and greenhouse gas emissions saving criteria laid down in Articles 29(2) to (7) and 29(10) of Directive (EU) 2018/2001 must not be considered.

3.1.1. Renewable energy produced on-site and nearby

Renewable energy produced on-site should be considered in relation to Article 2(54) that defines 'on-site" as '*in or on a particular building or on the land on which that building is located'*.

Recital 22 of the Directive provides examples of on-site renewable energy sources such as solar thermal, geothermal, solar photovoltaics, heat pumps, hydroelectric power, and biomass. Recital 22 also specifies that 'energy derived from combustion of renewable fuels is considered to be energy from renewable sources generated on-site where the combustion of the renewable fuel takes place on-site'. This makes it clear that the on-site use of systems powered by bioenergy is covered. Note that bioenergy produced outside the building's boundary will continue to be considered distant energy when calculating the energy performance and when setting the energy demand threshold of a ZEB, in accordance with Annex I of the Directive and the ISO standards indicated in Annex I (1).

Article 2(55) defines energy from renewable sources produced nearby as 'energy from renewable sources, produced within a local or district-level perimeter of a particular building, which fulfils all of the following conditions:

(e) it can be distributed and used only within that local and district-level perimeter through a dedicated distribution network;

(f) it allows for the calculation of a specific primary energy factor valid only for the energy from renewable sources produced within that local or district-level perimeter; and

(g) it can be used on-site through a dedicated connection to the energy production source, where that dedicated connection requires specific equipment for the safe supply and metering of energy for self-use of the building'.

An example of renewable energy produced nearby is a heating system powered by solar-thermal energy and/or bioenergy that produces the energy for a group of buildings located in the vicinity of each other, where there is a direct connection between the building and the system and where the renewable share and associated primary energy factor can be identified and calculated. A typical example of this is a hospital or university campus.

The definitions of renewable energy produced 'on-site' and 'nearby' are also aligned to EN ISO 52000-1 standard. They are relevant both to nearly zero-energy buildings (NZEB) and zero-emission buildings.

Since a ZEB may also be supplied by energy from carbon-free sources (see guidance below on this option), the definition of renewable energy from 'nearby' must be taken in its stricter sense and only renewable energy that is connected to the building by a 'dedicated connection to the energy production source' should be considered as generated 'nearby'. In this way, 'nearby' renewable energy can be precisely identified and metered and be distinct from (other) 'energy from carbon-free sources'. This clarification may encourage local authorities to prioritise a particularly high local renewable potential.

3.1.2. Renewable energy from a renewable energy community

As defined in Article 2(16) of Directive (EU) 2018/2001 and described in Article 22 of the same Directive, a 'renewable energy community' means a legal entity that fulfils three conditions, namely:

- ‘which in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity;
- the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities;
- the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.’

3.2. Efficient district heating and cooling system

Efficient district heating and cooling systems are described in Article 26(1) and (2) of Directive (EU) 2023/1791. Article 26(1) of that Directive sets out the conditions for district heating and cooling systems to be considered ‘efficient’; this is based on a gradual increase of the share of renewable energy, waste heat and high-efficiency cogeneration[9] until 2050 as follows:

- ‘until 31 December 2027, a system using at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat;
- from 1 January 2028, a system using at least 50 % renewable energy, 50 % waste heat, 50 % renewable energy and waste heat, 80 % of high-efficiency cogenerated heat or at least a combination of such thermal energy going into the network where the share of renewable energy is at least 5 % and the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 50 %;
- from 1 January 2035, a system using at least 50 % renewable energy, 50 % waste heat or 50 % renewable energy and waste heat, or a system where the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 80 % and in addition the total share of renewable energy or waste heat is at least 35 %;
- from 1 January 2040, a system using at least 75 % renewable energy, 75 % waste heat or 75 % renewable energy and waste heat, or a system using at least 95 % renewable energy, waste heat and high-efficiency cogenerated heat and in addition the total share of renewable energy or waste heat is at least 35 %;
- from 1 January 2045, a system using at least 75 % renewable energy, 75 % waste heat or 75 % renewable energy and waste heat;
- from 1 January 2050, a system using only renewable energy, only waste heat, or only a combination of renewable energy and waste heat.’

Article 26 (2) introduces alternative criteria for efficient district heating and cooling systems based on the gradual reduction of greenhouse gas emissions by 2050:

- until 31 December 2025: 200 grams/kWh;
- from 1 January 2026: 150 grams/kWh;

[9] High-efficiency cogeneration is defined in Article 2(40) of Directive EU/2023/1791 such as ‘cogeneration meeting the criteria laid down in Annex III’. See Annex III to Directive EU/2023/1791 for the criteria defining high-efficiency cogeneration.

- from 1 January 2035: 100 grams/kWh;
- from 1 January 2045: 50 grams/kWh;
- from 1 January 2050: 0 grams/kWh

The Commission Recommendation (EU) 2024/2395[10] setting out guidelines for the interpretation of Article 26 of Directive (EU) 2023/1791 provides more details.

3.3. Energy from carbon-free sources

In line with the objectives shared by co-legislators, energy from carbon-free energy sources comprise renewables and nuclear energy[11].

Some examples of energy from carbon-free sources:

- renewables or nuclear from the electricity grid,
- renewables and waste heat from a district heating system that is not considered efficient under Article 26 of Directive (EU) 2023/1791,

When quantifying the amount of 'energy from carbon-free sources' delivered to an individual building, it is recommended that the share of carbon-free sources in the electricity mix of the grid and the share of carbon-free sources in the energy mix of a district heating system be considered.

3.4. Total primary energy use covered on annual basis and exemptions

The calculation of the total annual primary energy use of a ZEB must be done following the methodology defined by Annex I to the Directive to determine the energy performance of the building. In particular, the approach must:

- be based on estimates and projections of the energy needs of the building and primary energy supply using monthly, hourly or even sub-hourly time calculation intervals in order to account for varying conditions;
- make use of primary energy factors or weighting factors, which in turn must be forward looking, be based on relevant information and take into account the expected energy mix on the basis of national energy and climate plans[12].

Article 11(7) provides that the total annual primary energy use of a new or renovated ZEB must be fully covered by the options listed in points (a) to (d) of that Article (while, as provided in Article 11(1), the on-site use of fossil fuels is clearly not allowed to cover the energy needs within the recast EPBD's scope).

