

Financing renovation of public buildings in Slovakia

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Abstract

In Slovakia, there is more than 12,000 public buildings, most of them in the need of a deep renovation. Renovation of public buildings can provide significant energy savings potential for space heating, both in Slovakia as well as in the EU. In order to utilise this potential, significant investment is necessary, which enable deep retrofit to the lowest possible level of energy demand. In Slovakia several financial mechanisms have supported renovation of public buildings (Munseff, Pilot project Energy efficiency of public buildings, Environmental fund, Structural Funds 2007–2013, European Structural and Investment Funds (ESIF) 2014–2020 etc.). However, most of these are ad-hoc and mainly dependent on European or international funding. Contrary to the residential buildings, no national financial mechanism for a stable support of public buildings renovation exists. Moreover, most of the mechanisms have no strict energy requirements in place, which may lead to lock-in effect. This changed only in Operational Programme Quality of Environment (2014–2020). Nevertheless, despite the number of different programmes, the total number of renovated buildings is relatively small, and the allocated funds are insufficient. The situation is similar in the Czech Republic and Hungary. It is envisaged that renovation of public buildings is going to be supported in the upcoming ESIF (2021–2027) and in the Recovery Plan. Therefore, it is of utmost importance to direct these investments in such a way that the energy savings potential is utilised to the fullest, further lock-in effect is prevented

and public money is spent efficiently. The aim of this article is to provide an overview of financial mechanisms for renovation of public buildings in Slovakia, summarize lessons learned as well as risks and opportunities of large-scale building retrofit and point out several examples from abroad. Finally, recommendations will be drawn for both national authorities and for municipalities.

Introduction

In Slovakia, there are more than 12,000 public buildings (Korytarova et al. 2015). Like in other Central and Eastern European (CEE) countries, due to a long-term underfinancing of the public sector, maintenance and systematic building renovation has been largely neglected for several decades. Therefore, there is a significant energy savings potential in public buildings in Slovakia and other countries, which was proven by several studies (e.g. Hungary: Korytarova 2010, Slovakia: Korytarova et al. 2015, Czech Republic: Lupíšek et al. 2021 etc.).

While there have been several programmes financing renovation of public buildings, these were mainly ad-hoc, not-systematic and with only a limited time-frame and budget. In some of these programmes, energy efficiency was not the primary goal, and thus the results were not properly monitored in terms of achieved energy savings. Moreover, most of the programmes rely on EU or international sources. Unlike in the residential sector, a stable long-term national support mechanism for renovation of public buildings is missing.

The main problem is a lack of a strong energy requirement for renovations financed through public funding. This is a problem, as according to EU legislation major renovations shall

fulfil minimum requirements of new buildings only when it is “technically, functionally and economically feasible” (Article 7 of Directive 2010/31/EU on energy performance of buildings, EU 2010). This is a rather weak provision.

The aim of the article is to provide an overview of financial mechanisms for renovation of public buildings in Slovakia; to summarize lessons learned from functioning of these mechanisms; to summarize risks and opportunities of large-scale building renovation and to point out at selected examples from abroad.

Methodology

Overview of the financial mechanisms is based on analysis of the past, existing and planned financial mechanisms aiming at renovation of public buildings. This includes ex-post evaluation of the different past and existing programmes. The main aim is to show the financial flows that have been used to fund renovation of public buildings and show the overall impact of these programmes both in terms of expenditures as well as achieved energy savings. On the other hand, investment intensity (€/MWh) of renovation of different building categories is analysed.

Main data sources are national strategic materials, such as National Energy Efficiency Plans (NEEAPs) (MoE SR 2011, 2014, 2017), Integrated Energy and Climate Plan (NECP) (MoE SR 2019), Long-Term Renovation Strategy (MoTC SR 2021), planning documents for Structural Funds (2007–2013), European Structural and Investment Funds (ESIF) (2014–2020); ESIF (2021–2027) and Renovation and Resilience Plan of the Slovak Republic (MoF SR 2021). Further sources included various data sets and public information on different programmes (such as webpages of different programmes, e.g. Environmental Fund, Munseff).

Each programme was evaluated on the basis of individual projects, i. e. bottom-up ex-post evaluation. The ex-post evaluation of financial flows and energy savings for the NEEAPs were conducted by the Ministry of Economy of the Slovak Republic (MoE SR) and Slovak Innovation and Energy Agency (SIEA).

First, the projects aiming at improving energy efficiency of public buildings were selected and data was gathered in a consistent and systematic way. This included project information, building information (location, building category, floor area), start and end of the project, allocated funding and break-down of financial sources, planned or achieved energy savings (while seeking the latest possible information). This data was then checked for any obvious mistakes and discrepancies, such as missing information and numerical and conversion mistakes (1st check). In such cases, additional information was sought from publicly available information on the project. In case renewable energy sources (RES) were also installed within single project (along with energy efficiency measures), financial sources related to RES installation were deducted from the total project expenditures. Next, the investment intensity of each project was calculated (€/MWh, expenditures per unit of energy saved) and compared to the average investment intensity of the corresponding building category (2nd check). Projects with extensive deviation from the average investment intensity were further investigated. In case such projects did not prove viable, they were excluded from the analysis.

