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ENERGIAMÄRGISTE UUS SKAALA VASTAVALT EPBD/EPB CENTER UUSTÖÖTLUSELE

NEW SCALES OF ENERGY LABELS ACCORDING TO EPBD/EPB CENTER REPROCESSING

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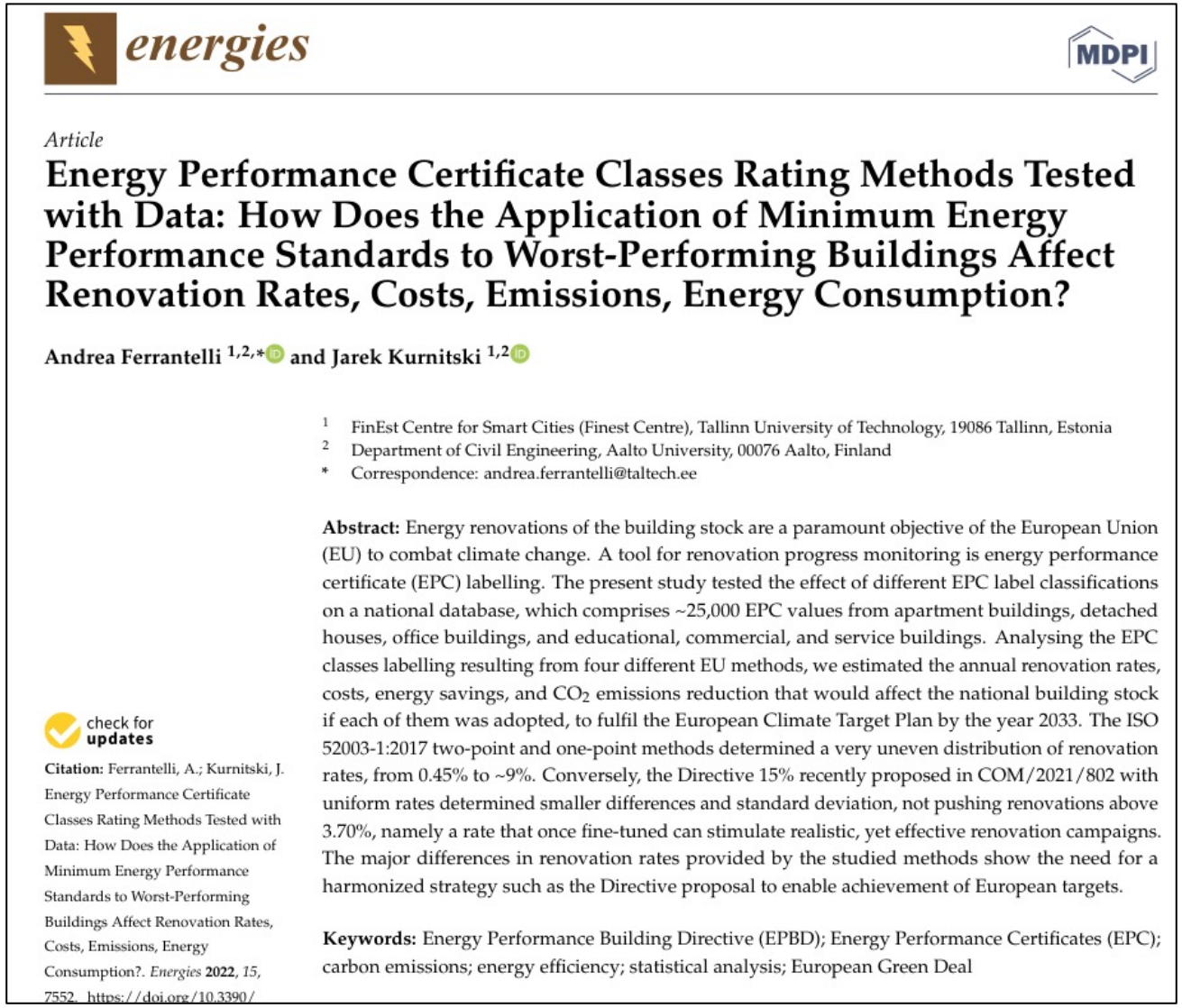

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Article

Energy Performance Certificate Classes Rating Methods Tested with Data: How Does the Application of Minimum Energy Performance Standards to Worst-Performing Buildings Affect Renovation Rates, Costs, Emissions, Energy Consumption?

