



NULLHEITEGA HOONED JA RENOVEERIMINE EPBD DIREKTIIVI UUSTÖÖTLUSES

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Teadmistepõhise
ehituse tippkeskus

Zero Energy Centre
of Excellence



EPBD 2002-2010-2018-2022

EPBD is in the third revision, the recast proposal was published in 15.12.2021, the Council version 21.10.2022

Main outcomes of EPBD:

- 2006-2008 energy frame and requirements based on the primary energy & energy performance certificates
- 2012-2013 cost optimal calculations – second round 2018 – progress easy to measure
- NZEB 12/2018 and 12/2020, NZEB level finally at least the 2021 cost-optimal level
- 2018 revised EPBD: long term renovation strategy & smart readiness

A zero emission building stock by 2050

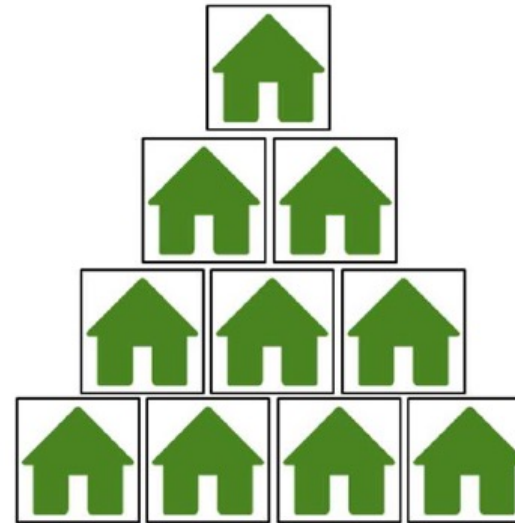
EU avg 2019:
22% of renewables H&C
34% renewable electricity*



G class building



Powered by renewables
zero direct CO2 emissions



ZEB building



MANY NEW ITEMS

- Zero-emission buildings
- Deep renovation (and major renovation)
- Minimum energy performance standards MEPS
- Harmonised EPC scale
- ~~Hourly energy calculation method~~
- Non-res. ZEBs to be equipped with measuring and control devices for the regulation of IAQ
- Inspection of stand-alone ventilation systems

Main changes compared to 2018 EPBD



- A new vision to transform EU building stock into zero-emission buildings by 2050
- The main new instrument to realize the ambition are National building renovation plans that are next step from long term renovation strategies

ZERO-EMISSION BUILDINGS ZEB

- New public buildings shall be ZEB from 2028 and all new buildings from 2030
- For existing buildings, major renovation and Minimum Energy Performance Standards (MEPS) requirements

ZEB definition (Art 2):

- 'zero-emission building' means 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 and producing zero or a very low amount of operational greenhouse gas emissions, in accordance with the requirements set out in Article 9b

ARTICLE 9B – ZERO-EMISSION BUILDINGS REQUIREMENTS

1. Requires to set a maximum **threshold of the energy use**, to be at least cost optimal (Annex I requires numeric indicator of primary energy use)
2. Requires to set a maximum **threshold of the operational greenhouse gas emissions** (Both thresholds may be adjusted for renovated buildings – deeply renovated building may have another EP-value than new ZEB)
3. The total annual primary energy use of a new or renovated ZEB is to be **covered, where technically and economically feasible**, by:
 - On-site, nearby, renewable energy community generated renewable energy
 - Effective district heating and cooling
 - Energy from carbon free sources (refers to grid electricity)
4. ZEB cannot cause any **on-site carbon emissions from fossil fuels**

ENERGY PERFORMANCE CERTIFICATES (ART. 16)

- Energy performance certificate scale is planned to be harmonised from 2027 so that:
 - **Class A⁰ is ZEB**
 - **Other classes are only letters from A to G**
 - **G shall correspond to worst performing buildings in the building stock**
 - Voluntary A+ to buildings which in addition to being ZEB also make a positive net annual contribution to the energy grid from on-site renewables, calculated in terms of total primary energy (excluding ambient heat)
- There is no guidance how the classes should be divided, but the same scale must be used both for new and existing buildings (the major renovation requirements do not need to be class A)
- **Life cycle carbon footprint** (GWP with the Level(s) framework) is required to be calculated and reported in EPCs from 2027 for new buildings larger than 2000 m² and from 2030 for all new buildings (Art 7)

DEEP RENOVATION & MEPS (ART. 9)