The investment intensity (€/MWh) shows how much initial investment is required per unit of energy savings within a renovation project. This value is based on total investment cost of energy efficiency part of renovation projects and average achieved annual energy savings reported during the monitoring period (e.g. this usually ranges from 3–5 years (e.g. in structural funds indicators are monitored for 5 years after completion of the project), depending on what is available at the time of calculation. The average investment intensity per building category is based on renovation projects funded by the Pilot project Energy Efficiency in Public Buildings (SIEA 2015), Munseff (2013) and assumptions, where such data was missing. These projects were taken as a basis as the funding was used solely for energy efficiency measures (i.e. no technical equipment etc.). The values range from €1,500/MWh for educational and small administration buildings to €2,300/MWh for cultural buildings. Investment intensity depends both on the building's specific energy use (kWh/(m².a)), and on its usage throughout the year.¹

Lessons learned and recommendations are based mainly on experience of the author with preparation and coordination of NEEAPs (required under Directive 2006/32/EC on energy services (EC 2006) and Directive 2012/27/EU on energy efficiency (EU 2012) and annual reports on progress towards achievement of energy efficiency targets (required under Directive 2012/27/EU) in 2011–2017, as well as on experience from preparation of analyses on energy savings potential in public buildings (Korytarova 2010, Korytarova et al. 2015).

Results

Results include overview of the financial mechanisms in 2008–2016 in terms of financial flows and achieved energy savings through different programmes and preliminary overview of planned new financial mechanisms.

FINANCIAL MECHANISMS IN 2008–2016

In total, in the period 2008–2016, €1,011 M was invested in renovation of public buildings in Slovakia, which brought energy savings of 1,218 TJ (338 GWh). Out of this, European Structural funds (SF 2007–2013) were the biggest contributor, both in terms of finances (90 %) and in terms of energy savings (74 %). Among these, the main contributors were the Regional Operational Programme (ROP) (2007–2013) and the Operational Programme Health Care (2007–2013) (see Figure 1).

In the examined period most energy savings were brought by ROP (2007–2013) (see Figure 2), which included renovation of educational, social and cultural buildings. The ESIF (2014–2020) were only starting in this period. The second largest contributor was the Environmental fund,² followed by Ekofond³

1. Note, that renovation of municipal cultural buildings is highly cost intensive as compared to other public buildings. This is due to the fact, that although these buildings are in a poor technical state, they are used scarcely and heated only occasionally, and the high initial investment does not bring enough energy savings.

2. Environmental Fund – national fund; supports i. a. renovation of municipal buildings within so-called Activity L: Increasing energy efficiency of public buildings including building insulation. This activity is financed from revenues from emission trading (based on Act No. 414/2012 Col. on Emission Trading as amended). Recently, energy savings (%) were added among the selection criteria for the support (Environmental Fund 2021).

3. Ekofond – private fund of SPP, a.s., supported renovation of public buildings in 2007–2013 (MoE SR 2017, Annex 5).

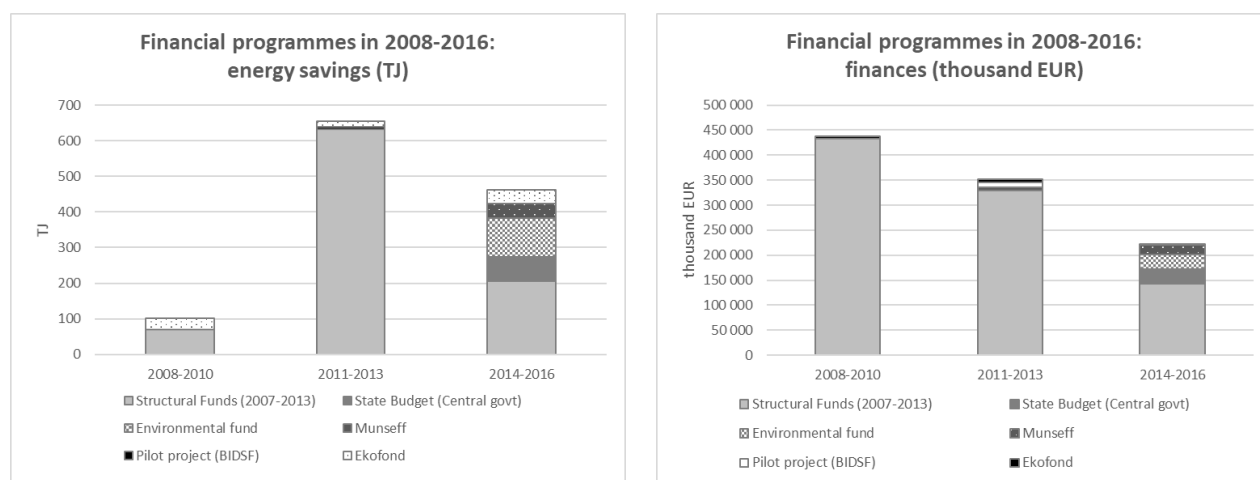


Figure 1. Financial programmes in 2008–2016: finances and energy savings. Sources: MoE SR (2011, 2014, 2017). Note: The data for ESIF (2014–2020) were not available at the time of writing.