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Abstract: Energy renovations of the building stock are a paramount objective of the European Union (EU) to combat climate change. A tool for renovation progress monitoring is energy performance certificate (EPC) labelling. The present study tested the effect of different EPC label classifications on a national database, which comprises ~25,000 EPC values from apartment buildings, detached houses, office buildings, and educational, commercial, and service buildings. Analysing the EPC classes labelling resulting from four different EU methods, we estimated the annual renovation rates, costs, energy savings, and CO_2 emissions reduction that would affect the national building stock if each of them was adopted, to fulfil the European Climate Target Plan by the year 2033. The ISO 52003-1:2017 two-point and one-point methods determined a very uneven distribution of renovation rates, from 0.45% to ~9%. Conversely, the Directive 15% recently proposed in COM/2021/802 with uniform rates determined smaller differences and standard deviation, not pushing renovations above 3.70%, namely a rate that once fine-tuned can stimulate realistic, yet effective renovation campaigns. The major differences in renovation rates provided by the studied methods show the need for a harmonized strategy such as the Directive proposal to enable achievement of European targets.

Keywords: Energy Performance Building Directive (EPBD); Energy Performance Certificates (EPC); carbon emissions; energy efficiency; statistical analysis; European Green Deal

check for updates

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TAL TECH

MOTIVATION: EUROPEAN GREEN DEAL AND ENERGY EFFICIENCY

- **Buildings consume too much energy! 40% in the EU, 36% of greenhouse gas emissions.**
- **EU Climate Target Plan** (European Green Deal Renovation Wave Strategy) to **double the current annual energy renovation rate (~1.0%) by 2030**.
- In July 2021, a European Commission's package called '**Fit for 55**' was released for specifically demanding a **cut of greenhouse gas emissions by at least 55% by 2030**.

- **RESEARCH QUESTION: what is the best way to accomplish these targets by renovating the national building stocks?**
- **We need to find the most realistic, yet effective renovation energy policy.**

METHODOLOGY: ENERGY PERFORMANCE CERTIFICATE (EPC) CLASSES

- Energy Performance Certificate **(EPC): *annual consumption* of a building [kWh/m2].**
- **Arranged into classes**: ***A*** (lowest consumption) to ***G*** (highest). In Estonia, also ***H***.
- Energy Performance of Buildings Directive (**EPBD**), December 2021 revision: **Minimum Energy Performance Standards** require a **renovation of the worst performing buildings** (EPC in classes G and F).
- **Public and non-residential buildings:** renovated to

✓ **at least class F by 2027**

✓ **at least class E by 2030**.

- **Residential buildings: class F by 2030**, and **at least class E by 2033**.

✓ This will execute a new vision, the **zero-emission building stock by 2050.**

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EPC DATABASE AND ESTONIAN ENERGY LABELLING

✓ 25000 Estonian buildings, EPC issued between the late 1990's and February 2022.

Tab. 1. EPC summary for all building categories: number N, % over the total, mean M [kWh/(m^{2}a)].

Category	N	% tot	M
Apartments	3945	15.8 %	172.6
Detached 1	2265	9.1 %	158.7
Detached 2	10089	40.5 %	143.2
Detached 3	5768	23.2 %	155.7
Offices	1081	4.3 %	198
Educational	1132	4.5 %	204.1
Commercial	618	2.5 %	228.4

En. label	D1 (EPC)	D2 (EPC)	D3 (EPC)
A	≤ 145	≤ 120	≤ 100
B	146-165	121-140	101-120
C	166-185	141-160	121-140
D	186-235	161-210	141-200
E	236-285	211-260	201-250
F	286-350	261-330	251-320
G	351-420	331-400	321-390
H	≥ 421	≥ 401	≥ 391

Tab. 2. Estonian energy labels for the three categories of detached houses D1, D2 and D3; EPC [kWh/(m^{2}a)].

Ferrantelli, A; Belikov, J; Petlenkov, E; Thalfeldt, M; Kurnitski, J (2022). Evaluating the energy readiness of national building stocks through benchmarking. IEEE Access, 10, 45430–45443. DOI: 10.1109/ACCESS.2022.3170716.

Ferrantelli, A.; Thalfeldt, M.; Kurnitski, J. (2022). Benchmarking the measured energy use of Nordic residential buildings and their Zero Energy-readiness. The 14th REHVA HVAC World Congress, Rotterdam, The Netherlands, 22nd – 25th May. TU Delft OPEN. DOI: 10.34641/clima.2022.171.