- It is expected that MS stimulate EPC class A renovation that is called deep renovation by financial incentives
- **Deep renovation** is defined as NZEB before 2030 and ZEB as of 01.01.2030 (requirements stay for **major renovation**)
- National renovation plan (Art 3) should include the sufficient allocation of budgetary and administrative resources
- Art. 15 about financial incentives sets that MS have to provide appropriate financing and support measures to stimulate both deep renovation as well as mandatory renovation of worst performing building stock that is targeted with MEPS

MEPS - MINIMUM ENERGY PERFORMANCE STANDARDS (ART. 9)

Non-residential buildings shall not exceed a maximum energy performance threshold:

- 15% threshold as of 2030 (refers to 2020 worst performing buildings, $\approx$ EPC G $\rightarrow$ F)
- 25% threshold as of 2034 (roughly EPC F, i.e. EPC class $\approx$ E to be achieved)

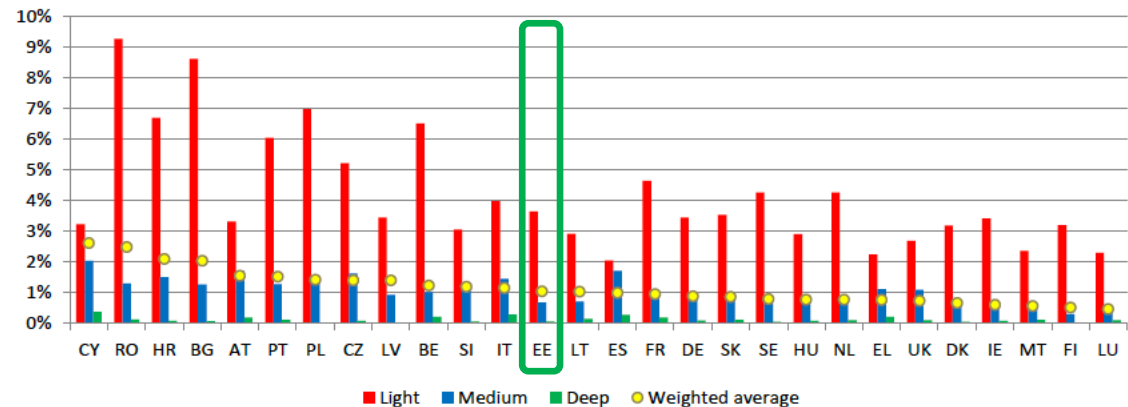
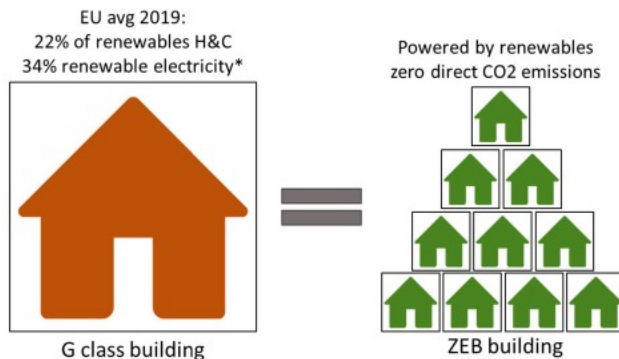
MEPS for residential buildings shall be based on a national trajectory for the progressive renovation of the building stock:

- The average primary energy use in kWh/(m².y) of the whole residential building stock must be at least equivalent to:
 - (a) the D energy performance class level by 2033;
 - (b) by 2040, a nationally determined value derived from a gradual decrease of the average primary energy use from 2033 to 2050 in line with the transformation of the residential building stock into a zero-emission building stock.
- Single-family may be excluded, but when sold or rented, D must be achieved in 5 years

MASSIVE TASK OF DEEP RENOVATION

- EU28 deep renovation rate is 0.2-0.3% and the annual weighted energy renovation rate is 1.0-1.2% (res vs. non-res, JRC 2021)
- Apartment building example from Estonia:
 - 22 000 buildings need renovation, from which 17 000 in use in 2050
 - 3 000 renovated, 14 000 to be renovated by 2050
 - Current deep renovation rate 0.8% (200 buildings per year/KredEx grants)
 - Required deep renovation rate 1.9% (467 buildings per year)
 - Deep renovation rate needs to be doubled – not yet covered by financial commitments
- Standard renovation concepts and processes, modular and industrial solutions needed to tackle the workforce and supply chain challenges