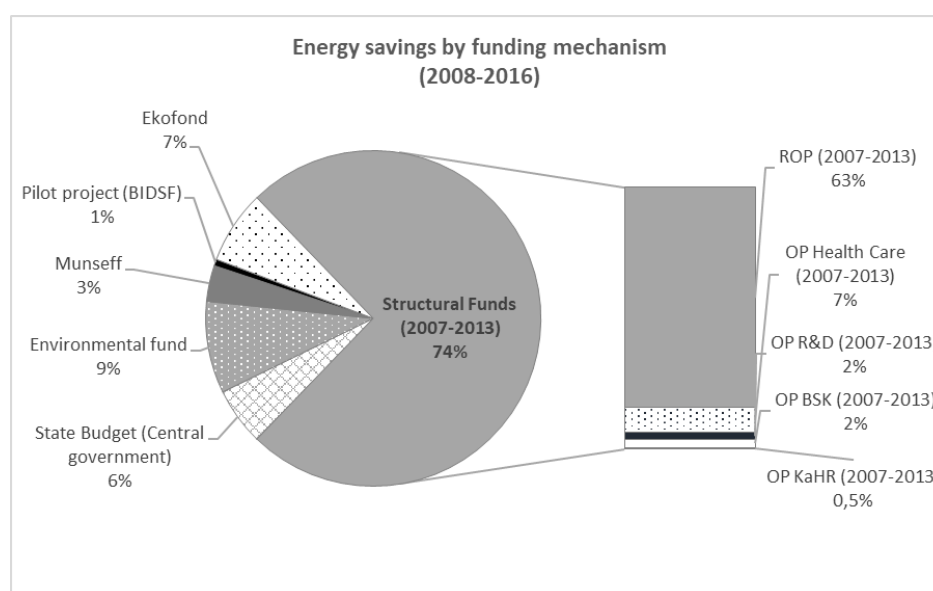


Figure 2. Energy savings by financial mechanism in 2008–2016 (TJ). Sources: MoE SR (2011, 2014, 2016).

and expenditures of the central government for renovation of their own buildings and buildings of their subordinated organisations.

PLANNED FINANCIAL MECHANISMS

Due to the increased need to achieve climate change targets and to spur economic recovery as well as still untapped energy savings potential, renovation of public buildings will be financed both from Recovery plan of the Slovak Republic and ESIF (2021–2027). Within the recently approved Slovak Recovery Plan (MoF SR 2021) approximately €396 M is designated for “green” energy renovation of public buildings, out of which €200 M is planned for renovation of historical and listed public buildings (MoF SR 2021) and the rest concerns educational, health care (including emergency services) and social buildings, courts, police stations and firefighter stations). However, the renovation of public buildings is not preconditioned by any ambitious energy requirement. The only requirement is that all renovated public buildings must achieve at least 30 % savings of

primary energy (MoF SR 2021), which is a rather weak energy requirement for renovation. Within ESIF (2021–2027), which consists of a single Operational Programme Slovakia, approximately €367.5 M is planned for renovation of public buildings (MoTC SR 2021). Details on the scope of support and energy requirements is not known yet.

Risks and opportunities of building renovation

Several studies have proven that there is significant energy savings potential in the public buildings, both in the CEE region (Korytarova 2010. Korytarova et al. 2015, Lipúšek et al. 2021) as well as beyond (e.g. Ürge-Vorsatz et al. 2012, Lucon et al. 2014). However, full utilisation of this potential requires that the currently available and new financial sources are dedicated only to deep renovation high-quality projects, which fulfil ambitious energy requirements.

In case the existing and new financial mechanisms provide support to suboptimal retrofit on a large-scale, this will lead to a

lock-in effect,⁴ which can range up to 42 % by 2050 (as compared to an ambitious scenario with transition towards Passive House Standard) (Korytarova 2010). Moreover, studies of Korytarova (2010) and Korytarova et al. (2015) proved that it is more cost-effective to renovate existing building stock towards Passive House Standard (PHS)/Nearly Zero Energy Buildings (NZEB) at a lower rate of retrofit, rather than investing massively into conventional retrofit at accelerated speed. The retrofit rate of 3 % p.a. to minimum requirements for energy performance of buildings (under Directive 2010/31/EU), which is often promoted by some policies (such as Directive 2012/27/EU), is also regarded as accelerated renovation to only conventional levels due to the rather weak provision for major renovations under Directive 2010/31/EU (see above).

Lessons learned

The lessons learned are based on experience with the financial programmes for public buildings renovation in Slovakia, gathered mainly through monitoring and reporting of energy savings under EU legislation in 2010–2017.

Main lessons learned from functioning of financial mechanisms:

- Several programmes lacked a strong energy requirement, which led to only average energy savings. This kind of sub-optimal renovations, when supported on a large-scale, may lead to a lock-in effect (Korytarova 2010). Therefore, it is crucial that the financial programme includes a strict energy requirement (such as in Operational Programme Quality of Environment (2014–2020)), upon the fulfilment of which depends provision of support.
- The methodology should prevent renovations with installing unnecessary RES as to compensate weak thermal envelope in order to reach the energy requirement.
- It is beneficial, when an energy audit (EA) is required as a basis for the project proposal (e.g. Munseff, OP QoE 2014–2020) and another EA (e.g. a simplified EA) after the renovation. This increases the quality of the project, renovation and data on achieved energy savings. It is also vital that energy savings are monitored at least 3–5 years after the renovation (e.g. Munseff, EU structural funds).
- An effective sanction mechanism ensures that the project fulfils the energy requirements (such as in OP QoE (2014–2020) or in the Hungarian legislation (see below)).
- When providing a soft loan, it proved motivational to provide also a bonus, the extent of which depends on the achieved energy savings, verified by a simplified energy audit (e.g. Munseff).
- When international and/or private investors are involved in the financial programme, the ambitiousness of the programme may be compromised by commercial perception of investment risks. On the other hand, national support

programme could be more effective in overseeing the long-term vision and contribution to the national targets.