ENERGY LABELLING METHODS

- ✓ There is NOT a **single common method** to define the EPC classes.
- ✓ We thus considered the current Estonian EPC labelling (from the Majandus- ja taristuministri, ”Nõuded energiamärgise andmisele ja energiamärgisele“) and **three different European methods:**

EPC LABELLING	In Use	Defined in	Methodology
Method 1 (2-points)	Yes	ISO 52003-1:2017 (EU)	- energy performance regulation reference Rr (point between two classes) - building stock reference Rs (median of distribution)
Method 2 (1-point)	Yes	ISO 52003-1:2017 (EU)	- nref = point between two classes - Class boundary: multiple of $Y = \sqrt{2}^{(n-n_{ref})}$
Directive 15%	No (proposed)	12/2021 EPB Directive proposal (EU)	- A = zero-emission buildings (**ZEB**) - **G =15% worst performing buildings** - B, C, D, E, F classes will have **equal bandwidth**

- ✓ What happens if these methods were applied to the Estonian buildings?

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ENERGY LABELLING SCALING

Method 2 is very unforgiving: allocated most buildings to bad classes. Good for ***new buildings***.

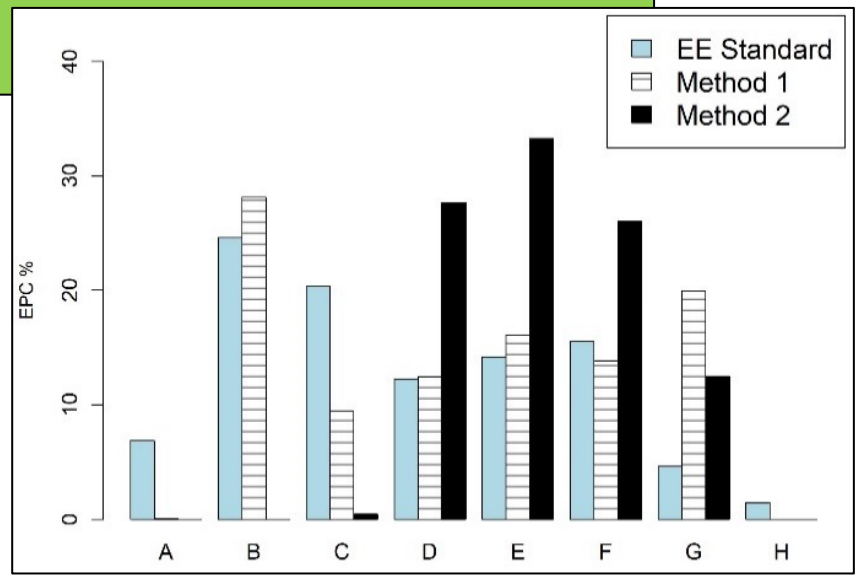

Figure 1. Comparison of number of EPC certificates per class, apartment buildings.

EE Standard, Method 1 and Directive 15% are more balanced for ***existing buildings***.