TAL
TECH



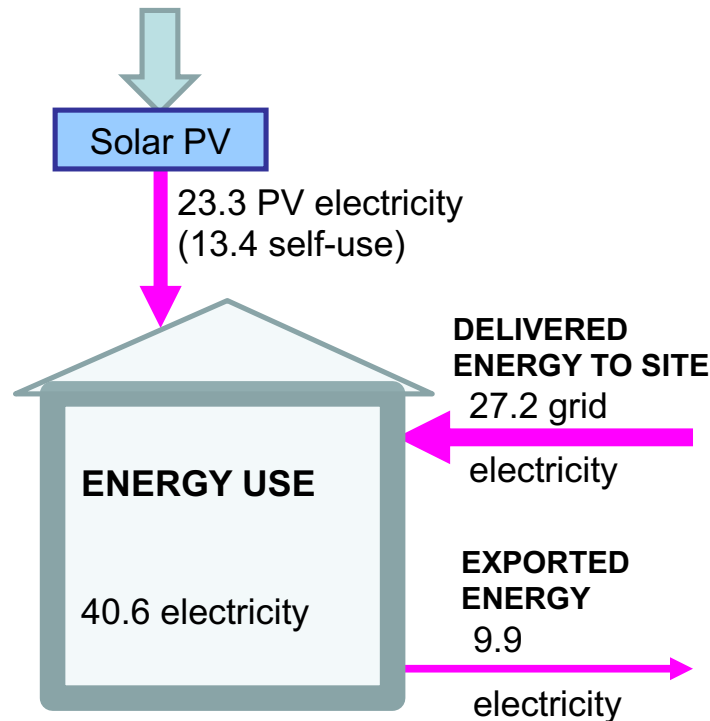
EPBD APPLICATION TO SET NATIONAL REQUIREMENTS

- EPBD proposal 21 October 2022
- Non-renewable primary energy or total primary energy? In many places EPBD uses unspecific expression of “primary energy” – so, which primary energy factor (PEF) should be used?
- Minimum requirements for ZEB/NZEB and EPC classes

EP-VALUE CALCULATION EXAMPLE

- Input data from <https://www.rehva.eu/rehva-journal/chapter/how-to-set-primary-energy-requirements-so-that-poor-building-envelope-cannot-be-compensated-with-extensive-pv>
- Assume that this data represent cost-optimal solutions (in a cold climate) and use exactly the same generation efficiency for district heating and gas boiler for illustrative purposes
- self-used and used in other on-site uses PV is included
- Total primary energy is calculated from the delivered energy to the site (ambient heat and on-site PV are excluded) = total primary energy of the delivered energy to the site

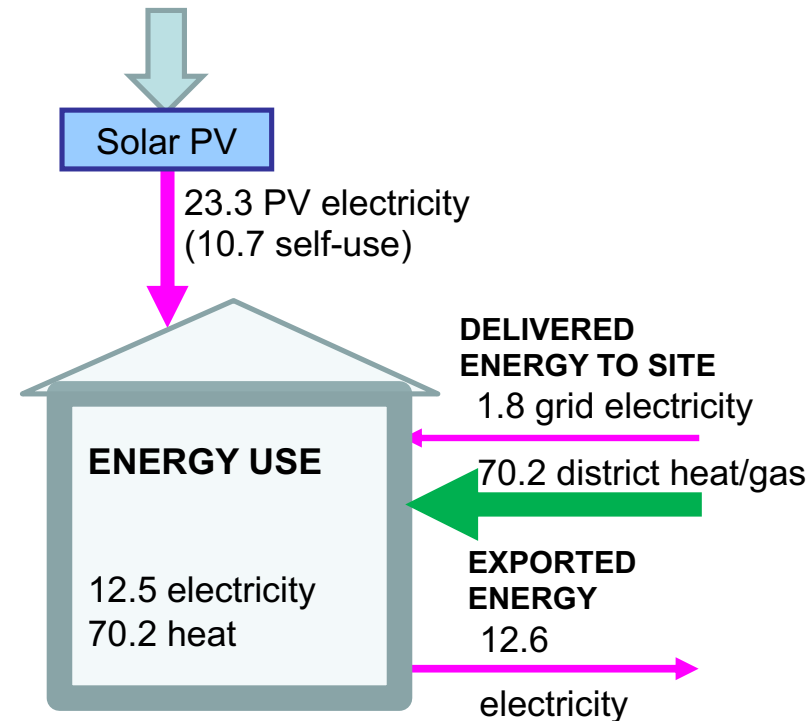
Air to water heat pump



$$EP_{nren} = 27.2 \times 2.3 = 62.4$$

$$EP_{tot} = 27.2 \times 2.5 = 68.0$$

District heating or gas boiler



$$EP_{nren} = 1.8 \times 2.3 + 70.2 \times 0.6 = 46.3 \text{ for district heat}$$

