Energy security impacts of renovating the EU's F and G class buildings

- Policy Brief -

Submitted by:
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1. KEY MESSAGES

The following three key messages can be derived from the analysis:

Key message 1: Deep renovation reduces oil and gas dependency significantly
Deep renovation of the European building stock would considerably decrease energy dependency on third countries. In total, renovating the EU's F and G class buildings to B/C class with a combination of thermal insulation and heat pumps has the potential to reduce the EU's overall gas imports of Russia by about 45%, or 71 bcm[1]. By contrast, renovating to E class (as per the current proposal in the EU buildings directive) would reduce overall gas imports from Russia by only about 13%, or 22bcm. An optimal allocation of available resources (material, workforce, etc.) is required to deliver these more ambitious renovation goals.

Key message 2: The impact on GHG reduction is very relevant
In the context of active measures taken to decarbonise European economy, phasing out gas, oil and coal use for heating in the F and G class buildings would have a significant impact on greenhouse gas emissions. Renovations to E level of the worst performing buildings would cut GHG emissions generated by heating and hot water by about 59 $MtCO_{2eq}$/year (13% of the 2020 emissions related to heating and hot water for the F and G class buildings) while refurbishments to C level would reduce them by about 176 $MtCO_{2eq}$/year (40% of the 2020 emissions related to heating and hot water for the F and G class buildings).

Key message 3: Reducing fossil energy dependency on the demand side is cost-efficient
In addition to the benefits of reducing energy dependency and GHG emissions, the required measures on the demand side are cost-efficient. This aspect has not been part of the analysis, but a pervious study on this aspect[2] and the analytical work in the framework of the 2021 EPBD Impact assessment[3] underpin these facts. The economic case for renovations has become even stronger with the significant increase in energy costs[4].

Measures on the supply side – such as increasing renewable electricity generation – are essential to reduce energy dependency, but i) they need energy efficient building shells as an enabler for heat pump installation and thus the usage of renewable electricity for heating, and ii) renewable electricity is a scarce resource and is urgently needed for decarbonisation in other areas as well.

Furthermore, renovations are an important booster for the local economy by increasing investments and thus supporting local employment.

[1] IEA 2022, 696 TWh/a compared to 1.550 TWh of Russian imports. Increasing the MEPS renovation target for all buildings from new EPC class E by 2030/2033 to class C is an estimate of potentials, not an analysis of a legal proposal.

[2] Bettgenhäuser (2014)

[3] European Commission (2021)

[4] see also Hinz/Enseling (2022)

2. SCOPE AND OBJECTIVE OF THE ANALYSIS

To ensure a sufficient energy supply for the European market, the European Union is greatly dependent on imports from third countries. Russia is the main source of fossil fuels imports, providing 41% of gas demand, 27% of oil and 47% of solid fuel consumption[5]. In the current energy mix, the energy consumption of the European worst performing buildings comes from 47% gas, 13% oil and 4% coal.

Based on these facts, the objective of the analysis is to show how EU energy dependency could be decreased through deep renovation measures of buildings – in particular the worst performing buildings – but also to provide elements and arguments to reinforce the case for a more stringent requirement than the E class renovation within the new EPC scale[6] proposed by the European Commission in the EPBD recast.[7]

In this context, the analysis focuses on the impact of renovating buildings within the new EPC classes F and G to reach B/C classes, primarily by improving the efficiency of the building shell. At this level they are considered heat pump ready, with heating loads reduced by approximately 50%. This means supply/return temperatures in the heating system can be reduced from 70/55°C or more to 50/40°C,[8] allowing efficient heat pump operation and reduced additional demand on power generation (just installing heat pumps without thermal insulation would significantly increase electricity demand and require the use of fossil fuel generation). Thus the combination of thermal insulation and heat pump technology would allow on the one hand to cut-off fossil fuels used for heating in the building sector, and on the other hand to improve living conditions for millions of European households and reduce energy bills.