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[10] Commission Recommendation (EU) 2024/2395 of 2 September 2024 setting out guidelines for the interpretation of Article 26 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the heating and cooling supply Commission Recommendation (EU) 2024/2395 of 2 September 2024 setting out guidelines for the interpretation of Article 26 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the heating and cooling supply (europa.eu)

[11] Nuclear energy is a low-carbon energy source but its operational carbon emissions are considered zero in the GHG emissions inventory for the UNFCC, in a similar way as renewables. More details in Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change at ipcc_wg3_ar5_chapter7.pdf and in The IPCC Task Force on National Greenhouse Gas Inventories (TFI) at TFI — IPCC

[12] For more details, see guidance on Common general framework for the calculation of the energy performance of buildings in Annex 12 to the Commission Notice providing guidance on new and substantially modified provisions of the recast Energy performance of Buildings Directive (EU) 2024/1275.

One possibility is that the total primary energy use of a ZEB over a year is fully and continuously covered by one or more of the options under (a) to (d). However, a ZEB may also temporarily be supplied by other energy sources, including energy with carbon content, and compensate this non-compliant energy[13], on an annual basis, by the renewable energy produced on-site and either used on-site for non-EPB uses[14] or exported to the grid.

An example for compensating non-compliant energy used by the renewable energy produced on-site and either exported to the grid or used on-site for non-EPB uses is presented in below figures and tables. It is a building that uses 14 500 kWh/y over a year and within the recast EPBD scope, out of which 6 500 kWh/y is electricity and 8 000 kWh/y heat energy. The heat energy use is fully covered by an efficient district heating system with a primary energy factor (PEF) of 1.2. The building has an on-site photovoltaic system (e.g. on the rooftop, on the building's façade or on balconies) that produces 6 400 kWh/y out of which 2 000 kWh/y are delivered to the on-site EPB uses, 1 800 kWh/y to the on-site non-EPB uses and 2 600 kWh/y are exported to the electricity grid. The additional electricity need of the building is covered by electricity from the grid having a mix of 27% renewables, 37% nuclear and 36% fossil fuels with an average PEF of 2.3, i.e. PEF=1 for renewables, PEF=3 for nuclear and PEF=2.5 for fossil fuels -based electricity (n.b. PEF_{el} = 0.27*1 + 0.37*3 + 0.36*2.5 = 2.3).

Therefore, when expressed in total primary energy, the building uses 4 050 kWh/y electricity of fossil fuels origin from the grid that is not compliant to the requirements of Article 11 (7) of the Directive. At the same time, from the on-site PV electricity production, 1 800 kWh/y are used by other on-site non-EPB uses and 2 600 kWh/y are exported to the electricity grid.

This means that when calculating the total primary energy use of the building on annual basis, the renewable energy produced on-site and exported to the electricity grid or used on-site for non-EPB uses amounts to 4 140 kWh/y and fully compensates the 4 050 kWh/y electricity of fossil fuels origin from the grid.

In below tables, the calculation of the total energy consumption of the building in primary energy use and the coverage of the total primary energy use of the building by options (a) – (d) from Article 11(7) of the Directive are performed in two boundary conditions: building assessment boundary and building site boundary. The results should be the same in both cases.

[13] Namely energy from sources other than those specified in Article 11(7).

[14] Other on-site energy use that is outside the recast EPBD's scope as defined in Annex I(1) is use by consumers such as energy used for recharging e-vehicles, ICTs (other than those which are part of a technical building system), TV sets, washing machines, dishwashers, cooking appliances, etc.

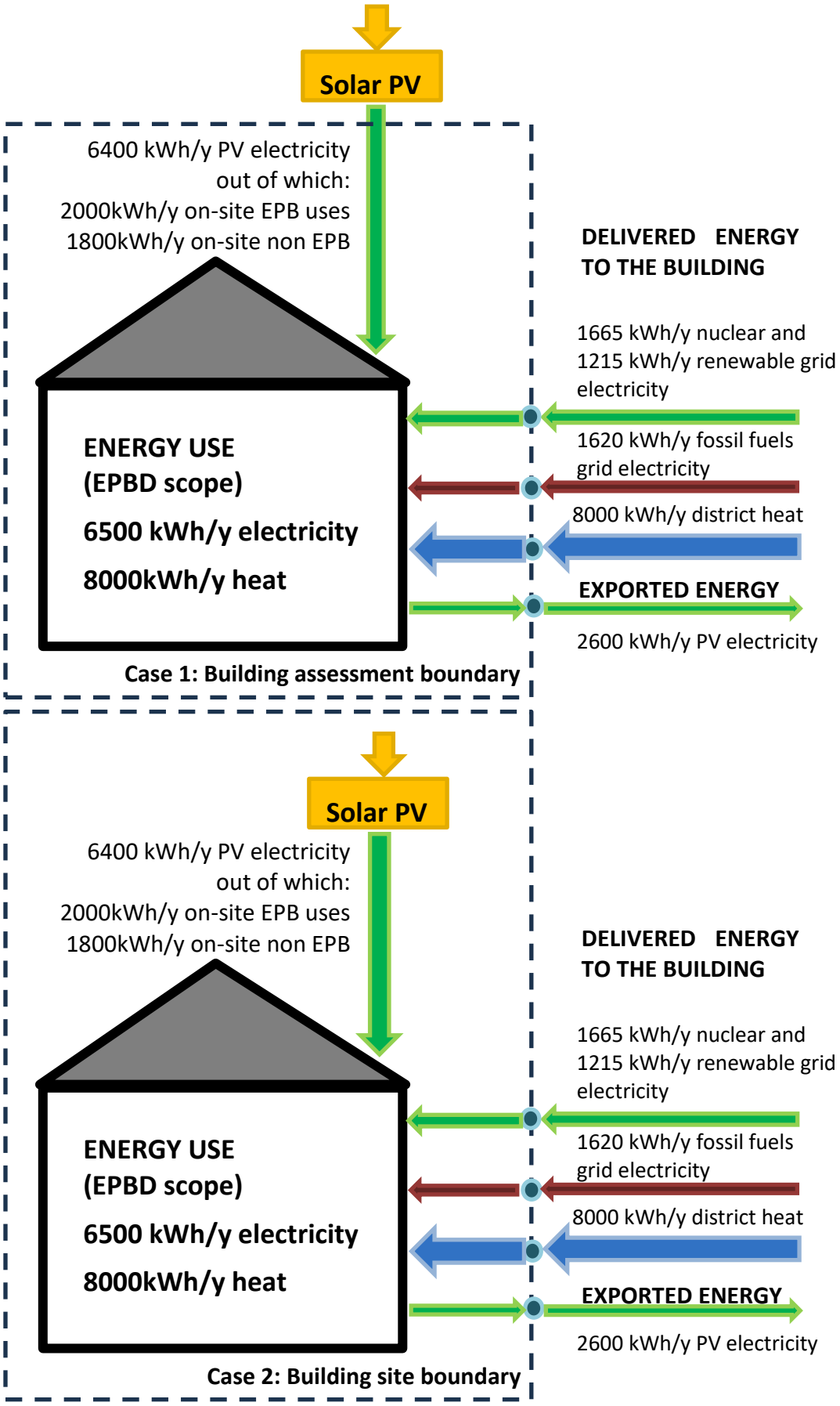

Figure 1: Building assessment boundary (Case 1, top picture) and building site boundary (Case 2, bottom picture) for primary energy calculation.

