Energy efficiency first policy landscapes for buildings: case studies in Germany, Hungary and Spain

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Abstract

Recognizing the value of energy efficiency improvements as the biggest domestic energy resource in the EU, Energy Efficiency First (EE1st) is a cross-cutting principle of EU energy policy. It is set out in the recast Energy Efficiency Directive, supported by a set of practical recommendations. Implementing EE1st challenges the way we compare demand-side and supply-side options, assessing the basis for and practicalities of prioritising demand-side options.

The Renovation Wave as part of the Green Deal emphasizes the importance of acting on energy efficiency of buildings. Implementing the EE1st principle here benefits the entire energy system, as buildings are able to reduce the energy demand and thereby have a direct impact on infrastructure needs.

This paper reviews EE1st implementation for the building sector in German, Hungary and Spain showing a diversity of preconditions. The overall buildings policy frameworks are analysed to determine if the two examples of EE1st policies discussed in this paper could be best suited for transferability in the realm of the institutional, financial and policy system. Germany has an already strong building code, which could still be strengthened to overcome barriers identified, such as silo thinking. Spain has strong renovation funding programmes which could be defined in terms of composite indicator instead of primary energy to lead to an EE1st approach. Hungary should increase the overall building code stringency and should integrate energy requirements into funding schemes. EE1st aspects coupled with rapid improvements in the decision-making process, in collaboration among decision-making and implementation bodies, as well as efficiency criteria in many, but at least in grant decisions could result in economic, social and climate benefits. The findings have been validated through expert consultations in the three countries through the ENEFIRST project.

Introduction

Most energy efficiency policies in Europe are primarily aimed at improving energy efficiency or reducing energy demand, thereby focusing on the demand side. Their results can also have an impact on the investments needed on the supply side (as the demand is reduced), but it is often implicit and not systematically considered.

Energy Efficiency First (EE1st) is a broader concept that applies across many areas of energy policymaking and energy investment that are not primarily aimed at reducing energy use. Policies or regulatory frameworks implementing the EE1st principle aim explicitly at **considering demand-side options as alternatives to supply-side options**, thereby valuing the contributions of energy efficiency to the energy systems and, where possible, other objectives (e.g., reducing GHG emissions, improved health).

Since the end of 2018, it is one of the major principles of the EU energy policy framework, as defined in the Regulation (EU) 2018/1999 on the governance of the Energy Union (Article

2(18))[1]. Acknowledging the challenges for implementing EE1st in the Member States (MS), the European Commission (EC) (2021) developed further guidance. Operationalising EE1st indeed requires more than a cursory look at efficiency options, with the recognition that:

- Demand is not fixed, and supply should not automatically be scaled up to meet assumed growing demand.
- Demand-side resources should be considered as an alternative to supply-side options before committing to investment decisions.
- Demand-side options should be chosen over supply-side solutions, whenever they are more cost effective from a societal viewpoint (i.e., a broader scope of costs and benefits, compared to the individual end-user's point of view).[2]
- Cost efficiency is a regulatory must.

This paper discusses two approaches to implement EE1st in buildings, thereby complementing the Commission's guidance (EC 2021) that does not cover the buildings' sector in details.

METHODOLOGY

The policy assessment is based on the combination of literature review and semi-structured interviews. First, a review collected 16 international best practice examples of policies operationalizing EE1st (ENEFIRST 2020). These analyses were complemented with a review of the EU legislative framework in a selection of policy areas, including buildings (ENEFIRST 2021a). The combination of the reviews of examples and EU legislative framework made possible to identify policy approaches that can be relevant for the implementation of the EE1st principle in EU Member States, when dealing with buildings and their energy supply (ENEFIRST, 2021b).

Next, policy mapping was carried out in three EU Member States, Germany, Hungary, and Spain, that were selected to undergo a deeper policy analysis for operationalizing identified EE1st approaches. These countries were chosen for convenience (e.g., language capacities of the authors) and for scientific reasons. The three MS represent jurisdictions with different policy systems, dissimilar building sector composition and features, as well as differing policy priorities.

This resulted in descriptive catalogues of the major policies in these countries (focusing on buildings). Key policy-level stakeholders, both at the national and local levels, were contacted to finetune the catalogue and discuss this policy landscape, with particular emphasis on policy approaches that were already in place or that could potentially be suitable for implementing EE1st. Altogether, 19 stakeholders were interviewed between October and December 2021 in the three countries. The interviews were conducted mainly online due to the pandemic restrictions, using a questionnaire with mostly open-ended questions. Using the policy mapping tool, we identified those policy approaches that came across as suitable in all of the three countries.

For each country and for each policy approach, we described and compared the (1) policy documents that could potentially host a tailored EE1st approach, (2) the local and current barriers to adopting and implementing the policy approach, (3) key stakeholders with their roles in the policy cycle, (4) a qualitative assessment of what enablers would be needed to achieve the EE1st goals with the approach in question in the building sector.