- The Bratislava region (BSK), defined as a developed region based on economic indicators, was not eligible for financing from EU structural funds for building renovation and energy audits of public buildings. As a consequence, i. public buildings in BSK could have not been renovated in such number as in other Slovak regions, and ii. there is limited data on energy consumption in the region's buildings. As a result, there were much fewer financing options for renovation, such as subsidies for emergency cases, EPC projects, international funds, ad-hoc studies (such as project LIFE-DELIVER).⁵ In summary, this exclusion resulted in buildings having been renovated only partially or not at all.
- Experience from the residential sector shows that it is not efficient to have several programmes supporting separately thermal insulation, renovation of technical systems and installation of RES. This increases administrative burden for both the programme administrator and the applicant, and important synergies between different measures may be lost.

Main lessons learned in the area of monitoring and reporting:

- Data collection for reporting under EU legislation showed that not all programmes for renovation of public buildings monitored energy savings before the reporting obligation under Directive 2006/32/EC. Thus, in several cases, energy savings had to be estimated (based on the expenditures per project and investment intensity of similar projects).
- Data quality problems – the data collected often included numerical and conversion mistakes, lacked start or end date of the project, or it was unclear whether the energy savings were annual or cumulative over the 5-year monitoring period. Often, projects reported unrealistic energy savings, which could have been due to some of the above-mentioned reasons or reporting in other units as required. This necessitated data checks and often also verification or cross-checking based on other publicly available information, or even contacting the beneficiary.
- Several of these data problems originated due to the fact, that the energy data collected by project beneficiaries were not checked, neither verified by project managers (who often lacked the relevant skills), nor by energy specialists. However, if the energy data is not checked at the project level, it creates unnecessary problems and delays for monitoring and reporting at the national level.
- Another problem with collected data was, that in case of building renovation, which included installation of RES, the investment costs were not reported separately for energy efficiency. This led to high investment intensity, and subsequently had to be split according to the data on RES installed capacity.

4. Lock-in effect means locking in a relatively high energy consumption of the renovated buildings for several next decades, until the next round of renovation (Korytarova 2010), in Hungary this ranges between 30–50 years (Csoknyai 2009).

5. <https://odolnesidliska.sk/zacali-sa-prace-na-hlbkovej-obnove-ms-koliskova-14/>

- All of the above-mentioned issues led to time-intensive data collection, as there was no experience on evaluation at national level before and limited staff. The Permanent inter-ministerial working group for preparation of NEEAPs, established in 2007, was instrumental for this purpose. Nevertheless, due to the lack of skills of the representatives in the working group as well as their frequent change, significant time had to be spent by the coordinating team of MoE SR and SIEA on their training, consultations and preparation of methodological and data collection material. Over time, majority of the main financial programmes started monitoring achieved energy savings after renovation (either themselves or by delegating monitoring to a specialized agency, such as in the case of Environmental Fund). Since 2016 monitoring and reporting is conducted by SIEA, which is responsible for administration of the Monitoring System of Energy Efficiency (MSEE).

Examples from abroad

Table 1⁶ includes selected relevant examples from abroad, which are worth considering, when developing or changing national support programmes in the area of renovation of public buildings.

The examples show, how energy criteria can be set in financial mechanisms (DE), and also that certain level of energy performance can be prescribed by legislation (HU, FR). However, for it to be effective, it is necessary to have strong enforcement provisions as well. They also show that EU structural funds can be utilised to finance new construction and renovation of public buildings to the level of PHS (CZ) and that public procurement can enable it (CZ). MEES (UK) show how to mobilize landlords to renovate their buildings, decrease their energy demand and help decrease energy poverty. The example of London (UK) shows that transition towards zero carbon buildings can be implemented at the local level.

Furthermore, it shall be noted, that the sources for the financial mechanism for renovation of public buildings can come from different sources, such as revenues from emission trading, revenues from fines and sanctions in the energy sector, revenues from energy and/or CO₂ taxes and other types of taxes. For instance, in the Czech Republic all revenue from EU Emission Trading System is devoted to energy renovation of residential buildings in the New Green Savings Programme (Lupíšek et al. 2021).

Moreover, the support of high-performance building renovation cannot be viewed as a solely question of setting of a financial mechanism. The financial mechanisms should be complemented and supported by other measures, including other financial support instruments and legislative measures. The sensitivity analysis in Ürgel-Vorsatz et al. (2012) shows that the cost-effectiveness of the ambitious scenarios highly depends on energy prices and technology learning. Therefore, it might be

beneficial to both eliminate energy subsidies, which are counterproductive to energy savings efforts and support technology development.

Recommendations

The recommendations are based on the lessons learned in Slovakia, on the examples from abroad as well as on the literature and modelling. This section includes recommendations on financial mechanism for national authorities and recommendations for municipalities.