3. MAIN FINDINGS

The European building stock of the worst performing buildings of class F and G has been estimated in the EPBD Impact Assessment 2021 at around 33% of the total floor area. In total, the EU counts around 8 billion m² in the worst performing building stock which represent 40.1 million buildings,[9] of which most of them belong to the residential sector (around 76% of the total floor area of F and G class are households).

In the context of the overall ambition of the European Commission within the EPBD revision[10] to bring all buildings to EPC class E, **renovations from F and G class to E class** would **reduce**

[5] Eurostat 2022 - Solid fuels- fossil fuels covering various types of coals and solid products derived from coals

[6] European Commission 2021; The European Commission is planning in the proposal for an EPBD revision to harmonize the EPC classes across all Member States (by defining EPC class G as 15% of the worst performing buildings of the respective countries and class A as zero emission building ZEB)

[7] European Commission 2021

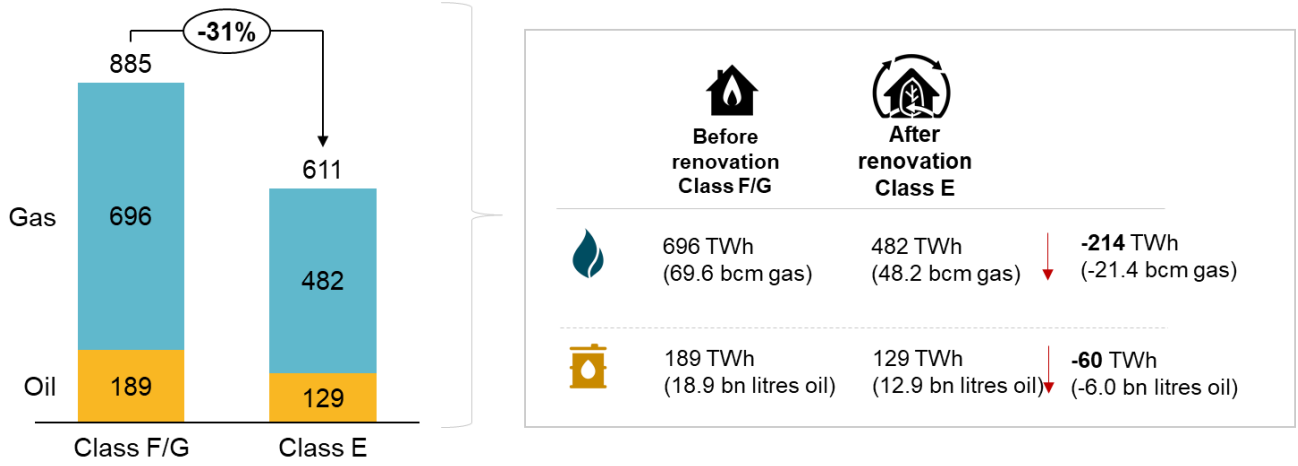
[8] As currently discussed in the expert consortium for new requirements for heat pumps in the upcoming update of the German Gebäudeenergiegesetz (GEG). In addition, many of the current heat pumps are limited to lower supply/return temperatures than 70/55°C.

[9] The 40.1 million buildings consist of 35.5 million single-family houses, 3.1 million multi-family houses and 1.6 million non-residential buildings. (Hermelink et al. 2019)

[10] European Commission 2021

gas and oil consumption in buildings by approx. 31% on average.[11] This could reduce imports of Russian gas by about 13% (214 TWh per year / 22 bcm) and oil by about 4% (60 TWh per year / 5 Mtoe).

Energy savings in oil and gas consumption by 2030 after renovation of the F and G classes buildings to E level (in TWh)



Sources: Guidehouse 2022 (own calculations)

However, considering the EU leaders' commitment in the Versailles Declaration[12] to phase out imports of Russian gas, oil and coal as soon as possible, and in the context of the Commission's work on the RePowerEU[13] plan, it seems prudent to maximise energy savings by renovating the F and G class buildings to a higher energy performance class as soon as possible.