We present in this paper two of these approaches: (1) passive-level building code, that can be used for regulations for new buildings and/or renovations; (2) Fabric First approach, that can be used for incentive schemes for existing buildings. These two approaches are first introduced explaining how they implement the EE1st principle, and illustrating them through existing applications in Belgium (Brussels' region) and Ireland respectively. We then take a look at if and how they could be implemented in three countries which differ geographically, politically and climate wise: Germany, Hungary and Spain.

Two examples of approaches to implement EE1st in buildings

PASSIVE-LEVEL BUILDING CODE: EXAMPLE FROM THE BRUSSEL'S REGION

Building codes have been among the first policy instruments to face the oil shocks in the 1970's. From 2002, the Energy Performance of Buildings' Directive (EPBD, 2002/91/EC and numerous revisions[3]) required all Member States to set energy performance requirements for new buildings and major renovations. However, the EPBD has not set the actual minimum requirements at EU level, but defined the methodology (cf. EPBD Annex III on cost-optimal levels): MS can postulate their own nZEB (nearly Zero Energy Buildings) definition, adopt more ambitious requirements and provisions about how the requirements are implemented and enforced.

Designing building codes in line with EE1st means considering several aspects, including:

- using a **broad scope of costs and benefits** when defining the levels of minimum requirements;
- ensuring these minimum requirements are **in line with the national long-term objectives** (to avoid lock-in effects);
- ensuring that the requirements allow for a **fair comparison between demand-side options** (e.g., reducing the energy needs) **and supply-side options** (e.g., new or renewed generation, on-site RES, efficiency of distribution, etc.).

One approach to meet these conditions is to define the requirements of the building code to prioritize the reduction of the energy demand in the design options of the building. **The EE1st principle thus became embedded in the "passive house law" (officially called the PEB Regulation) of the Brussels' Region in 2011**. It requires close-to-passive level overall performance for all new construction as of 2015 and most renovation from 2017, and was further refined in 2019 (Brussels Environment, 2020). The passive house law foresees the drastic reduction of

1. For more details about the EE1st definition and background, see e.g., (Mandel et al. 2021).

2. This is common practice in cost-benefit analysis. See, for example, Mourato et al. (2018).

3. For details see the EC dedicated site at https://bit.ly/3qncll5

energy demand, supplying the remaining demand from renewable sources.

The introduction of these strict building standards was preceded by a package of voluntary and mandatory policy measures between 2002 and 2014. Belgium's thermal regulations (K55) in 2002 had set out insulation requirements. In 2006, a few public buildings were renovated to passive-level, as demonstration sites. Then a competitive programme for exemplary buildings (titled BatEx) was run from 2007 to 2013, providing financial support for very low-energy tertiary and residential construction and renovation projects. The energy performance of subsidised buildings was not predefined, only capped, and the market was allowed to define it on a competitive basis.

The BatEx programme led by example and provided robust technical support and workforce development to the building sector. It resulted in 243 projects by 2020 (621,000 m^2 in total of which over 50 % are at passive level) at zero or minor cost premium. This ignited market forces to prepare both the demand and the supply sides of the construction and renovation markets, that produced over 3000 passive houses beyond the subsidised projects as of 2018, with an estimated job impact of about 1250 additional jobs (EnEffect, 2014; van Daalen and Petersen, 2018). New buildings not meeting the requirements of PEB is less than 2 %, mostly on ventilation (Danlois et al. 2020). **Heating energy use per capita dropped by 25 %** and greenhouse gas emissions by 16 % between 2004 and 2014, **achieved with a combination of policies and actions through three phases: first, awareness, incentives, and demonstration projects; second, support and large-scale implementation; and finally, a massive investment in new and retrofitted buildings** (Ürge-Vorsatz et al. 2020).

The success factors include the participatory process to overcome the initial resistance, by informing owners, tenants and the construction industry, and allowing them to contribute to the formulation of the law. A pilot phase (with demonstration buildings) and then the BatEx programme have also been essential in getting the market actors involved and ready for the next regulations, demonstrating the feasibility on an increasing scale (Brussels Environment 2016; Ürge-Vorsatz et al. 2020).

Information instruments, such as the strengthening of the energy performance certificates (EPC), guidelines for home owners, collection of best practice examples, an office of advisors and facilitators; supporting the industry with networking, trainings and certifications; the set-up of a one-stop shop; and financial instruments such as green loans all strengthened buy-in and implementation success. **Moreover, new buildings must meet so-called "do no significant harm" criteria in the field of climate adaptation, water, circular economy, pollution prevention and biodiversity. This package of measures has ensured that the rationalisation of energy demand has been treated equally and even given priority over supply-side options**.

Specific building segments (e.g., historical buildings, tower buildings) might be more challenging to address and might require specific provisions.