RECOMMENDATIONS FOR FINANCIAL MECHANISM FOR RENOVATION OF PUBLIC BUILDINGS

- When only scattered and ad-hoc financial programmes exist for renovation of public buildings, a stable national financial mechanism should be established with a long-term mission and clear and strict energy requirements for renovation. The strict energy requirement is necessary so that the full energy savings potential is utilised, and the public funds are spent effectively, without the risk of lock-in effect. Only once this is ensured, the retrofit rate can be increased further.
- The mechanism should include effective sanctions in case of non-fulfilment of energy requirements.
- The financial mechanism should be set in line with an ambitious long-term renovation strategy and regularly adjusted to its long-term goals. This should include a gradual transition towards high performance buildings (such as NZEB, Passive House Standard for renovation (i.e. 25 kWh/(m².a), PHI 2016), whichever is more ambitious), instead of a speedy renovation (such as at 3 % p.a.) to only conventional levels of retrofit (Korytarova 2010, Korytarova et al. 2015).
- The support can be differentiated according to the achieved energy savings or energy performance, (such as in the KfW).
- A part of the support can be provided one year after the renovation, as a motivation to conduct commissioning and to ensure that the measured energy savings after a year of operation are close to the planned energy savings.
- The financial mechanism should support only quality projects. For this purpose, an energy audit (EA) should be required as a basis for each project proposal, and another EA after renovation to prove that energy requirements have been achieved.
- Proper monitoring should be ensured for at least 3–5 years, where both finances and energy savings are checked and, if needed, verified at the project level. For this purpose, a thorough methodology should be developed. Monitoring of energy-related outcomes can be conducted by in-house energy specialists or delegated to a specialised agency.
- The financial mechanism can be administered by a national fund, which can be supplied from various national and international sources depending on their availability (ESIF, national funds, revenues of emission trading, revenues of energy and/or CO₂ taxes and fees, sanctions collected in the energy and climate change field), governed by a national independent authority. For instance, the State Fund for Build-

6. Comment for legislative provisions: Act on Energy Efficiency: energy requirement for public renovations and sanction mechanism (HU). Note, that the requirement based on cost-optimum would not be applicable in Slovakia, as the cost optimal levels are weaker than the NZEB levels, which would lead to lock-in effect (Bendžalová et al. 2020, Bendžalová 2021).

Table 1. Overview of selected examples from abroad.

Programme/initiative	Main features	Comments/Sources
Financial schemes and public procurement		
KfW-Efficient House Standard for existing buildings (incl. listed buildings) (DE)	<ul style="list-style-type: none"> The scheme provides soft loans and a bonus, which depends on the extent of achieved energy performance level in terms of primary energy demand: 55, 70, 85, 100, 115 (in % as compared to the currently valid EnEV Regulation reference building). 	<ul style="list-style-type: none"> The bonus takes into consideration also the heat losses as compared to currently valid EnEV Regulation. Source: KfW (2021)
Operational Programme Environment (CZ)	<ul style="list-style-type: none"> The scheme enables new construction of public buildings to the level of Passive House Standard (PHS). It enables renovation of public buildings to the level of PHS (installation of ventilation with heat exchange is eligible for funding). It is administered through the State Environmental Fund (which supports also new construction and renovation of residential buildings). The support is applicable to all governance levels. 	<ul style="list-style-type: none"> Cons: The scheme also supports EPC projects and partial renovations and does not include ambitious energy requirements for building renovation. This can lead to lock-in effect. Source: MoEn CZ (2020)
Usage of public procurement for new building in PHS (CZ)	<ul style="list-style-type: none"> Primary Art School in Holice built in PHS. The city of Holice demanded the building to be built in PHS, which was included as a criterium in the public procurement for both project documentation and for the construction project as such. 	<ul style="list-style-type: none"> Source: TZB-info (2015), Borák et al. (2015)
Legislative provisions		
Act on Energy Efficiency: energy requirement for public renovations and sanction mechanism (HU)	<ul style="list-style-type: none"> Since 2015 all renovations receiving public funding are obliged to fulfil cost-optimal energy requirements. Sanctions: in case of non-fulfilment, the beneficiary shall return the funding (extent of which depends on extent of non-fulfilment) (Szoltés 2019). 	<ul style="list-style-type: none"> This is an example of how a framework energy requirement as well as of a sanction mechanism can be set at national level (and not to which level of energy requirements are the sanctions linked). Cons: Currently practical enforcement of this provision is limited. Sources: MND HU (2015a, 2015b)
New French Legislation – Energy efficiency measures for non-residential buildings (Éco énergie tertiaire) (FR)	<ul style="list-style-type: none"> Mandatory renovation of tertiary buildings over 1000 m², 2 options: <ul style="list-style-type: none"> a) Gradual reduction of building's total final energy use (by 40 % in 2030, by 50 % in 2040, by 60 % in 2050) as compared to a reference year, which cannot be earlier than 2010. b) reaching energy consumption thresholds defined per decade for each building category. Control and sanction system (fines, name and shame, etc.). 	<ul style="list-style-type: none"> Target: to renovate all existing buildings by 2050. Obligation of annual reporting of building's energy consumption through a digital platform OPERAT. Display of results (to employees and public) on annual basis. Source: Rosenstein (2020)
Minimum level of energy efficiency standard for rented property (MEES) (UK)	<ul style="list-style-type: none"> The provision forbids rental of buildings, which are in the worst energy classes (EPC Band) (F, G). Landlords are required to improve energy efficiency of their property with possibility to gain support to cover the costs. Sanction: fine up to £5,000 for breaching of the regulation. Exemption: if the cost of renovation is over £3,500 (incl. VAT). Exemption is valid for 5 years. 	<ul style="list-style-type: none"> There are two regulations: for domestic and non-domestic private rented property. Landlords can utilize these support schemes: Energy Company Obligation (ECO), Green Deal, Local authority grants. The MEES will change to EPC Band C by 2030. The coverage is extended over time: all existing commercial leases will be covered by 2023. The measure also aims to reduce energy poverty. Source: BEIS (2017, 2020)
Municipal measures		
London Plan 2021 (UK)	<ul style="list-style-type: none"> Major developments should be net zero-carbon; renovations should aim at net zero-carbon. Residential developments should be 10 % and non-residential 15 % more energy efficient than the 2013 Building Regulations. Energy performance is monitored at all stages of construction process. Monitoring of energy use for at least 5 years after construction through online portal. 	<ul style="list-style-type: none"> London is committed to become a carbon neutral city by 2050. Information from monitoring feeds into London Building Stock Model (LBSM). Source: Major of London (2021)

ing Renovation (ŠFRB) supporting renovation of residential buildings, is administered at the national level since 1997 (MoE SR 2014), and thus provides stability of the scheme and conditions of support. The fund relies mainly on state budget, with additional funds from European structural funds.