Table 1: Total primary energy use of the building and compensation of the non-compliant energy from the grid by the renewable energy produced on-site and either exported to the grid or used on-site for non-EPB uses

	Case 1: Building assessment boundary				Case 2: Building site boundary		
	Delivered and exported energy	PEF[15]	$M_{primary}$[16]	Total primary energy	Delivered and exported energy	PEF	Total primary energy
	[kWh/y]	[-]	[-]	[kWh/y]	[kWh/y]	[-]	[kWh/y]
rooftop PV	6 400	1	0	0			
PV electricity used on-site for non-EPB uses	1 800	1	1	1 800	1 800	1	1 800
exported PV electricity to grid	2 600	0.9	1	2 340	2 600	0.9	2 340
electricity from the grid:	4 500	2.28	1	10 260	4500	2.28	10 260
out of which:							
renewable	1 215	1	1	1 215	1 215	1	1 215
nuclear	1 665	3	1	4 995	1 665	3	4 995
fossil	1 620	2.5	1	4 050	1 620	2.5	4 050
heat from an efficient district heating	8 000	1.2	1	9 600	8 000	1.2	9 600
Total primary energy (for energy demand threshold)				**15 720**			**15 720**
Covering total primary energy by a)-d) options from Article 11(7)				**17 280**			**17 280**
out of which:							
covering by rooftop PV				6 400			6 400
covering by renewable electricity				1 215			1 215
covering by nuclear				1 665			1 665
covering by efficient district heating				8 000			8 000

Another example (see below figures and tables), now with the energy balance calculated as per m2, is an efficient building with a heat pump that uses within the recast EPBD scope 20

15 PEF means primary energy factor.

16 $M_{primary}$ is the multiplier factor from delivered energy to primary energy. In case 1 from the above picture where using the building assessment boundary, the multiplier is necessary to specify which energy flow through the assessment boundary is considered. The multiplier is not necessary when using a building site boundary as in case 2 from the above picture where the on-site rooftop PV system is within the assessment boundary. More details in REHVA paper 'Primary energy and operational CO indicators calculation in revised EPBD' that is available here: EPBD_Guidance_2024.pdf

kWh/(m2.y) of electricity and 21.6 kWh/(m2.y) representing the ambient heat from outdoor air captured by the heat pump. The building has an on-site photovoltaic system (e.g. on the rooftop, on the building's façade or on balconies) that produces 22.8 kWh/(m2.y) out of which 5.6 kWh/(m2.y) are delivered to the on-site EPB uses, 6.6 kWh/(m2.y) to the on-site non-EPB uses and 10.6 kWh/(m2.y) are exported to the electricity grid. The additional electricity need of the building is covered by 14.4 kWh/(m2.y) electricity from the grid having a mix of 27% renewables, 37% nuclear and 36% fossil fuels with an average PEF of 2.3, i.e. PEF=1 for renewables, PEF=3 for nuclear and PEF=2.5 for fossil fuels -based electricity (n.b. PEF_{el} = 0.27*1 + 0.37*3 + 0.36*2.5 = 2.3).

Therefore, when expressed in total primary energy, the building uses 12.96 kWh/(m2.y) electricity of fossil fuels origin from the grid that is not compliant to the requirements of options (a) – (d) of the Article 11 (7) of the Directive (see below table). At the same time, from the on-site PV electricity production, 6.6 kWh/(m2.y) are used by other on-site non-EPB uses and 9.54 kWh/(m2.y) are exported to the electricity grid.

This means that when calculating the total primary energy use of the building on annual basis, the renewable energy produced on-site and used on-site for non-EPB uses or exported to the electricity grid amount at 16.14 kWh/(m2.y) and over-compensate the 12.96 kWh/(m2.y) electricity of fossil fuels origin from the grid.

In below tables, the calculation of the total energy consumption of the building in primary energy use and the coverage of the total primary energy use of the building by options (a) – (d) from Article 11(7) of the Directive are performed in two boundary conditions: building assessment boundary and building site boundary. The results should be the same in both cases.

To note that in this case there is a relatively low amount of total primary energy use of the building that is not covered by options (a) – (d) from Article 11(7) and may be compensated additional renewable energy produced on-site and exported to the grid.