This experience of the Brussels' Region has been used by other cities and regions to learn from. For example, New York City has followed the pathways of Brussels to contribute to the overall city target of an 80 % reduction of carbon emissions by 2050 (Yancey et al. 2016).

For more details about the example of passive-level building code, see (Boza-Kiss, 2020).

FABRIC FIRST APPROACH: EXAMPLE FROM IRELAND

A Fabric-First approach to building design and renovation aims to maximise the energy performance of the components and materials that make up the building fabric itself (i.e., walls, roof, floors, windows and doors) in a cost-effective way over the building's lifecycle. Based on this, improving the building fabric comes before considering the improvement of the heating systems and other building services to achieve overall and ambitious energy efficiency levels. The Fabric First approach can be seen as a practical transcription of the EE1st principle to the buildings' sector:

- it makes sure that **demand-side options are considered** (here, the improvements of the building fabric) **when deciding about investment(s) in a building**;
- it **prioritizes demand-side options** in the patterns used to maximise energy performance;
- it usually **considers a long-term perspective** (buildings' or major components' lifetime).

Fabric First can be an overarching principle applicable to all buildings' policies, for example to building regulations or incentive schemes for renovations. Its implementation in building regulations is close to passive-level building codes presented above. We therefore focus here on the case of incentive schemes.

SEAI (Sustainable Energy Authority of Ireland) has adopted the Fabric First approach for several of these grant schemes for building renovations, including the Better Energy Communities (BEC) and Heat Pump System Grant schemes, operational since 2012 and 2017 respectively. The BEC scheme[4] has been supporting community-oriented innovative projects from various sectors, including residential housing upgrades and non-residential building works, and with the aim to trigger the implementation of deeper and more technically and economically challenging measures than is possible under other grant schemes or market basis. The Heat Pump System Grant[5] was introduced in April 2018 to increase the share of renewable heat and phase-out fossil-fuel heating systems while reducing heating bills and increasing home comfort levels.

The Fabric First approach was initially applied in the pilot Residential Combined Fabric Upgrade package in 2017. The Combined Fabric Upgrade released a financial bonus (15 % of additional support) when all fabric-related measures are carried out (as Step 1) and lead to higher building energy performance, before upgrading heating installations (as Step 2) or applying additional renewable installations (as Step 3). The measures of Step 1 are roof insulation, external wall insulation, full window replacement, external door replacement, minimum air permeability test performance and ventilation requirements of a mechanical ventilation system (SEAI 2017).

4. For more information about BEC visit: https://bit.ly/3tVx7Jg

5. For more information on the Heat Pump System Grant visit: https://bit.ly/3KIPyb5

Credits for Steps 2 and 3 are only released when all measures of Step 1 are carried out demonstrating the priority put on investments that reduce heat demand over investments that improve the efficiency of heat supply.

In addition, a bonus was provided only when all measures were carried out to meet the minimum technical and energy efficiency specifications required by the scheme. Though this pilot scheme was only tested in 2017, the approach was transferred to the following funding cycles. Since 2017, **applicants to the Better Energy Communities are required to give priority to energy efficiency measures to be eligible, and since 2019, projects must comply with minimum technical standards with a post-renovation Building Energy Rating (BER) of B2**. This approach is in line with Energy Efficiency First, with renewable and smart technologies being eligible then.

Likewise, the **Heat Pump System Grant includes minimum requirements of the energy performance of building envelope for eligible projects**. The applicant needs to get a BER certification from a technical advisor registered with SEAI, which is subsidised (€200). The advisor is expected to recommend improvements to meet the minimum requirements, with which the scheme assures an appropriate sizing and efficient use of the heat pump system.

While the detailed results of the schemes are not yet available, SEAI observed a decrease in the number of applications (especially from product manufacturers) and an increase in the average size of the investment and number of measures per project, before and after the inclusion of the minimum energy efficiency requirements (about 4000 homes upgraded in 2014 vs. 800 in 2015). This shows that the market needs to adapt to develop more ambitious projects meeting the Fabric First requirements[6].

The Fabric First approach was implemented in Ireland to prevent inappropriate and expensive renewable heating systems or other energy services of being installed without improving the energy performance of the building envelope. Earlier, SEAI had noticed a trend by product manufacturers to focus projects around their products rather than the buildings in question (Flynn, 2020), and found that the Fabric First approach could overcome this progressively (see more details in Rieke Boll 2020a).

The requirements to carry out comprehensive insulation measures to increase energy performance of the building envelop are more complex and cost-intensive than a single replacement of a heating system. Though the increased costs had a significant impact on the project volume right after their implementation, SEAI has then seen a growing interest in the Fabric First approach by experienced contractors. This approach is becoming more acceptable and the costs are moderating (Flynn, 2020). The Irish government launched in February 2022 a new National Retrofitting Scheme[7], including a new National Home Energy Upgrade Scheme with increased grant levels of up to 50 % of the cost of a typical B2 home energy upgrade with a heat pump (up from the previous level of 30–35 %), together with One-Stop-Shops for an end-to-end service for homeowners.