- The fund should have a specialized steering committee for the programme of renovation of public buildings including representatives of specialized agencies and national authorities with competencies in the area of energy efficiency, technical systems, RES and climate change.
- In order to increase the leverage effect, the mechanism may enable innovative financial solutions, such as the combination of a soft loan and a grant (e.g. Munseff), or combination of a grant and integrated Energy Performance Contracting projects (EPCs). However, only integrated EPCs (EPC projects integrated with systematic, wholesome deep renovation project, such as in Sochoř 2010) should be supported. Public funding should not be provided to stand-alone EPC projects.⁷
- The financial mechanism for renovation of public buildings should follow the EU's "Energy Efficiency First" principle, however, should not be aiming at the energy savings alone. It should integrate thermal renovation, highly efficient technical systems, relevant and cost-effective utilisation of RES and integration of adaptation measures in the building and its surroundings. This will not only decrease beneficiaries' administrative burden, but also may decrease transaction cost of the financial mechanisms and help more efficient use of public funds. In addition, it will also decrease the need for new utilities providing energy for these buildings.
- While the renovation project should utilise synergies of such an integration (thermal renovation-technical systems-RES-adaptation measures), it is recommended that the financing is reported separately for all four types of measures, as to allow for evaluation of the impact and investment intensity (€/MWh) of the different measures.
- The mechanism should be set in a wider framework supporting measures towards long-term energy efficiency and climate change targets, which would include also other financial instruments for larger leverage effect (such as energy/CO₂ taxes, tax relief, taxes on highly energy intensive consumption, elimination of fossil energy subsidies etc).
- Further, in order to enable developing the national inventory of public buildings (basis for developing the long-term renovation strategy), it is highly recommended that reliable and periodic statistical collection of key data on public buildings at national level is established (such as number of buildings and their floor area) and the results are summarized in a publicly available and regularly updated database of public buildings (crucial in Slovakia).

7. Stand-alone EPC projects focus solely on renovation of technical systems, such as heating, ventilation and/or cooling systems and/or energy management.

- Last, but not least, the national authorities could provide support inter alia to highly innovative pilot projects, ensure integration of sustainable construction education into school curricula, encourage life-long learning; set up a platform of energy efficiency and construction specialists and provide free consultancy services for municipalities in the area of sustainable construction, energy savings and efficient use of available financial sources.⁸

RECOMMENDATIONS FOR MUNICIPALITIES AND OTHER LOCAL AUTHORITIES

- In order to have an overview of the biggest energy uses it is recommended to establish an inventory of buildings operated by the public entity, based on either an energy audit and/or energy certificate.⁹
- Based on the inventory, investment priorities should be identified. The priority list of buildings for renovation should take into account the current technical state of each building, its energy demand and estimated energy savings potential, usage, urgency for renovation and investment intensity (€/MWh).
- Based on the investment priorities a long-term investment strategy should be developed, which should take into account the financial possibilities (e.g. national funds, ESIF, EPC, commercial loans, own resources, ELENA for project development at municipal level,¹⁰ InvestEU¹¹ etc.),
- If EPC projects are considered, they should be an integral part of a deep renovation project.
- Public procurement for project documentation and renovation works should include fulfilment of ambitious energy criteria (instead of adhering to the principle of lowest price). The authority shall ensure quality inspection of renovation projects by an independent expert and shall require commissioning to be an integral part of any renovation project.
- Post-monitoring of achieved energy savings, operational costs, energy management system and regular maintenance shall be ensured.
- For better facilitation of the above mentioned, it is highly recommended that the municipality employs an energy manager or, in case of a group of smaller municipalities, they share one.

Discussion and conclusions

Although there have been several programmes aiming at renovation of public buildings in Slovakia, the majority of these buildings are still not renovated and further finances are need-

8. Such consultancy services for municipalities can be provided by Regional Centres for Sustainable Energy, a planned measure in the Slovak National Climate and Energy Plan (MoE SR 2019, Annex 2).

9. For instance, the city of Bratislava developed a building inventory and a map of their energy use – www.opendata.bratislava.sk (Bratislava 2020).

10. ELENA (European Local Energy Assistance) – <https://www.eib.org/en/products/advising/elena/index.htm>.

11. <https://europa.eu/investeu>

ed. The paper provides an overview of financial programmes for renovation of public buildings, both in terms of financial flows and energy savings. Based on the experience in Slovakia with these different schemes, lessons learned are summarized. Both the lessons learned as well as selected examples from abroad lead to several recommendations.

First, in order to avoid lock-in effect, it is important that any financial mechanism for renovation of public buildings from public sources should require fulfilment of ambitious energy requirements, and this is supported by a strong enforcement mechanism (i. e. sanctions, such as in OP QoE (2014–2020)). Only once such strong energy requirements are in place, the retrofit rate can be further increased.

Second, there should be a stable, long-term financial mechanism, ideally administered at the national level, while its financial sources can stem from different sources depending on their availability. This is evident from the State Fund for Building Renovation (ŠFRB) providing support for renovation of residential buildings, which is administered at national level since 1997 and provides a stable environment for building renovation. Experiences also show, that it is very important that energy specialists are involved in project management throughout the project.