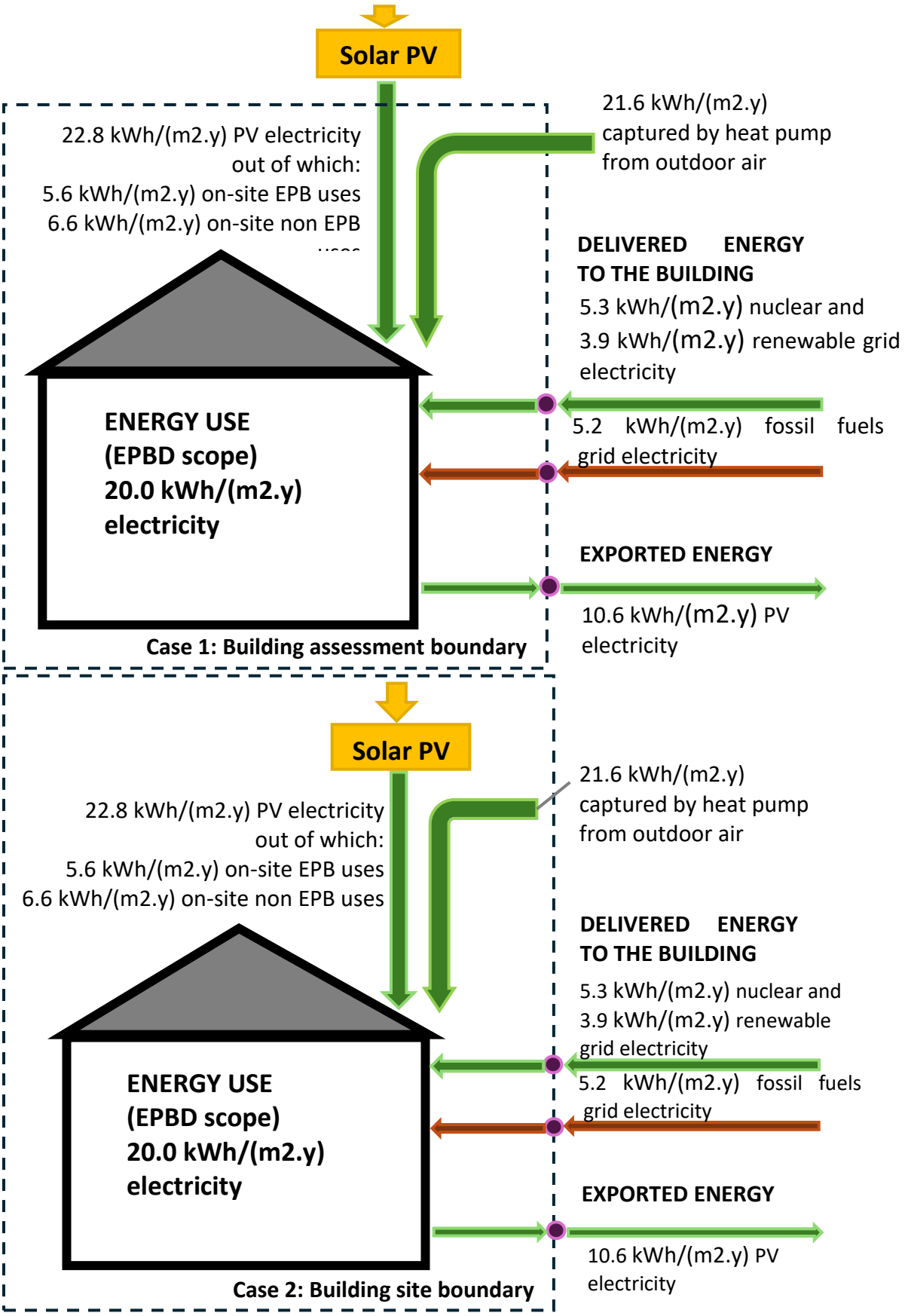

Figure 2: Building assessment boundary (Case 1, top picture) and building site boundary (Case 2, bottom picture) for primary energy calculation.

Table 2: Total primary energy use of the building and compensation of the non-compliant energy from the grid by the renewable energy produced on-site and either exported to the grid or used on-site for non-EPB uses

	Case 1: Building assessment boundary				Case 2: Building site boundary		
	Delivered and exported energy	PEF [17]	$M_{primary}$ [18]	Total primary energy	Delivered and exported energy	PEF	Total primary energy
	[kWh/(m2.y)]	[-]	[-]	[kWh/(m2.y)]	[kWh/(m2.y)]	[-]	[kWh/(m2.y)]
rooftop PV	22.8	1	0	0			
ambient heat for heat pump	21.6	1	0	0			
PV electricity used on-site for non-EPB uses	6.6	1	1	6.6	6.6	1	6.6
exported PV electricity to grid	10.6	0.9	1	9.54	10.6	0.9	9.54
electricity from the grid:	14.40	2.28	1.0	32.83	14.40	2.28	32.83
out of which:							
renewable	3.89	1.0	1	3.89	3.89	1	3.89
nuclear	5.33	3.0	1	15.98	5.33	3	15.98
fossil	5.18	2.5	1	12.96	5.18	2.5	12.96
Total primary energy (for energy demand threshold)				**16.7**			**16.7**
Covering total primary energy by a)-d) options from Article 11(7)				**53.6**			**53.6**
out of which:							
covering by rooftop PV				22.8			22.8
Covering by ambient heat for heat pump				21.6			21.6
covering by renewable electricity				3.9			3.9
covering by nuclear				5.3			5.3

17 PEF means primary energy factor.

18 $M_{primary}$ is the multiplier factor from delivered energy to primary energy. In case 1 from the above picture where using the building assessment boundary, the multiplier is necessary to specify which energy flow through the assessment boundary is considered. The multiplier is not necessary when using a building site boundary as in case 2 from the above picture where the on-site rooftop PV system is within the assessment boundary. More details in REHVA paper on Primary energy and operational CO indicators calculation in revised EPBD 2 that is available here: EPBD_Guidance_2024.pdf

Another possibility to comply with the provisions of Article 11(7) of the Directive is provided by the last sentence of the paragraph stating that where it is not technically or economically feasible to cover the total annual primary energy use of a ZEB by options (a) to (d), it is possible to use other energy from the grid complying with criteria established at national level.

As a first step, Member States must detail in which specific cases meeting the requirements of Article 11(7) is not feasible from a technical or economic perspective[19]. These cases should be clearly identified categories of buildings and/or specific situations with concrete limitations due to, for example, local weather conditions and context. They should be transparently set out, made publicly available and be applied in a non-discriminatory way. As is the case for all exemptions, the exemption related to technical and economic feasibility should be narrowly interpreted.

Technical feasibility should be assessed with a view to contextual limitations and local conditions.

As an example, it might not be technically feasible to ensure 100% of supply using the options (a) to (d) due to local limitations. For example, in the case of multi-family buildings in high-density environments where the rooftop is not large enough for the use of solar thermal and an inefficient district heating system is in place, 100% compensation by on-site renewables is not technically feasible due to the lack of space (e.g. insufficient surface area for solar panels) and other solutions are not feasible (e.g. it is not possible to install heat pumps in each apartment due to space limitations, nor to install a heat pump supplying the whole multi-family building).

Another example may be remote buildings in a low-density community in a mountain area with a heat pump supplied by electricity that is not decarbonised, where the compensation by solar power is not feasible (e.g. due to the shading induced by surrounding mountains or trees or other climatic conditions which do not allow for efficient solar installations).

As regards economic feasibility, Member States could establish that it is economically feasible to cover the total primary energy use of a building using options (a) to (d) where the expected benefits outweigh the costs of the required intervention, taking into account the expected lifetime of the system; for example, the compensation by solar electricity would be considered economically feasible where, over the expected lifetime of the solar panels, the expected economic benefits of producing solar electricity outweigh the costs of installing the solar panels.

It is important to underline that the exemption for non-feasibility only relates to covering the annual energy use by options (a) to (d). The other ZEB requirements (very high energy performance and no carbon emissions from fossil fuels) must always be respected. Also, buildings that cannot fulfil the requirements using options (a) to (d) should still contribute to decarbonising the building stock as much as possible.