Success factors include SEAI's long experience with designing and administering grant schemes for the residential sector, enabling to build on existing knowledge and create synergies between the schemes. Over the years, SEAI has been fine-tuning its approach and funding requirements, for example the schemes' technical requirements and specifications, or in the registries of qualified professionals (assessors and contractors).

Barriers include the inertia of the markets and the possible lack of qualified assessors and contractors. Training schemes might thus be needed to avoid creating bottlenecks. Moreover, the mindset of installers has to adapt to do comprehensive pre-assessments prior to suggesting to homeowners the most relevant actions (Burton, 2019). This also often implies that contractors need to get familiar with building trades they were not working with earlier: implementing EE1st in buildings indeed requires more cooperation between different trades and/or for professionals to acquire new skills. Breaking the silos can be challenging. Whereas this is essential for getting contractors to develop comprehensive offers of renovation services, or to work with complementary building trades. The schemes therefore need to ensure there will be a minimum level of demand for this new market to be attractive enough for contractors to get involved.

Integrating EE1st approaches with current policies in Germany, Hungary and Spain

IMPLEMENTING EE1ST IN GERMANY

Germany follows a three-tiered approach towards improved energy efficiency and increased energy savings consisting of regulation, financial support and information provision. The buildings sector was responsible for 35 % of primary energy consumption in Germany and for approximately 30 % of CO_2 emissions in 2020 (BBSR 2020). 75 % of buildings in Germany are built before 1979, before the first thermal insulation ordinance (BBSR 2020). To ensure that these buildings are brought up to a higher standard, the German government has gradually raised minimum efficiency standards and introduced a long-term modernisation roadmap for existing buildings (Federal Republic of Germany 2020). These are in line with the EPBD and the Paris Agreement.

The **Buildings Energy Act (GEG)**[8] came into force on 1 November 2020, **implementing the Coalition Agreement of 2018 and the Climate Action Programme 2030 in relation to energy conservation for buildings**. The new GEG continues from its predecessor to set out requirements for the energy performance of buildings, the issuing and use of energy performance certificates, and the use of renewable energy in buildings. It also implements European requirements regarding the total energy performance of buildings and integrates the regulations governing nZEB standards in energy conservation legislation. It does not increase previous energy performance requirements for new construction and renovation and should not lead to further increases in construction and living costs.

6. For more figures about BEC achievements see (Flynn 2020) and for a comparison with the main renovation scheme, Better Energy Homes, see (Reddy 2020).

7. For more information about the National Retrofitting Scheme visit: https://bit.ly/3wiCvJx

8. For more information about GEG visit: https://bit.ly/3I6enfm

Strong building regulations with further opportunities to promote Passive Level buildings in Germany

The Buildings Energy Act (GEG) has created a uniform and coordinated body of legislation regulating energy performance requirements for new construction, existing buildings and the use of renewable energy for heating and cooling buildings. While not equivalent to passive level, the **GEG requirements are already high**.

A passive level building code could be implemented in Germany through the GEG or alternatively on a state or local level, although experts agreed that measures for EE1st should ideally be implemented at a national level. In line with the Climate Action Programme 2030 and related benchmarks, the **GEG includes a clause for review of the energy performance requirements** for new construction and existing buildings in 2023, which **has been preponed to 2022, which could be used to implement the passive level building code**.

An **alternative instrument towards passive level building performance in Germany could be the integration with the building renovation passport** (Individueller Sanierungsfahrplan), which was supported by the interviewees. It is not mandatory so far but can show owners and planers the pathway to a decarbonized building. Buildings have a long lifecycle and are only renovated at certain intervals or trigger points (e.g., sale) which makes them prone to lock-in effects. Planning instruments, such as the renovation passport, can support the implementation of the EE1st principle by promoting a holistic approach about building renovation, facilitating the comparison of renovation scenarios or patterns, and helping to prioritize demand-side options whenever relevant. The guidelines of the renovation passport could also be tailored to fit with the municipal heat planning, thereby favour a better integration of demand-side and supply-side planning at local level (ENEFIRST 2021c). Experts suggested that the passport should be mandatory at trigger points, such as sale of the building.

High-efficiency buildings are also promoted through the ***EffizienzHaus* label**, that is referred to by the main funding programmes for energy efficiency in buildings (see below), and well identified by market actors. This helps to get energy efficiency (and especially demand-side) options considered by building owners or buyers.

Incentive schemes under redesign in Germany, but unlikely to adopt the Fabric First approach

A set of programmes was established to help achieve the target of a **climate-neutral building stock in Germany by 2045**, of which some have already been in place for many years. The Climate Action Programme 2030 has improved the funding conditions in a new **'Federal funding for efficient buildings' (BEG) started in 2020**. It combines several modules coming from the former funding programmes:

- BEG Residential Buildings (former KfW programme for energy-efficient construction and renovation);
- BEG Non-residential Buildings (former KfW programme for energy-efficient refurbishment of non-residential buildings);
- BEG Individual Measures BAFA (former KfW Market incentive programme for renewable energies).