Renovations from F and G class to C/B class instead of E class would significantly reduce Russian fossil fuel imports. If, in a first step the building shell is renovated properly to class C and – in a second step – heat pumps are introduced to replace the fossil fuel heating systems, the gas, oil and coal demand for those buildings could be cut-off completely. This would lead to **approx. 90% of final energy savings**, and fossil fuel consumption in those buildings could theoretically be reduced to zero. This could reduce imports of Russian gas by about 45% (696 TWh per year / 71 bcm) and oil by about 12% (189 TWh per year / 16 Mtoe).[14]

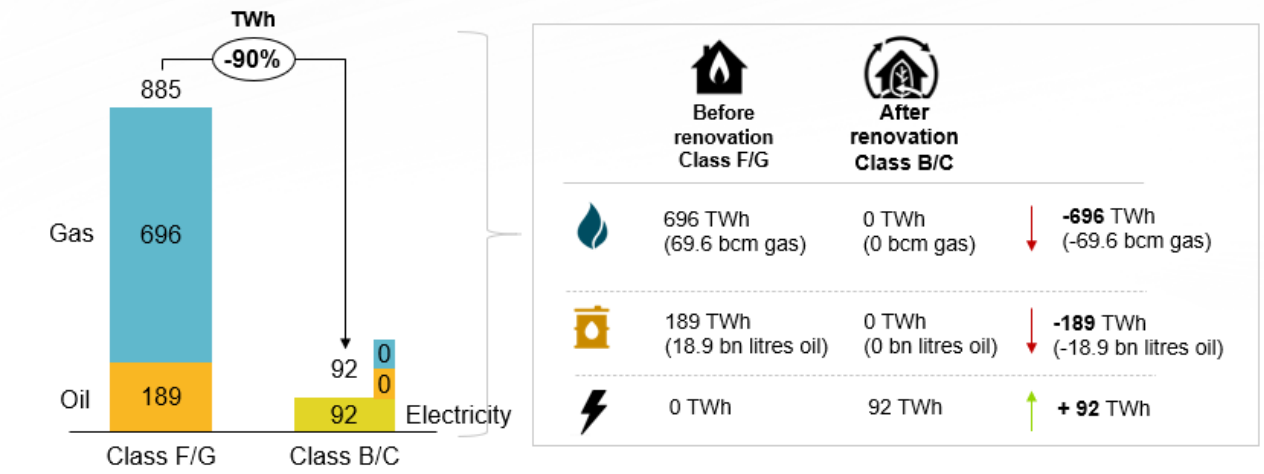
[11] Gas consumption reduction: 696 to 482 TWh/year (-214); oil consumption reduction: 189 to 129 TWh/year (-60). This is based on the assumption that gas and oil are evenly distributed across the F and G class buildings. (Guidehouse 2021)

[12] European Commission 2022a

[13] European Commission 2022b

[14] Specifically, the first step consisting of a deep building shell refurbishment (wall, roof, floor insulation and windows) of the F and G class buildings to B/C level contributes to an oil and gas consumption reduction in the order of 70% to 80%. The second step, installing a heat pump in these refurbished buildings, would further reduce total energy consumption by about 90% to 95%.

Energy savings in oil and gas consumption by 2030 after renovation of the F and G classes buildings to B/C level (in TWh)



Sources: Guidehouse 2022 (own calculations)

The evaluations lead to the following conclusions on the European energy dependency from Russian gas[15]:

Renovations to E level only (moderate building shell renovation) as proposed in the revised EPBD proposal would cut overall gas imports from Russia by 13%. Renovation of Europe's worst performing buildings to EPC class B/C (deep renovation including heat pump), would enable a 45% reduction of gas imports from Russia.

Deep renovations of the building shell and heat pump installation would impact **coal consumption** as well. Today, direct use of coal for heating and hot water in EU is low and represents a total demand of approx. 74 TWh for the F and G class buildings. In depth renovation and heat pump installation would support the exclusion of coal from the heating mix of European households.