$$EP_{nren} = 1.8 \times 2.3 + 70.2 \times 1.1 = 81.3 \text{ for gas}$$

$$EP_{tot} = 1.8 \times 2.5 + 70.2 \times 1.2 = 88.7 \text{ for district heat}$$

$$EP_{tot} = 1.8 \times 2.5 + 70.2 \times 1.1 = 81.7 \text{ for gas}$$

Energy balance	Energy need kWh/m ² a	Energy use kWh/m ² a		
		DH	Gas	AWHP
space heating	38.5	43.9	43.9	16.6
DHW	25.0	26.3	26.3	13.5
supply air heating (electric)	5.0	5.0	5.0	5.0
fans and pumps	5.5	7.5	7.5	5.5
PV self use		10.7	10.7	13.4
PV export		12.6	12.6	9.9
Non-ren. primary energy, self-use only		46.2	81.3	62.4
Non-ren. primary energy, export included		17.3	52.4	39.7
Total primary energy, self-use only		88.7	81.7	67.9
Total primary energy, exported included		57.2	50.2	43.1
Renewable energy		65.8	23.7	62.2
CO ₂ emissions, kgCO ₂ /m ² a		3.9	10.9	7.2

Primary energy factors & CO ₂ emission coefficients				
	non-ren.	renewable	total	kgCO ₂ /kWh
grid electricity & PV export	2.3	0.2	2.5	0.42
natural gas	1.1	0	1.1	0.22
DH (district heat)	0.6	0.6	1.2	0.12
RE (solar, geo, ambient)	0	1	1	0



PRIMARY ENERGY REQUIREMENT

- To set cost-optimal requirement in terms of the total primary energy:
 - to enable the use of effective district heat, the cost-optimal value cannot be smaller than $EP_{tot} = 89$.
 - in the case of gas boiler or AWHP the building envelope or technical systems performance may be reduced to comply with this value
- By setting the EP_{tot} cost-optimal value we did not follow ANNEX I requirements to take into account the positive influence of renewable energy and benefits of district heating (total PEF makes no difference in between renewables and fossil fuels)
- To follow ANNEX I, an additional numeric indicator must be set:
 - In this case, additional non-renewable primary energy indicator $EP_{nren} = 63$ can be set to enable the use of AWHP and district heat
- In conclusion, the threshold $EP_{tot} = 89$ enables to use all three systems studied, but $EP_{nren} = 63$ only AWHP and district heat. **Therefore, it can be concluded that EP_{tot} threshold is redundant, and it is enough to use EP_{nren}**

PRIMARY ENERGY COVERING REQUIREMENT (ART 9B)

- Another factor needed to account carbon free electricity (does not equal to renewable PEF, because nuclear energy is carbon free). If no nuclear electricity, carbon free factor = renewable PEF = 0.2 in this example
- AWHP case: $23.3 + 27.2 \times 0.2 = 28.7 < 27.2 \times 2.5 = 68.0$, where 23.3 is PV and 27.2 grid electricity – **not satisfied**
- Effective DH case: $23.3 + 70.2 + 1.8 \times 0.2 = 93.4 > 88.7$ – **satisfied**
- Extensive PV and/or smaller grid electricity PEF needed to satisfy for AWHP, currently not technically and economically feasible

EPC CLASSES & CONCLUSIONS

- To calculate EPC classes Art 9 (MEPS) clarifies that by unspecific expression of “primary energy”, the total primary energy is meant
- Art 16 EPC A+ class uses explicitly total primary energy and excludes ambient heat
- Therefore, while non-renewable PEF can be applied for the requirements, EPC classes should be calculated with total PEF
- In all, **three type of factors** are needed to follow EPBD:
 - Non-renewable PEF for the requirements
 - Total PEF for EPC classes
 - Carbon free electricity factor for the second requirement of ZEB
- Alternatively, Annex I allows to use **weighting factors** for numeric indicator of primary energy, which would allow to use the same factors for requirements and EPC