As an alternative to BEG, **tax incentives for the energy-efficient renovation of residential buildings** were also introduced from 2020. The Corona stimulus package included an increased funding for building refurbishment, which made it possible for the German government to increase funds distributed through BEG.

The former KfW programmes have been well-known for their grant rates depending on the performance achieved and linked to the *EffizienzHaus* label, which can be a way to implement EE1st. However, the number of comprehensive renovation projects has been much lower than the number of individual measures. The precise conditions of the new programmes are not known yet. **The new programmes could adopt, at least partly, a Fabric First approach**. But experts and government officials are sceptical that it could lead to higher efficiency and higher renovation rates. Government officials argued that when looking at the cost-benefit ratio of installing only renewable-energy-based heating or upgrading the building envelope, the latter will mostly win, thereby automatically implementing EE1st without any government intervention. Experts do not agree with this automatism and voiced concerns that there will be less applications for funding due to the difficulty in implementing this approach and the differing perspective of planners and owners. There could also be a shift setting the priority on reducing CO_2 emissions (and gas dependency), which could be a step back from EE1st, depending on the design of the new conditions.

Another factor mentioned by experts on EE1st and building renovation was the **measurement and monitoring of real time performance**, which would be **necessary for the Fabric First approach** and ensuring that it triggers proper renovation. In Germany, with its two different systems of EPC calculation (according to the users' energy demand or according to an estimate based on building data), they deem it as too difficult to make differentiations for this approach. A solution that was offered, was **digital energy monitoring** – which is not yet implemented on a large scale. This could be coupled with **digital building logbooks and energy advisor services**. These tools could help create an incentive that buildings are as efficient in practice as on paper.

IMPLEMENTING EE1ST IN SPAIN

Spain is among the Member States with the lowest energy consumption in the residential sector in the EU. Buildings represent only 30 % of total final energy demand in Spain (2010–2019[9]), compared to the EU average of 38.5 % (according to 2014 data (Spanish Government 2017). Heating represents only 43 % of Spain's total residential energy consumption, compared to the EU average of 64.4 % (2014).

Moreover, Spain is the most climate diverse country in Europe, and among the 10 most climate diverse countries in the world. This climatic diversity, and the fact that the **exclusive competences for housing and urban development are hold by the regions**, imply that measures on energy efficiency and energy savings depend significantly on **interinstitutional cooperation and strategic planning** tailored to each region needs. This represents an important challenge at a political lev-

9. For more statistics, see https://bit.ly/3q4hJt8

el, as the priorities among the different governments involved may significantly differ concerning this topic.

The overall central strategy shaping the Spanish EE1st approach is based on the following three overarching and highly interrelated policies:

- **ELP 2050** (Long-term Strategy for a Modern, Competitive and Climate Neutral Spanish Economy in 2050), which is the strategic planning instrument that establishes the long-term objectives of energy saving and emissions for all economic activities, including the building sector, approved in November 2020.
- **ERESEE 2020** (the Spanish Long Term Renovation Strategy for buildings), last updated in June 2020, and that formally develops the section of the ELP 2050 concerning buildings. Regarding the residential sector, the main objectives for 2050 include a reduction of final energy use by 37.3 % compared to 2020 levels, an increased electrification aiming at 81.4 % of the residential consumption, and a reduction of carbon emissions by 98.8 % compared to 2020, which means almost a total decarbonization of the sector by 2050.
- **PNIEC 2021-2030** (National integrated Energy and Climate Plan 2021–2030) which, among others, defines a specific pathway (based on current technology and knowledge) to achieve the renovation objectives between 2021 and 2030.

The analysis of the whole Spanish policy landscape regarding energy efficiency in the building sector (beyond the documents listed above) made it possible to identify challenges and opportunities to integrate the EE1st principle in the country, looking more specifically at building codes and the main incentive schemes for energy renovation of buildings.

A building code definition not in line with whole-building approach in Spain

The **CTE-DB-HE0** (Código Técnico de la Edificación, CTE), part of the building code (Ministerio de Fomento 2019), defines the **energy consumption limitation of buildings in terms of non-renewable primary energy/m2.** This requirement is subject to conversion coefficients from final energy values, based on the characteristics of the different fuels and to a certain extent, arbitrariness or interference with political interests. For example, the production mix of electricity, and thereby the primary energy factor, vary constantly. As a result, buildings may be described by different non-renewable primary energy demand depending on the value of the coefficients in force when the assessment takes place. **Other primary energy coefficients are also controversial**, for example the consideration of biomass with a conversion coefficient 0.034. According to the interviewees, these conversion coefficients may be subject of further updates in a near future, too, and the changes create an unstable framework.