A key point in the current context is that increasing heat pump penetration without improving the building shell would increase electricity consumption, in a context where 13% of the electricity generated in the EU comes from coal and 20% from gas[16]. Should renewable energy sources not be able to provide the additional demand – a real concern given the ambitious electrification plans announced in the different sectors – coal and gas-fired generation would increase. Therefore, heat pumps installations with high efficiencies (COPs, coefficients of performance) are required, which can only be reached in properly insulated buildings.

[15] Based on IEA 2022 figures: 69.6 of 155 bcm of gas imports from Russia could be avoided (45%).

[16] Eurostat 2022

Renovation of the worst performing buildings in the EU would in addition have a **significant impact on greenhouse gas emissions savings**. Renovation of F and G class buildings to E level, would reduce GHG emissions by 59 $MtCO_{2eq}$/year (13% of heating and hot water emissions generated by the worst performing buildings) while refurbishment to B/C level would cut emissions by 176 $MtCO_{2eq}$/year (40% of heating and hot water emissions generated by the worst performing buildings).

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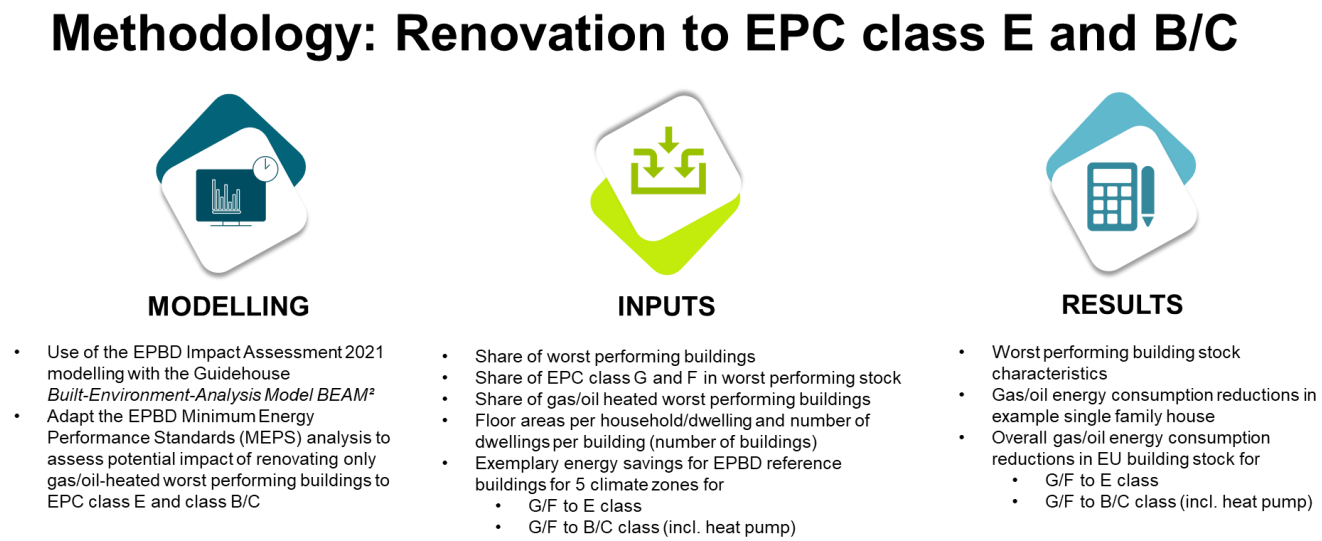
APPENDIX: METHODOLOGY

A step-by-step approach has been developed to estimate the total oil and gas reduction potential through deep renovation of worst performing buildings towards ZEB-level including heat pump installation. A combination of Guidehouse's *Building Energy Performance Model (BEP)*[17] and the *Built-Environment-Analysis Model*[18] *BEAM²* has been applied running several possible combinations of insulation/windows and heat pump equipment allowing the worst performing buildings (F and G) to reach EPC class B/C.
Based on this model, the energy savings resulting from the above-mentioned renovations have been estimated together with the associated reduction in oil and gas consumption.



[17] Guidehouse 2022

[18] Guidehouse 2021