Third, the financial mechanism should be interlinked with an ambitious long-term building renovation strategy and have a vision to contribute to long-term energy efficiency and climate targets. This can be better achieved, if the mechanism is managed by national authority, which is responsible for fulfilment of such targets.

Some of the recommendations that resulted from the lessons learned in Slovakia and analysis of energy savings potential, are similar to those suggested by other literature. For instance, Lupíšek et al. (2021) recommended *inter alia* also “tightening of the energy performance standards for subsidized building renovation”, maximizing the use of ESIF for increasing energy efficiency of buildings, combining the grants with EPCs in the public sector and considering tax benefits for energy efficient buildings. Moreover, as the Czech Republic already dedicates “all income from the EU Emission Trading System for GHG reduction in the existing subsidy scheme, New Green Savings Programme for energy retrofitting of residential buildings“, the authors recommend maintaining this good practice even into the future. They go even further and suggest improving the NZEB standard closer towards the PHS, as PHS is stricter than NZEB (Lupíšek et al. 2021). All this can help utilizing the potential of renovation of public buildings, while avoiding lock-in effect and using public finances effectively.

References

- BEIS (Department for Business, Energy and Industrial Strategy) (2017) The Non-domestic Private Rented Property Minimum Standard. Guidance for landlords and enforcement authorities on the minimum level of energy efficiency required to let non-domestic property under the Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015. February 2017. Web: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/824018/Non-Domestic_Private_Rented_Property_Minimum_Standard_-_Landlord_Guidance.pdf.
- BEIS (Department for Business, Energy and Industrial Strategy) (2020) The Domestic Private Rented Property Minimum Standard. Guidance for landlords and Local Authorities on the minimum level of energy efficiency required to let domestic property under the Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015, as amended. October 2017, amended version April 2020. Web: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/882957/Domestic_Private_Rented_Property_Minimum_Standard_-_Landlord_Guidance_2020.pdf.
- Bendžalová, J. (2021) (ENBEE – Environment and Building Energy Efficiency) Email communication, May 2021.
- Bendžalová, J., Zirngibl, J., Muškátová, D. et al. (2020) D2.2 – ALDREN Methodology note on energy rating procedure. Annex C European Voluntary Certificate. ALDREN project report D2.2. Web: https://aldren.eu/wp-content/uploads/2021/04/ALDREN_D2-2-ANNEX-C-EVC-template_2020.pdf [Last accessed 10 May 2021].
- Borák, D., Effenberk, L., Bakeš, M. (2015) ZUŠ Holice – verejná budova v pasívnom štandarde. Ako vznikla a prečo sa mestu vypláti. Presentation at the conference “Budovy A0” [A0 Buildings], Trnava, 22–23 October, 2015. Web: <https://www.siea.sk/pozvanky/prezentacie-z-konferencie-o-budovach-s-takmer-nulovou-potrebou-energie/> [Last accessed 10 May 2021].
- Csoknyai, T. (Lecturer at the Technical University of Budapest, BME). (2009). Personal and email communication, Budapest, July – December 2009.
- European Community (EC). 2006. Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC. Official Journal of the European Union. 27 April 2006.
- European Union (EU). (2010). Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on energy performance of buildings (recast). Official Journal of the European Union, Strassbourg, 19 May 2010.
- European Union (EU). (2012). Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. Official Journal of the European Union, Strassbourg, 25 October 2012.
- Environmentálny fond (Environmental Fund) (2021) I. Rozšírenie špecifikácie činností podpory na rok 2021 [I. Extension of specification of activities of supported for 2021]. Web: http://www.envirofond.sk/_img/Ziados-ti/2020/DOTACIE/I.%20Rozsirenie_specifikacie_cinnosti_podpory_2021.pdf [Last accessed on 20 May 2021].
- KfW (2021) Der KfW-Effizienzhaus-Standard für bestehende Immobilien und Baudenkmale. Web: <https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestehende-Immobilie/Energieeffizient-sanieren/Das-KfW-Effizienzhaus/> [Last accessed on 20 May 2021].