As a second step, Member States must establish national criteria for those buildings where full compliance with Article 11(7) is not feasible. In their national criteria, Member States should still aim to maximise the use of renewable energy sources and other sources listed in options (a) to (d).

[19] For more details, see the section on technical, economic and functional feasibility from the guidance on technical building systems, indoor environmental quality and inspections in Annex 10 to the Commission Notice providing legal and practical guidance on new and substantially modified provisions of the recast Energy performance of Buildings Directive (EU) 2024/1275.

Member States are also encouraged to take additional and parallel measures, so that buildings that fail to meet the requirements of Article 11(7) can still contribute effectively to a decarbonised building stock. Measures could include:

- Additional minimum energy performance requirements for elements of the building envelope. For example: the national criteria may comprise specific stricter requirements for the thermal transmittance (U-value) of building envelope elements (e.g. walls, windows) from a dense urban area.
- Minimum levels of coverage by renewable energy. For example: a minimum 60% coverage.
- Minimum levels of on-site renewable energy production. For example: 80% of roof must be used for solar energy generation or 60% of roof and at least 10% of façade must be used for integrated solar photovoltaic systems, in accordance with the optimised solar energy generation potential under Article 10(1).
- Minimum levels of connectivity and demand response. For example: buildings must achieve a minimum SRI (smart readiness indicator) score for the capacity to adapt to signals from the grid and demand response criteria.

4. ARTICLE 11(2) AND (3) - MAXIMUM THRESHOLD FOR ENERGY DEMAND

According to Article 11(2) and (3), a ZEB must comply with a maximum threshold for its energy demand. The maximum energy demand threshold must comply with several conditions:

- It must be set 'with a view to achieving at least the cost-optimal levels established in the most recent national cost-optimal report pursuant to Article 6';
- It must be revised 'every time that the cost-optimal levels are revised';
- It must be 'at least 10% lower than the threshold for total primary energy use established at Member State level for nearly zero-energy buildings on 28 May 2024'.

The energy demand threshold for ZEBs is to be interpreted in the context of all requirements under Article 11 of the Directive. Article 11(3) links the maximum energy demand threshold of a ZEB to the threshold for total primary energy use for nearly-zero energy buildings. Consequently, the maximum energy demand threshold must also be set for total primary energy use (both renewable and non-renewable), reflecting the energy performance of the building, which is expressed in kWh/(m^2.y) and calculated in accordance with Annex I to the Directive[20].

Acknowledging the different energy consumption patterns due to the type of activities, occupancy and climatic context, the maximum energy demand thresholds for ZEBs can be established for different building types, taking into consideration the outdoor climate conditions (e.g. climatic zones) and local context, as shown in the energy performance calculation methodology set out in Annex I.

[20] For more details, see guidance on Common general framework for the calculation of the energy performance of buildings in Annex 12 to the Commission Notice providing legal and practical guidance on new and substantially modified provisions of the recast Energy performance of Buildings Directive (EU) 2024/1275.

Furthermore, Article 11(2) states that the maximum energy demand threshold must be set 'with a view to achieving at least the cost-optimal levels established in the most recent national cost-optimal report pursuant to Article 6' and that it must be reviewed 'every time that the cost-optimal levels are revised'.

This indicates that the maximum energy demand threshold should be at least at cost-optimal levels and may be established as part of the cost-optimal calculation. The cost-optimal calculation must be carried out in accordance with Article 6(2) of the Directive and following the Commission Delegated Regulation (EU) …/2025 concerning the establishment and revision of a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements[21]. In accordance with Article 6(2), Member States must report their cost-optimal calculations to the Commission at regular intervals not longer than 5 years. The first report based on the revised Delegated Regulation is due by 30 June 2028. Under Article 11(2), Member States must revise the maximum energy demand threshold for ZEBs every time that the cost-optimal levels are revised; however, if the updated cost-optimal reports do not entail any changes to the cost-optimal levels, there will be no need to change the maximum energy demand threshold for ZEBs.

Nonetheless, in accordance with Article 7(1) of the Directive, the first maximum energy demand thresholds for ZEBs must be established in time for the application of ZEB requirements for new buildings, namely:

- from 1 January 2028 for new buildings owned by public bodies; and
- from 1 January 2030 for all new buildings.

The 2028 update of cost-optimal reports under the revised Delegated Regulation 2025 will come too late to be relevant for the introduction of ZEB requirements for new buildings owned by public bodies and it may also be challenging to use them to set the maximum energy demand thresholds for all new buildings from the beginning of 2030. This means that, in order to apply the ZEB requirements in 2028 (new buildings owned by public bodies) and 2030 (all buildings), the maximum energy demand thresholds may first need to be based on the 2023 cost-optimal reports and then be revised following the 2028 cost-optimal reports.

The maximum energy demand thresholds for ZEBs must be reported to the Commission by the transposition deadline for this Directive; Member States must also report them through the national building renovation plans.

According to Article 11(3), the maximum energy demand threshold of a ZEB must be 'at least 10% lower' than the threshold for 'total primary energy use' as established at Member State level for nearly zero-energy buildings on 28 May 2024[22]. This 'NZEB -10%' cap will remain in place over time, which means that the maximum energy demand threshold for ZEBs cannot be revised upwards beyond this cap, irrespective of the results of future cost-optimal calculations.

Meanwhile, the methodological framework for the calculation of the energy performance of buildings changed slightly with the amendments to Annex I to the Directive. Furthermore, Delegated Regulation (EU) …/2025 introduces additional changes compared with Delegated Regulation (EU) No 244/2012, in line with Article 6 and Annex VII. Additionally, the current thresholds for nearly-zero energy buildings are not always defined in terms of total primary

[21] Commission Delegated Regulation (EU) …/2025 concerning the establishment and revision of a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements.

[22] The date of entry into force of Directive (EU) 2024/1275.

energy use, unlike the maximum energy demand threshold for ZEBs, which have to be expressed in terms of total primary energy use.

Therefore, the thresholds in place on 28 May 2024 for nearly-energy buildings must be "translated" to current requirements of the recast Directive to be meaningful as a reference for the maximum energy demand thresholds for ZEBs. This adaptation may be done by revisiting the calculation for the thresholds for nearly-zero energy buildings, which are assumed to have been established with a view to the 2018 cost-optimal reports.

This diagram below shows an example on how to set the maximum energy demand threshold over time and in relation to the results of the cost-optimal calculation.