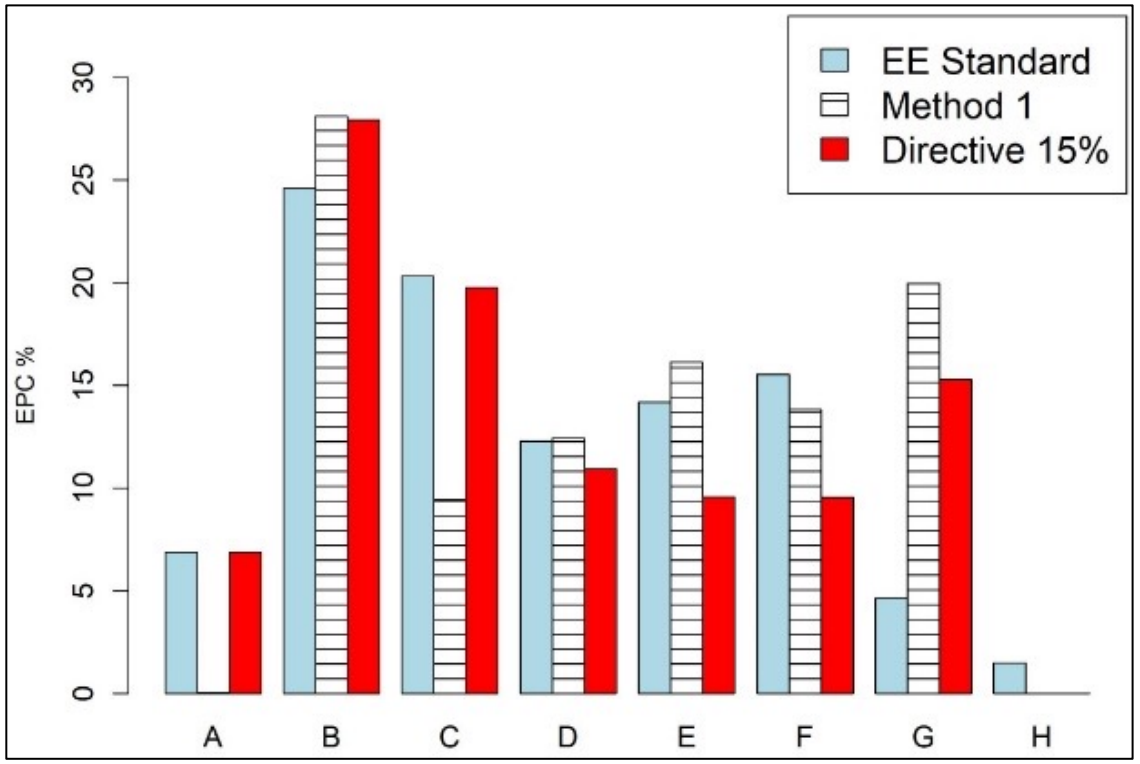

Figure 2. Comparison of number of EPC certificates per class including the Directive 15%, apartment buildings.

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RENOVATION RATES

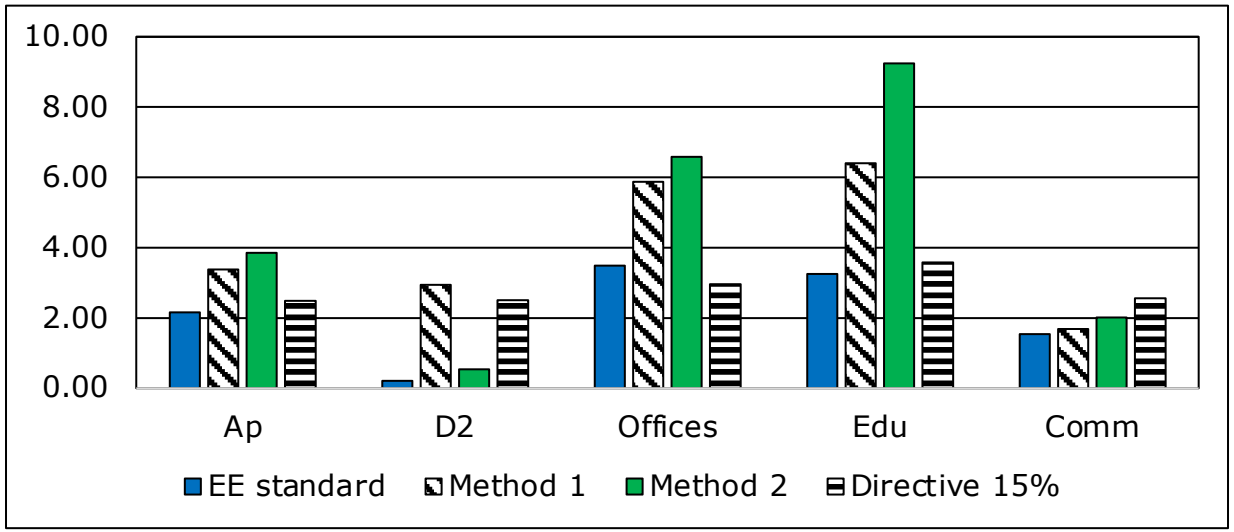
- **Residential buildings** -> EPC class F by 2030 & EPC class E by 2033.
- **Non-residential buildings** -> EPC class F by 2027 and class E by 2030.

✓ **Method 2** pushes Offices and Educational **over 6%** !

✓ Estonian Standard and Method 2 are very **forgiving with dwellings**.

✓ **Directive 15%** very uniform, **less than 3%** on average.

Figure 4. Renovation rates (%) for selected building categories.