- Korytarova, K. (2010). Energy efficiency potential for space heating in Hungarian public buildings. Towards a low-carbon economy. Doctoral thesis, Department of Environmental Sciences and Policy, Central European University, Budapest. http://www.etd.ceu.hu/2011/korytarova_katarina.pdf
- Korytárová, K., Šoltéssová, K. Knapko, I. (2015). Analýza potenciálu úspor energie vo verejných budovách. Finálna správa z projektu „Podpora nástrojov na zavádzanie a optimalizáciu opatrení v oblasti energetickej efektívnosti verejných budov“. [Analysis of energy savings potential in public buildings. Final report of the project “Support for instruments for the introduction and optimization of measures in the area of energy efficiency in public buildings.”] Bratislava, December, 2015.
- Lucon O., D. Ürge-Vorsatz, A. Zain Ahmed, H. Akbari, P. Bertoldi, L.F. Cabeza, N. Eyre, A. Gadgil, L.D.D. Harvey, Y. Jiang, E. Liphoto, S. Mirasgedis, S. Murakami, J. Parikh, C. Pyke, and M.V. Vilariño. (2014). Buildings. 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 [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Lupíšek, A., Trubačík, T., Holub, P. (2021) Czech Building Stock: Renovation Wave Scenarios and Potential for CO₂ Savings until 2050. *Energies* 2021, 14, 2455. <https://doi.org/10.3390/en14092455> [Last accessed on 7 May 2021]
- Major of London (2021). The London Plan. The Spatial Development Strategy for Greater London. March 2021. Web: https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf [Last accessed on 10 May 2021].
- Ministry of Economy of the Slovak Republic (MoE SR) (2011). Second National Energy Efficiency Action Plan for the period 2011–2013. Approved by the Governmental Decree No. 301/2011 of 11 May 2011. Web: <https://rokovania.gov.sk/RVL/Material/7287/1> [Last accessed on 24 May 2021].
- Ministry of Economy of the Slovak Republic (MoE SR) (2014). Third National Energy Efficiency Action Plan for the period 2014–2016 with an outlook up to 2020. Approved by the Governmental Decree No. 350/2014 of 9 July 2014. Web: <https://rokovania.gov.sk/RVL/Material/11043/1> [Last accessed on 24 May 2021].
- Ministry of Economy of the Slovak Republic (MoE SR) (2017). Fourth National Energy Efficiency Action Plan for the period 2017–2019 with an outlook up to 2020. Approved by the Governmental Decree No. 200/2017 of 26 April 2017. Web: <https://rokovania.gov.sk/RVL/Material/21959/1> [Last accessed on 24 May 2021].
- Ministry of Economy of the Slovak Republic (MoE SR) (2019). Integrated National Energy and Climate Plan for 2021–2030. Approved by the Governmental Decree No. 606/2019 of 11 December 2019. Web: <https://rokovania.gov.sk/RVL/Material/24390/1> [Last accessed 10 May 2021].
- Ministry of Environment of the Czech Republic (MoEn CR) (2020). Prioritní osa 5 – Energetické úspory. [Priority axis 5 – Energy savings]. Operační program životní prostředí. [Operational Programme Environment] Web: <https://www.opzp.cz/o-programu/podporovane-oblasti/prioritni-osa-5/> [Last accessed 11 November 2020].
- Ministry of Finance of the Slovak Republic (MoF SR) (2021). Plán obnovy a odolnosti Slovenskej republiky. [Recovery and resilience plan of the Slovak Republic]. Approved by the Governmental Decree No. 221/2021 on 28 April 2021. Web: <https://rokovania.gov.sk/RVL/Material/25932/1> [Last accessed 30 April 2021].
- Ministry of National Development of Hungary (MND HU) (2015a). National Building Energy Performance Strategy. Commissioned by the Ministry of National Development and drawn up by ÉMI Építésügyi Minőségellenőrző és Innovációs Nonprofit Kft. [ÉMI Non-Profit Limited Liability Company for Quality Control and Innovation in Building]. adopted by Government Decree No. 1073/2015 of 25 February 2015. Web: 2014_article4_hungary_en translation.pdf (europa.eu) [Last accessed 07 January 2021].
- Ministry of National Development of Hungary (MND HU) (2015b). Hungary's National Energy Efficiency Action Plan until 2020. August 2015. Web: https://ec.europa.eu/energy/sites/ener/files/documents/hungaryActionPlan2014_en.pdf [Last accessed 07 January 2021].
- Ministry of Transport and Construction of the Slovak Republic (MoTC SR) (2021). Dlhodobá stratégia obnovy fondu budov [Long-term building renovation strategy]. Approved by the Governmental Decree No. 36/2021 of 20 January 2021. Bratislava, January 2021. Web: <https://rokovania.gov.sk/RVL/Material/25606/3> [Last accessed 28 January 2021].
- Munseff (2013). List of supported projects. www.munseff.eu
- Passivhaus Institut (PHI) (2016). Criteria for the Passive House, EnerPHit and PHI Low Energy Building Standard. Web: https://passiv.de/downloads/03_building_criteria_en.pdf.
- Rosenstein, F. (2020). Éco énergie tertiaire, ADEME: French Decree: Paving the way to energy consumption mitigation for the Non-Residential Building sector. Presentation at the final conference of ALDREN project. Web: https://aldren.eu/wp-content/uploads/2020/11/S3_03_ADEME.pdf [Last accessed 10 May 2021].
- Slovak Innovation and Energy Agency (SIEA) (2015). Pilotný projekt Energetická efektívnosť vo verejných budovách. [Pilot Project Energy Efficiency in Public Buildings]. Data on energy consumption in renovated buildings for 2011–2013.
- Sochoř, V. (2010). Průběh veřejné soutěže při uplatnění energetických služeb s garantovanou úsporou (EPC) ve veřejném sektoru [The process of public procurement when energy services with guaranteed savings are implemented in public sector.]. Presentation at Národní technická knihovna, 10 May 2010.
- Szoltész, Ilona. (Hungarian Energy and Public Utility Regulatory Authority (MEKH). (2019). Email communication. (2019). Email communication, November 2019.

TZB-info (2015). Redakční návštěva: Pasivní Základní umělecká škola Karla Malicha v Holicích. Web: <https://stavba.tzb-info.cz/pasivni-domy/13082-redakcni-navsteva-zakladni-umelecka-skola-v-pasivnim-standardu-ocenena-energy-globe-award> [Last accessed 10 May 2021].

Ürge-Vorsatz, D., Petrichenko, K. Antal, M., Staniec, M., Labelle, M., Ozden, E., Labzina, E. (2012). Best Practice Policies for Low Energy and Carbon Buildings. A Scenario Analysis. Research report prepared by the Center for Cli-

mate Change and Sustainable Policy (3CSEP) for Global Buildings Performance Network. GBPN, CEU, May 2012. Web: <https://www.gbpn.org/reports/best-practice-policies-low-carbon-energy-buildings-based-scenario-analysis> [Last accessed 8 January 2021].

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