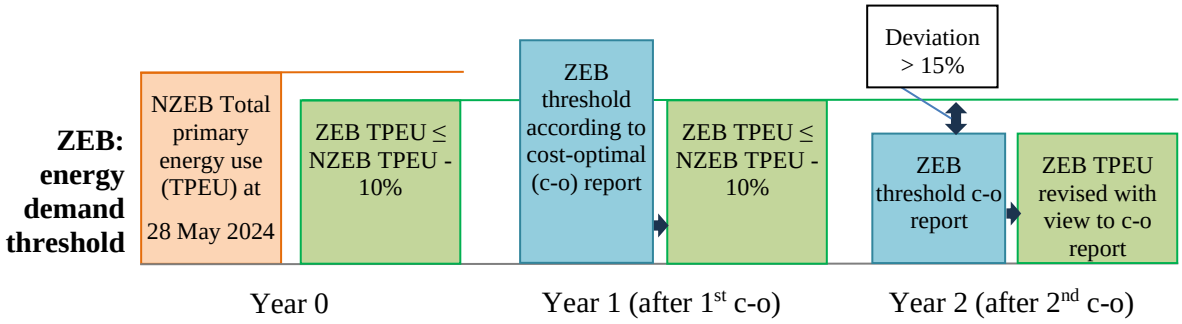

Figure 3: Example on how to review and revise, if necessary, the energy demand threshold for zero emission buildings

5. ARTICLE 11(4) – MAXIMUM ENERGY DEMAND THRESHOLD FOR ZEB AFTER RENOVATION

Article 11(4) of the Directive provides for the possibility of adjusting the maximum energy demand threshold of a ZEB for renovated buildings. The maximum energy demand threshold for renovated buildings must also be set with a view to achieving cost-optimal levels.

The 'NZEB -10%' cap also applies, but only if Member States have established specific thresholds for renovated nearly-zero energy buildings.

As in the case of new ZEBs, the 'NZEB -10%' cap (where it applies) will remain in place over time and the maximum energy demand threshold for ZEBs cannot be revised upwards, irrespective of the results of future cost-optimal calculations.

The maximum energy demand threshold for renovated ZEBs is particularly relevant in relation to Article 2(20), which introduces a new deep renovation standard: deep renovation is defined as a renovation in line with the 'energy efficiency first' principle, transforming a building or a building unit into a nearly-zero energy building before 1 January 2030, and into a zero-emission building from 1 January 2030.

The ZEB threshold for renovated buildings is also relevant for the designation of energy performance class A for renovated buildings and for Article 6(1) of Directive (EU) 2023/1791 on the 'exemplary role of public bodies' buildings', which requires that 'at least 3% of the total floor area of heated and/or cooled buildings that are owned by public bodies is renovated each year to be transformed into at least nearly zero-energy buildings or zero-emission buildings'.

The energy demand thresholds for renovated ZEBs must be reported to the Commission by the transposition deadline for this Directive and through the national building renovation plans.

6. ARTICLE 11(5) - MAXIMUM THRESHOLD FOR OPERATIONAL GHG EMISSIONS

Article 11(5) provides that Member States have to establish a maximum threshold for the operational greenhouse gas emissions of ZEBs. The maximum operational greenhouse gas emissions thresholds may be set at different levels for new and renovated buildings, and it is recommended that they be calculated based on the provisions of Annex I, in line with the building standards. It is also recommended that, where necessary, the building categories and climatic and local conditions be taken into consideration when calculating the maximum energy demand thresholds.

The maximum threshold for operational greenhouse gas emissions must be expressed in $kgCO_2eq/(m^2 .y)$ in accordance with Annex I(3).

When setting the thresholds for the operational greenhouse gas emissions of ZEBs, both the operational greenhouse gas emissions released on-site (direct GHG emissions) and those caused by the off-site generation of energy used by the building (indirect GHG emissions) should be considered.

According to Article 11(1), a ZEB must not have direct operational greenhouse gas emissions from the on-site use of fossil fuels. However, the on-site use of bioenergy is allowed under Article 11(1) and the resulting operational greenhouse gas emissions should be taken into account. The consideration should follow the approach from the annual European Union greenhouse gas emissions inventory and as indicated in the IPCC guidelines for national greenhouse gas inventories[23].

The indirect operational greenhouse gas emissions from the off-site generation of energy used by the building include the following:

- greenhouse gas emissions from the use of efficient district heating and cooling systems (i.e. option c) of Article 11(7))
- greenhouse gas emissions from the use of electricity generated off-site or heat from district heating and cooling systems or other secondary energy products with carbon content that may be consumed on an annual basis (being either compensated by the renewable energy produced on-site and exported to the grid or used on-site for non-EPB uses, or allowed under the exemption related to technical and economic feasibility)

The operational greenhouse gas emissions from the building's energy use cannot be physically eliminated by the export to the grid or by the on-site use for non-EPB uses of the carbon-free energy produced on-site. However, it is possible to consider that the carbon-free energy produced on-site and exported to the grid or used on-site for non-EPB uses will displace an equivalent amount of energy with carbon content elsewhere (for example, by supplying another building or by being used in another final sector).

Therefore, the operational greenhouse gas emissions displaced in the energy system by the renewable energy produced on-site and either exported to the grid or used on-site for non-EPB uses may be deducted from the sum of the direct and indirect operational greenhouse gas emissions presented above, if such option for compensation is part of national methodology

[23] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary combustion, Chapter 2.3.3.4.: Treatment of biomass and 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary combustion, Chapter 2.3.3.4: Treatment of biomass. Although the CO2 emissions from the combustion of biomass or biomass-based products are already included in the Agriculture, Forestry and Other Land-Use (AFOLU) sector, methane (CH4) and nitrous oxide (N2O) emissions are included in the sectoral total emissions.

and regulations. In all other cases it is recommended to provide as additional information the amount of exported energy as well as on potentially avoided GHG emissions elsewhere. The selection of the type of approach should be described and notified to the Commission together with the maximum operational GHG emissions threshold as indicated in Article 11(6).

It should be noted that this approach may lead to buildings with negative operational greenhouse gas emissions and this may introduce the risk of double counting. In these cases, Member States should address this by stopping the possible compensation of greenhouse gas emissions at net zero. The remaining GHG emissions displaced by the renewable energy produced on-site that is either used on-site by non-EPB uses or exported to the grid can be taken into account separately as another indication showing the building contribution to the decarbonisation of the whole building stock or economy[24].

The threshold for the operational greenhouse gas emissions of a ZEB may be set out together with the cost-optimal calculation or based on its results.[25]

For instance, the considerations on reference buildings, technology packages and variants, done in the framework of the cost-optimal calculations, may help Member States to lay down the greenhouse gas emissions thresholds for ZEB.