RENOVATION COSTS

- All methods exhibit large variations in the total costs, the **EE normative** is the most consistent.

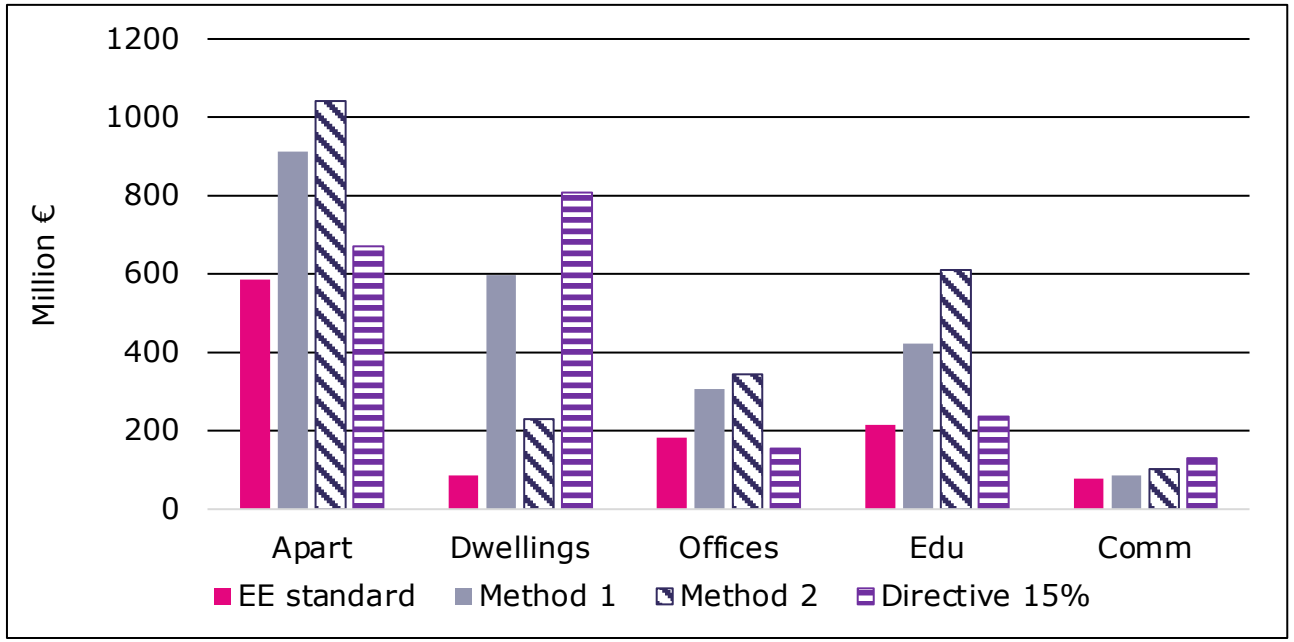


Figure 5. Cost estimates to class E (EPBD) up to 2033, million euros.