Whatever the primary energy coefficients, the approach to set the main requirements in terms of non-renewable primary energy per m² is not in line with the EE1st principle. This indeed allows to compensate a weak energy performance of the building envelope with a larger RES supply. This is the opposite approach to a passive-level building code, with the risk that demand-side solutions to limit the final energy demand would not be fully considered in the building design (or for large renovations). This can **result in oversizing RES or other supply-installations**, possibly with negative environmental impacts. The Spanish building code does include minimum requirements about the thermal performance of the building envelope featuring in other subdocuments (e.g., in terms of U-values). However, this sub-criterion may not be sufficient to ensure that the design and performance of the building envelope are considered in a holistic way to provide the best option for the building overall.

Two major incentive schemes for energy renovation in Spain that perform differently for EE1st

The "***Housing rehabilitation programme for economic and social recovery in residential environments***" is currently the most generous fund for building renovation in Spain, with 3.42 billion EUR of public funds, as part of the Spain's recovery and resilience plan. The use of these funds to support building renovations can be seen as a way to implement EE1st in the allocation of public funds to different policy priorities (in line with EU's Renovation Wave). The **programme requirements** – as in the case of the building code – **are set in terms of primary energy** (30 % reduction in primary energy consumption, Decree 853/2021, article 14), and **not in final energy, or an indicator that would combine both**, that would reflect the performance of the building envelope. In the lack of a definition of light/medium/deep retrofitting, there is no **standardized way of determining the basis for financial support**, which should at least consider the introduction of final energy consumption, a parameter more in line with the EE1st principle as done with the Fabric First approach.

PREE ("Programme for the energy rehabilitation of buildings") (IDAE n.d.) is the main "regular" national programme for energy renovation, continuing the previous PAREER-CRECE and PAREER II programmes. PREE has a smaller funding (EUR400 million) than the recovery programme, but still significant. It is a long-lasting programme, with likely renewals of its budget. It provides grants for **three different types of interventions** (on the building envelope, on thermal systems and in lighting) in private buildings. This **effectively advocates for the Fabric First approach, but not making it mandatory for renovation projects to be eligible**. The use of differentiated grant rates is encouraging joint rehabilitation interventions, issuing a 35 % grant instead of 25 % if the renovation deals with the whole building instead of on an individual dwelling in the case of insulation actions or RES heat systems. This is important in Spain due to the high share of condominiums. Further bonus rates favour joint interventions (i.e., projects including several action types) and reaching high energy performance (A or B energy class). Though this last criterion is **based on the CO_2 emission levels** (so not necessarily promoting to consider first the reduction in final energy demand). Overall, it can be considered that **PREE is partly in line with the Fabric First approach.** The results, in terms of number of projects per type of project, could be a good indicator to assess whether this flexible approach is enough to trigger projects in line with EE1st.

IMPLEMENTING EE1ST IN HUNGARY

Hungary hosts over 3.7 million dwellings with a total floorspace of 274 million m². There are around 24,000 public buildings that are larger than 250 m², summing up to ca. 50 million m² heated floorspace (LTR 2020). The average consumption of residential buildings is around 235 kWh/m²/year (Másfélfok 2021).

The Hungarian climate and energy efficiency policy framework has changed unexpectedly in 2020. While the Hungarian government vetoed the EU climate target in 2019, a new climate protection act, the Law XLIV. on Climate Protection was adopted by Parliament in July 2020. It is commendable that the law defines a legally binding climate neutrality goal for 2050, and a greenhouse gas emission reduction target of 40 % by 2030 compared to 1990 levels, set in line with the EU targets. While the law makes Hungary a frontrunner among the Central Eastern European countries, serious concerns have been raised in the literature (e.g., Egyensúly Intézet 2021) and by interviewees for leaving the heavy lifting for future generations for the period after 2030. The renovation roadmap suffers from imbalanced milestones, (similarly to the overall climate targets roadmap described above), having adopted only a 20 % reduction of final energy demand of the residential building sector by 2030. Reaching the 2030 goal would require the deep renovation of 100-130 thousand residential buildings annually (Másfélfok 2021).

The Climate Protection Law does not detail the measures and policies to be taken, nor defines the responsibilities. Other MS often set-up a committee to support implementation, such as the German Committee on Climate Change. The evaluation of the applicability of the below EE1st approaches had to be based on other framework documents, whose relationship with the Climate Law is yet to be expressed by the government.