The operational greenhouse gas emissions thresholds of new ZEBs and renovated ZEBs must be reported to the Commission by the transposition deadline for this Directive and through the national building renovation plans.

Some examples of how to approach the calculation of the operational GHG emissions are presented below.

Example 1: A ZEB with useful floor area of 110 m^2 has an annual energy use of 6 000 kWh/y out of which 2 000 kWh/y is carbon-free electricity from a nearby photovoltaic generator (zero GHG emissions), while 4 000 kWh/y is heat from an efficient district heating system with an emission intensity of 140 g CO2eq/kWh. Therefore, the total operational greenhouse gas emissions of the ZEB in a year will be:

140 g CO_2eq/kWh * 4 000 kWh/y = 560 000 g CO_2eq = 560 kg CO_2eq/y.

Therefore, the annual operational greenhouse gas emissions of this ZEB represented per unit of floor area will be:

560 kg CO2eq / 110 m^2 = 5.1 kg CO2eq/(m^2 .y)

Example 2: A ZEB with useful floor area of 110 m^2 has an annual energy use over one year of 6 000 kWh/y (n.b. calculated as shown in the Guidance document for Annex I to the Directive). Of this, 1 200 kWh are from an on-site photovoltaic generator (zero GHG emissions), 800 kWh/y are from the electricity grid that has 80% carbon-free electricity and 20% electricity from fossil fuels with emission intensity of 200 g CO2eq/kWh, and 4 000 kWh/y are from an inefficient district heating system with 30% renewables and 70% fossil fuels with an emission intensity of 240 g CO2eq/kWh. On annual basis, the delivered energy with carbon content is:

[24] For more details about how to consider the operational GHG emissions due to the renewable energy produced on-site and either exported to the grid or used by other on-site non-EPB uses, see the standard EN 15 978 and the Commission Delegated Regulation on Union Framework for life-cycle GWP calculation pursuant to Article 7(3) of the Directive, due to be adopted by end of 2025.

[25] Commission Delegated Regulation (EU) No … supplementing Directive (EU) 2024/1275 of the European Parliament and of the Council as regards the establishment of a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements.

20% * 800 kWh/y + 70% * 4 000 kWh/y = 160 kWh/y + 2 800 kWh/y = 2 960 kWh/y

The annual emissions to the energy use with carbon content is:

(800 kWh/y * 20%) * 200 g CO2eq/kWh + (4 000 kWh/y * 70%) * 240 g CO2eq/kWh = 32 000 g CO2eq/y + 672 000 g CO2eq/y = 704 kg CO2eq/y

This energy with carbon content used by the building is partially compensated by an on-site photovoltaic generator that produced 4 200 kWh/y, out of which 1 200 kWh/y are used on-site for the EPB uses 1400kWh/y are used on-site for non-EPB uses (with a recommended PEF=1) and 1600 kWh/y are exported to the electricity grid (with a possible PEF=0.9). Therefore, the operational greenhouse gas emissions displaced by the renewable electricity produced on-site by the photovoltaic generator and exported to the grid in a year are:

-1 400 kWh/y * 1 * (20% * 200 g CO2eq/kWh) - 1 600 kWh/y * 0.9 * (20% * 200 g CO2eq/kWh) = - 113.6 kg CO2eq/y

Therefore, the annual greenhouse gas emissions of this ZEB represented per unit of useful floor area will be:

704 kg CO2eq/y – 113.6 kg CO2eq/y = 590.4 kg CO2eq/y

590 kg CO2eq / 110 m2 = 5.4 kgCO2eq/(m2 .y)

Example 3: For the second example from Chapter 3.4 of this Guidance document, i.e. a building with a heat pump and a rooftop PV system using electricity from the grid, the calculation of the operational GHG emissions is presented in Table 3 below.

If compensation is not considered, then the operational GHG emissions of the building will be the sum of the operational GHG emissions due to the energy use of the building. Therefore, the building will have 2.07 kg CO2 eq./(m2.y).

If compensation is considered, then the operational GHG emissions displaced by the PV electricity produced on-site and either used on-site for other non-EPB uses or exported to the grid will be deducted from the operational GHG emissions due to the energy use of the building. Therefore, the result will be -0.25 kg CO2 eq./(m2.y). As indicated above, in cases where compensation leads to negative operational GHG emissions building, the building should be attributed with zero emissions or 0 g CO2eq./(m2.y), while the difference can be taken into account separately.

Table 3: Example for the calculation of the operational GHG emissions

	Delivered and exported energy	**CO_2 emission coefficient**	**Offset factor**	**Operational GHG emissions**
	[kWh/(m2 y)]	**[g CO2eq/kWh]**	**[-]**	**[kg CO2eq/(m2 y)]**
electricity from the grid:				
renewable	3.89	0		0.00
nuclear	5.33	0		0.00
fossil	5.18	400		2.07
rooftop PV:				
exported PV electricity to grid	10.6	144	0.9	1.37
PV electricity to other non-EPBD uses	6.6	144	1	0.95

Total operational greenhouse gas emissions (without compensation)	**2.07**
Total operational greenhouse gas emissions (with compensation)	**-0.25**

To note that, according to local context, it is possible to further consider a lower greenhouse gas emissions intensity of the one of the electricity grid, e.g. because the amount of PV electricity produced on-site and exported to the grid may be higher during the summer season when the grid electricity mix has a lower share of fossil fuels. Consequently, in this case the displaced greenhouse gas emissions will be lower than when considering greenhouse gas emissions intensity of the annual electricity mix.

7. ARTICLE 11(1).2 - REACT TO EXTERNAL SIGNALS AND ADAPT

According to the second sentence of Article 11(1), a ZEB must, where economically and technically feasible, have the capacity to react to external signals and adapt its energy use, generation or storage.

This requirement should be understood in relation to Recital 23 that states that a ZEB 'can contribute to demand-side flexibility for instance through demand management, electrical storage, thermal storage and distributed renewable generation to support a more reliable, sustainable and efficient energy system'.

This means, in particular, that a ZEB must have technical building systems with the capacity to communicate with the grid and, whenever they receive the appropriate signal from the grid, to contribute to system flexibility by reducing their energy demand to the extent possible, by storing more energy when there is more and/or cheaper energy available, or by exporting more or less renewable energy generated on-site. A ZEB should interact dynamically with the energy system, while nevertheless prioritising the indoor comfort, liveability, reliability and proper functionality of the building and its technical systems.

A ZEB's capacity to react to external signals mainly concerns the technical building systems within the recast EPBD's scope but may also include other equipment in the building such as appliances and ICTs.