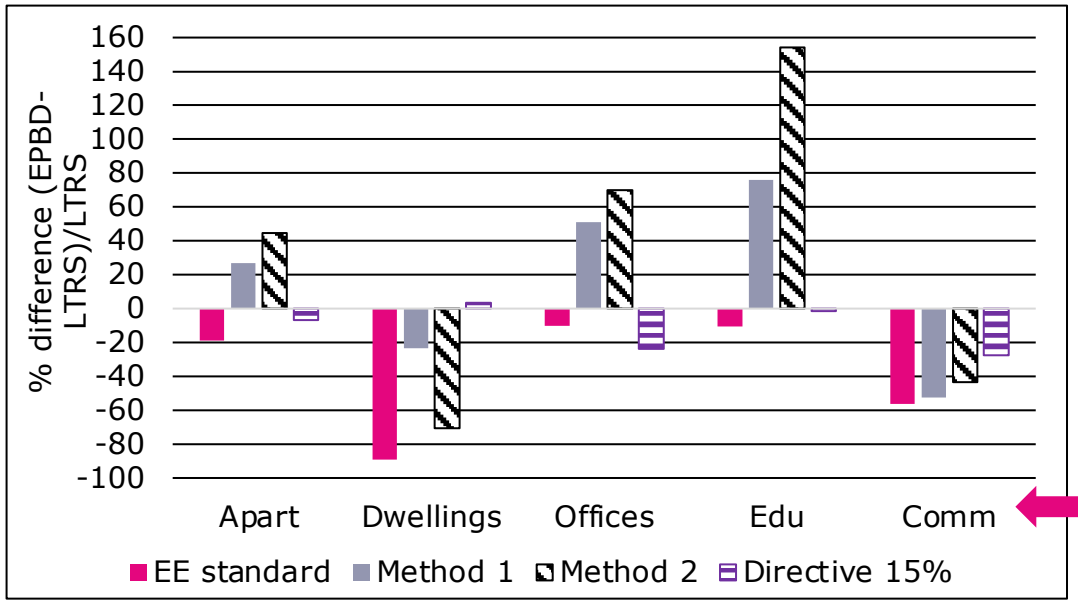


Figure 6. % difference of cost estimates until 2033 between EPBD and class C ambition in 2050 (LTRS).

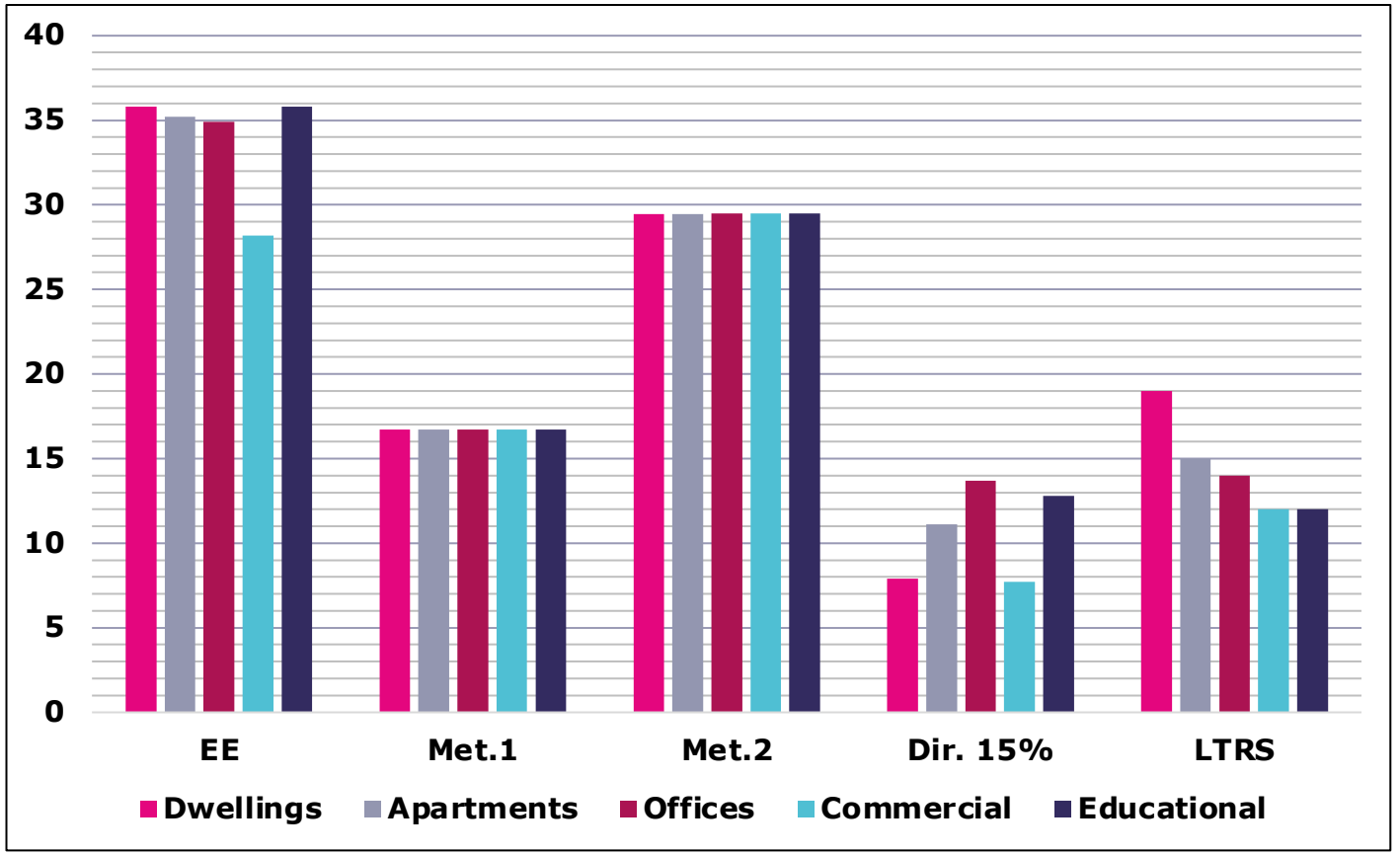
The % differences of renovation volumes between EPBD 2033 and EE LTRS = constant renovation rate to class C by 2050:

”How much would it cost to assume a constant renovation rate to class C by 2050 (LTRS*), instead of adopting the EPBD right away?”. **The Directive 15% is the clear winner**.

*“Long-term strategy for building renovation“ , Estonian Ministry of Economic Affairs and Communications, 2020 for the EU.

ENERGY SAVINGS

- No clear winner here, all methods give **above 10% savings** (but the **Directive 15% is the worst**).
- Is the EE Standard really the best? Here's the CATCH: **renovations start from class H**, but the **others start from class G**.



Energy consumption reduction in 2033 vs 2020 for EPBD and LTRS, %.

CO2 EMISSIONS REDUCTION

- Again, EE ***seems*** to be the best performer because of improving ***from H class***.
- Method 2 is therefore the best, but it demands too high renovation rates!
- ✓ **Method 1 and Directive 15% are therefore the best compromise here.**

CO2 % reduction in 2033 according to EPBD and LTRS vs 2020.

DISCUSSION

- **RATES: commonly ~ 1.0% annually in residential and 1.2% in non-residential buildings**.
- European agenda aiming at **step-wise renovations ~2%-3%**.
- EE and **Directive 15% stay below 3.7%** -> **a small remodulation can be successful**.
- **Directive 15%** proposal: **very uniform demands** across the categories.
- **COSTS:** EPBD's **Method 1** requires for apartments **26.8% larger costs** than the LTRS.
  - ✓ **Directive 15%** gives **~20% savings** for apartment and commercial compared to LTRS.
  - ✓ The **EE Standard** saves too!
- **EE** shows huge improvements because **renovations occur from H-class**, G for the others.
- **Method 1 and the Directive 15%** : the best compromise among **costs**, annual **renovation rates** and **environmental gains**.

TAL TECH

EPBD UPDATE 21.10.2022 – PT1

- Very likely, a final draft **to replace the Directive 15%**.
- The EPC scale is planned to be **harmonised from 2027** so that:
  - **Class A^0 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 more 15% worst performing and equal bandwidth**, but these would still be logical choices – the ***easiest way to tackle MEPS requirements***.

TAL TECH

EPBD UPDATE 21.10.2022 – PT2

- **Non-residential buildings** shall not exceed a maximum energy performance threshold:
  - ✓ 15% threshold as of 2030 (refers to 2020 worst performing buildings ~ ***Directive 15%***)
  - ✓ 25% threshold as of 2034 (roughly EPC F, i.e. EPC class ˜ E to be achieved).

- **Residential buildings:** national trajectory for the progressive renovation of the 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**; (EPC class ***E by 2033 in the 2021 draft***)
  - ✓ (b) by **2040**, a ***nationally determined value*** from a gradual decrease of the average primary energy use from 2033 to 2050 (***towards zero-emissions***).
  - **Single-family** may be excluded, but when sold or rented -> **class D within 5 years**.

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CONCLUSION

- **Energy renovations** are necessary to **combat climate change and the energy crisis**. The **EU** is pushing towards such renovations.
- Four EPC labels classifications tested on the Estonian database: ~25000 EPC values from **apartment** buildings, detached **houses**, **office** buildings, **educational**, and **commercial** buildings.
- To fulfil the **European Climate Target Plan** by the year **2033,**
  - **ISO 52003-1:2017 two-points and one-point methods: very uneven distribution of renovation rates**, from 0.45% to ~9%.
  - **Directive 15%**: **renovation rates below 3.70%**, more realistic.
  - **Costs until 2033: Estonian LTRS** (class C by 2050) results in **additional costs compared to the EPBD directive**.
  - **EPBD Directive 15%** can provide up to **~14% energy consumption reduction** and **over 30% CO2 emissions reduction**.
- ***Future work: update this analysis with the 21.10.2022 updated EPBD.***

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THANK YOU VERY MUCH! AITÄH!