Building codes far from passive levels in Hungary

Regulations have been a major part of the Hungarian energy policy and **building codes could be a strongpoint of reaching the decarbonization targets**. Traditionally, the construction industry has had well-trained planners, implementers and appropriate financing solutions, however the competition between supply (different renewable source alternatives, district heating and traditional solutions) and demand measures (efficiency improvements, sufficiency solutions) have been on the agenda and filtered into policy decisions for the last decades. Furthermore, the regulations and their implementation, as well as the sector have seen serious downgrading. The **definition of the building codes has been driven by the obligations of the EPBD, however aimed at the minimum compliance**. For example, Hungary postponed the introduction of nZEB requirements from 1st January 2018 to 30th June 2022 (BPIE 2021), and the definition of nZEB levels is well above the EU benchmark at **ca. 100 kWh/m²/year** (BPIE 2021). Currently, the building codes provide for the **efficiency level and the RES integration level separately**.

Operationalizing EE1st through **passive level building codes** would first and foremost contribute to significantly more energy savings, faster decarbonization simply due to the almost **10-fold more stringer requirements** than today. In addition, a **whole building approach** could further increase the cost-effectiveness and adaptability, because the efficiency and the generation measures would be evaluated on an equal evaluation basis at the building level.

Supporting policies are existent in Hungary that could further improve the impacts and cost-effectiveness of a passive-level standard. Most of these would need some adaptations. **Energy performance certificates (EPCs)** are used as required and could support the evaluation and monitoring of investments. Financial policies (see in the subchapter below) would need to be reformed, in particular to **include and monitor energy performance requirements**. A combination of grants, credit lines, guarantees – all of which are already available in the country for different types of construction projects – would serve the move towards passive level requirements using the least public funding. In addition, the recently launched **one-stop shops** (Renopont) and energy information centres could help alleviate the technical, informational and hurdle-related barriers.

The current system locks-in low-energy performance by design, which casts a long-term cost, comfort and social set of problems. The impacts of the immature building codes currently are aggravated with the centrally set residential energy prices for the residential sector, which discourage energy investments and extend the payback times artificially, especially in days when fossil prices are soaring.

High potential to integrate the Fabric First Approach in funding schemes, but needs political backing

The country has an active construction industry, both in terms of new buildings and renovations, boosted in large by three key policies: (1) **There are a number of competing programs that subsidize building construction and renovation**. For example, the program CSOK for families (in the range of 1.5 million to 10 million HUF (EUR4000–27000)) non-refundable grants and combined preferential credits. These used to include energy performance requirements, but were removed, and were not monitored even previously. The program is a social policy, even though the richest families enjoy its benefits due to its design (MEHI 2021). (2) The **"Green Home for All" mixed subsidy, credit and guarantee program has project pipelines specifically for heating equipment exchange, insulation, renewable integration, exchange of old home appliances**, etc. (3) T**ax relief for construction materials** was a measure introduced as a recovery measure during the pandemic.

The ultimate concern about of these programs is that there is **no reliable energy evaluation before and/or after the project**. Nevertheless, these programs have been identified as most suitable for the implementation of the Fabric First approach, but should be strengthened by an evaluation, validation and monitoring element. In defining the efficiency requirements, the programs should integrate the evaluation of balancing between efficiency and supply measures.

A number of supporting policies and framework conditions would be enabling such a transition. A green mortgage bond purchase programme was notified in September 2021 at the National Bank (MNB 2021), which could be earmarked to support projects and programs leading to overall social benefits. The programs could also leverage the motivation of the Hungarian tenants, both in the residential and non-residential sectors, which were shown by MEHI (2021) to reach up to 20 % of all buildings per year.

Conclusions and discussions

Taking the example of two possible approaches to implement EE1st in the buildings sector, namely passive-level building codes and the Fabric First approach for incentive schemes,

Table 1. Comparing the potential of the two reviewed EE1st approaches (Passive-level building code and Fabric First approach) in the three Member States.