If a smart readiness indicator scheme exists, this can be used by defining minimum thresholds for the scores for adapting to signals from the grid for a ZEB.

More recommendations about how to implement this requirement can be found in the Guidance document for Article 13 of the Directive on technical buildings systems.

It should be noted that the capacity of a building to react to external signals and adjust the energy consumption must be shown on the energy performance certificates as indicated in Annex V.

A few examples of how ZEBs can react to external signals:

- The ZEB has (digital) demand response and demand management capabilities, at building level or at the level of the main equipment, meaning that, at electricity grid peak hours, the supply of a technical building system of the ZEB can be temporarily turned off or postponed, potentially based on a pre-defined protocol (e.g. turn off the heat pump if temperature is within a certain acceptable range).
- The ZEB has demand management capabilities that make it possible to maximise the use of cheaper electricity from the grid and to store it in on-site batteries or by heating water from the boiler that will then be used at a time of

day when electricity from the grid is more expensive and/or when the building needs are higher.

- The ZEB has a bi-directional electric vehicle charger that allows the vehicle's battery to temporarily support the electricity grid to cope with demand.

8. TIMELINE AND REPORTING

Article 7(1) states the dates from which new buildings must comply with ZEB requirements, namely:

- from 1 January 2028, for new buildings owned by public bodies [26]; and
- from 1 January 2030, for all new buildings.

According to Article 7(4), Member States may decide not to apply the ZEB requirements from paragraph 1 'to buildings for which building permit applications or equivalent applications, including for change of use, have already been submitted by the dates pursuant to paragraphs 1'.

Article 11(6) states that the maximum energy demand and operational greenhouse gas emissions thresholds for a ZEB, including a description of the calculation methodology per building type and relevant outdoor climate designation, must be notified to the Commission, which must review the thresholds and recommend adjustments where appropriate. According to Annex II(e), both thresholds must be reported through the national building renovation plans.

It is recommended that the initial proposals for the maximum energy demand thresholds and the greenhouse gas emissions thresholds be reported with the draft building renovation plans that are to be submitted to the Commission by the end of 2025, as set out in Article 3 of the Directive.

The maximum energy demand and operational greenhouse gas emissions thresholds must be laid down and reported by the end of the general transposition period for the recast EPBD, i.e. 29 May 2026, together with the transposition measures for the other requirements of Article 11.

[26] In Article 2(5) of Directive (EU) 2024/1275, the meaning of 'public bodies' is cross-referenced to the definition in Directive (EU) 2023/1791. According to Article 2(12) of Directive (EU) 2023/1791, 'public bodies' means national, regional or local authorities and entities directly financed and administered by those authorities but not having an industrial or commercial character.

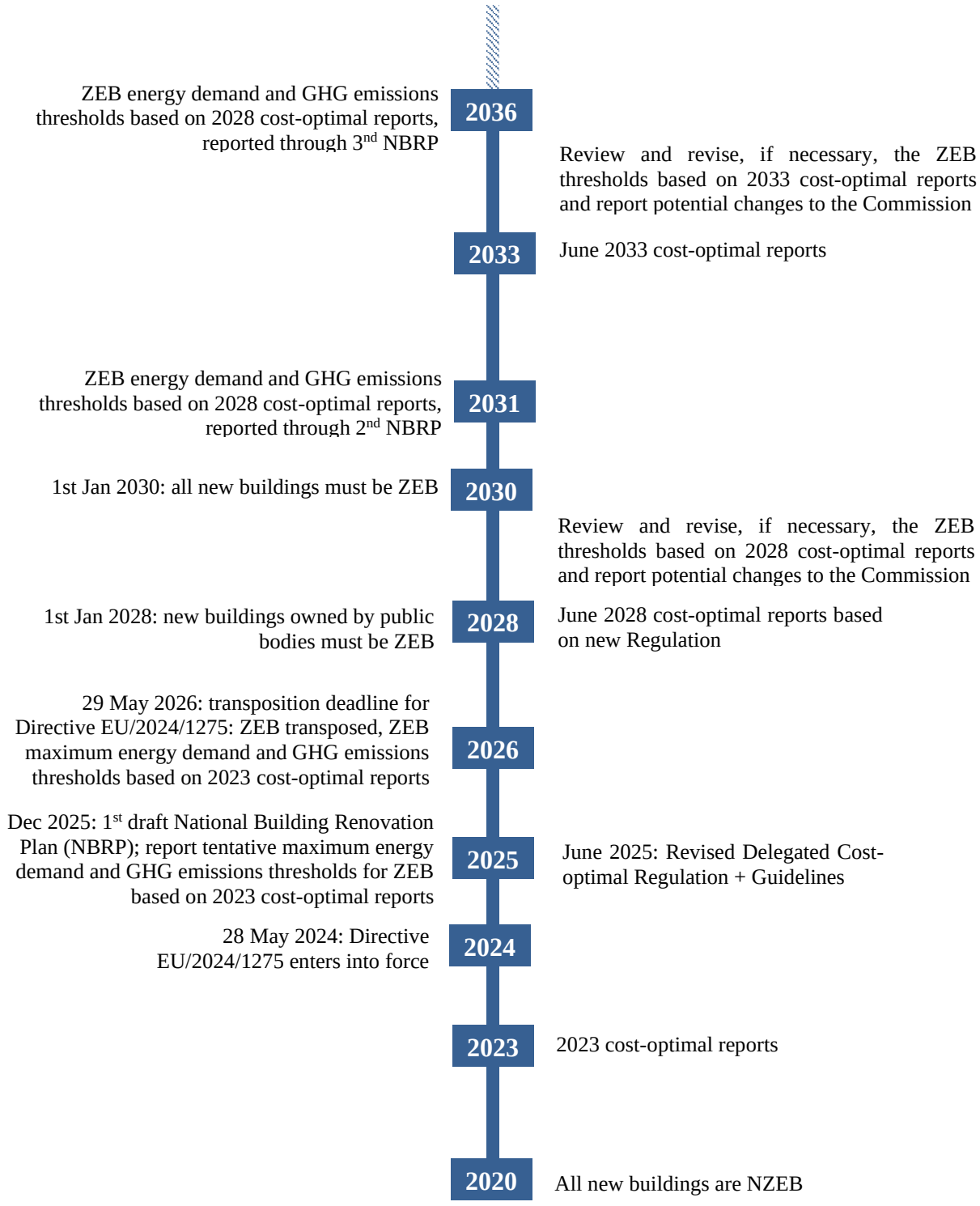

Figure 4: Timeline for zero-emission buildings