<table>
<tr><th></th><th></th><th>Germany</th><th>Spain</th><th>Hungary</th></tr>
<tr><td colspan="2">Decision power</td><td>Federal system (joint decision-making and evenly distributed financial power)</td><td>Quasi-federal system (decentralisation of legislative powers is mixed, financial distribution is uneven, yet considerable autonomy)</td><td>Unitary/Centralized (most power and financial decision and power are at national level)</td></tr>
<tr><td colspan="2">Building policies</td><td>Energy and building strategies at Government/Ministry level, buildings policies placed at federal level, complemented with regional schemes.</td><td>Building policies placed at national level, implementation and specifications mostly at regional level.</td><td>Strategies and building policies at national level, with specific requirements and implementation at local/ sub-local level.</td></tr>
<tr><td rowspan="2">Passive-level building code</td><td>Current policy-environment</td><td>Already relatively stringent building codes in the scope of the Buildings Energy Act (GEG) with energy performance requirements that are to be revised in 2022.</td><td>Building codes define requirements in terms of reduction of primary energy/m2. Together with changing conversion coefficients, the standards lead to a focus on supply change and oversizing.</td><td>The energy performance requirements in the current building code are too low, and define efficiency levels and RES integration separately. Together with subsidized residential energy prices and specific grants, investments are lopsided.</td></tr>
<tr><td>Opportunities to integrate</td><td>In the forthcoming GEG review stringency should be further increased. The building renovation passport, or the EffizienzHaus label could integrate EE1st more directly in combination or as alternative instruments.</td><td>A whole-building approach, e.g., requirements defined in terms of final energy, or its combination with building shell specifications could lead to a more EE1st-like approach.</td><td>Increasing the stringency significantly, with proper enforcement and removing energy price caps, could lead to significant market-based investments in whole-building solutions.</td></tr>
<tr><td rowspan="2">Fabric First Approach in funding schemes</td><td>Current policy-environment</td><td>Previous incentive scheme (kfW) included performance-based incentive rates, in line with EE1st, the new incentive schemes (BEG) is still uncertain in its approach to EE1st.</td><td>Two key funding schemes exist in parallel. The new housing fund sets requirements in primary energy, while PREE is partly in line with the Fabric First approach, because it promotes combined and ambitious renovations.</td><td>A number of support programmes for new construction and renovation are very generous in budget per building, but do not include energy performance requirements.</td></tr>
<tr><td>Opportunities to integrate</td><td>It could be possible to integrate a Fabric First approach in BEG, but an attention to measurement and monitoring is critical for success. An option is to couple BEGwith the digital building logbooks and the energy advisor services.</td><td>The housing fund should change its target definition from primary energy to a whole-building approach. PREE is already line with EE1st, even if less demanding that the Irish Fabric First approach.
A standardized way to differentiate regarding the depth of renovation could improve EE1st compliance.</td><td>There is a high potential to use these funds for energy renovations could integrate EE1st factors. However, monitoring has been a critical problem already in previous programs. These need to be introduced and strengthened.</td></tr>
</table>

Note: The grouping according to policy and decision-making powers is largely based on political science works, from the perspectives of financial powers, social, building sector and climate policy-making, which are relevant for the current analysis. Sources: Valdesalici (2021) and Requejo (2017)

the analysis of three MS shows diversity in the extent to which these approaches (or similar approaches) are already in place or could be implemented. The differences are due to national conditions in their building sectors (e.g., importance of heating in the national energy consumption), the general policy-making and decision-making structures, and the past and current set of policies for energy efficiency in buildings (e.g., in the way to set minimum requirements for buildings).

Implementing EE1st does not mean uniform policies across regions and can take into account national, and even sub-national, specificities. Then EE1st can help harmonize the overall ambition of the policies, and above all, ensure they are aligned with long-term objectives.

Volume vs. performance level: A major dilemma arises between putting the priority on increasing the number of renovation projects (irrespective of their ambition) or on increasing the ambition of the renovation projects to avoid lock-in and fit with long-term goals. The decision is influenced by the time-perspective taken in e.g. the presented incentive schemes. Most of the renovation programmes as part of the recovery and resilience plans tend to prioritize the number of projects over their ambition level. Still, their minimum performance requirements are sometimes higher than the previous renovation programmes. Both experiences from Brussels' region and Ireland, show that there is a need for a clear signal and accompanying measures for the market to adapt and get ready to deliver higher overall energy performance, either for new or for existing buildings. The longer the policies fail to provide enabling conditions, the more difficult it becomes to reach long term goals. The need to obtain results on short term should not delay the implementation of policies to make the building industry fit with the energy transition, which requires more integrated approaches and comprehensive offers.

Having a national renovation sector ready for the renovation wave: A potential obstacle that the renovation sector is facing in many countries is the potential lack of capacity or workforce, creating a bottleneck for the number of projects or a limitation for reaching higher performance per project. The role of vocational training at all levels (i.e., for both white-collar and blue-collar workers) is essential, and must be promoted across the board: not only by public institutions (such as vocational schools or universities) but also by professional associations. For example, Spain has already been implementing programmes for vocational retraining, after the major crisis of its construction sector after the burst of the Spanish property bubble in early 2008. The development of the renovation markets was then perceived as a way to compensate the drop in the market of new buildings. This experience could be a basis for further developing the renovation sector, with a focus on energy efficiency improvements. The experience from the Brussel's region and Ireland shows that setting schemes with ambitious performance requirements and making it clear that this will become the new norm has given a clear signal to the market, paving the way for the transformation of the industry to go from pilot project to regular practices. Involving the building industry's stakeholders in the preparation of the schemes and a clear communication about the objectives and benefits for the building industry are also essential success factors.

EE1st is an opportunity to assess and incorporate multiple benefits: Evaluating policy or implementation alternatives on the demand and the supply-side leads to the need to consider multiple impacts (positive and negative) on both sides. This can bring them on a level playing field, and takes into account the benefits that are typically overlooked in simple energy efficiency analyses. While building owners rarely enter into comprehensive cost-benefit analysis, public policies can provide information and incentives that directly reflect the integration of these multiple benefits.

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