



PRIORITIZING ENERGY RENOVATION
IN THE CEE COUNTRIES

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POLICY BRIEFS



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PREFACE

The PERCEE project—*Prioritizing Energy Renovation in the CEE Countries*—brings together four leading organisations from Central and Eastern Europe to support the implementation of the revised EU Energy Performance of Buildings Directive (EPBD). The project is a collaborative initiative between:

- **Hungarian Energy Efficiency Institute (MEHI)** — the project coordinator, an independent non-profit promoting energy efficiency and building policy in Hungary.
- **Buildings for the Future (B4F)** — a Slovak alliance of business and civil society actors advocating for legislative changes supporting energy efficiency.
- **Chance for Buildings (Ch4B)** — a Czech alliance of key industry associations promoting energy-efficient and climate-adapted construction.
- **Polish Green Building Council (PLGBC)** — the leading NGO for sustainable construction in Poland, active in circularity, retrofit, and decarbonization.

Together, the partners aim to provide national decision-makers with tailored policy briefs and practical guidance rooted in the regional context. In its initial phase, the project mapped best practices and renovation frameworks, setting the stage for a more aligned and effective transposition of EPBD in the Visegrad 4 countries.

INTRODUCTION

Buildings account for around 40% of energy consumption and over a third of greenhouse gas emissions in the EU. The revised 2024 EPBD, under the European Green Deal and “Fit for 55” package, sets a clear trajectory: fossil fuel phase-out, increased renovation rates, and life-cycle climate performance of buildings.

This document presents four policy briefs developed by expert teams from Czechia, Hungary, Poland, and Slovakia, each addressing one of the EPBD’s priority areas:

- **Financing energy renovations** (*Ch4B, CZ*)
- **Technical assistance & information barriers** (*B4F, SK*)
- **Heating decarbonization** (*MEHI, HU*)
- **Life-cycle GWP of buildings** (*PLGBC, PL*)

The briefs highlight national strategies, identify practical barriers, and share replicable good practices. Although the EPBD sets common goals, its implementation must reflect national contexts—especially in the V4 region, where ageing buildings, affordability concerns, and administrative complexity pose significant challenges.

This publication serves as a platform for mutual learning and policy exchange, offering insights into how Central Europe can meet the EPBD’s ambitions through actionable and locally grounded solutions.



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A.

WHOLE-LIFE CARBON

1. INTRODUCTION

Aligning the building and real estate sector with climate neutrality goals relies on the availability and transparency of operational data and CO₂ emissions across the industry. New EU regulations mandate the assessment of carbon emissions over the full life-cycle of buildings, which is expected to speed up data collection and analysis. This will make it possible to identify the sources and scale of emissions and set baselines for buildings. The gradual tightening of targets will help steer the sector toward nearly-zero emissions by providing clear guidelines for CO₂ reduction.

The whole-life carbon footprint of a building, described by the global warming potential (GWP) indicator, expressed in kilograms of carbon dioxide equivalent (kg CO₂e), is determined by conducting a life cycle assessment (LCA) of the building. The total carbon footprint of a building consists of operational emissions (related to the use of the building) and embodied emissions (related to the acquisition of raw materials, production of construction materials, transportation of materials, construction processes, maintenance and retrofitting, and end of life of the building).

The life-cycle GWP calculation process, including the selection of data and scenarios, must comply with EN 159784, which is performed using LCA analysis, according to which greenhouse gas emissions (GHG) are calculated for different phases of a building's life-cycle. There are mostly 17–18 phases divided into four main modules — A, B, C and D:

- Product and construction stage (A1–A5).
- In-use stage (B1–B7).
- End of life stage (C1–C4).
- Beyond building life-cycle (D, or sometimes D1–D2).

A complete list of the phases identified in EN 159784 is shown in Figure 1.

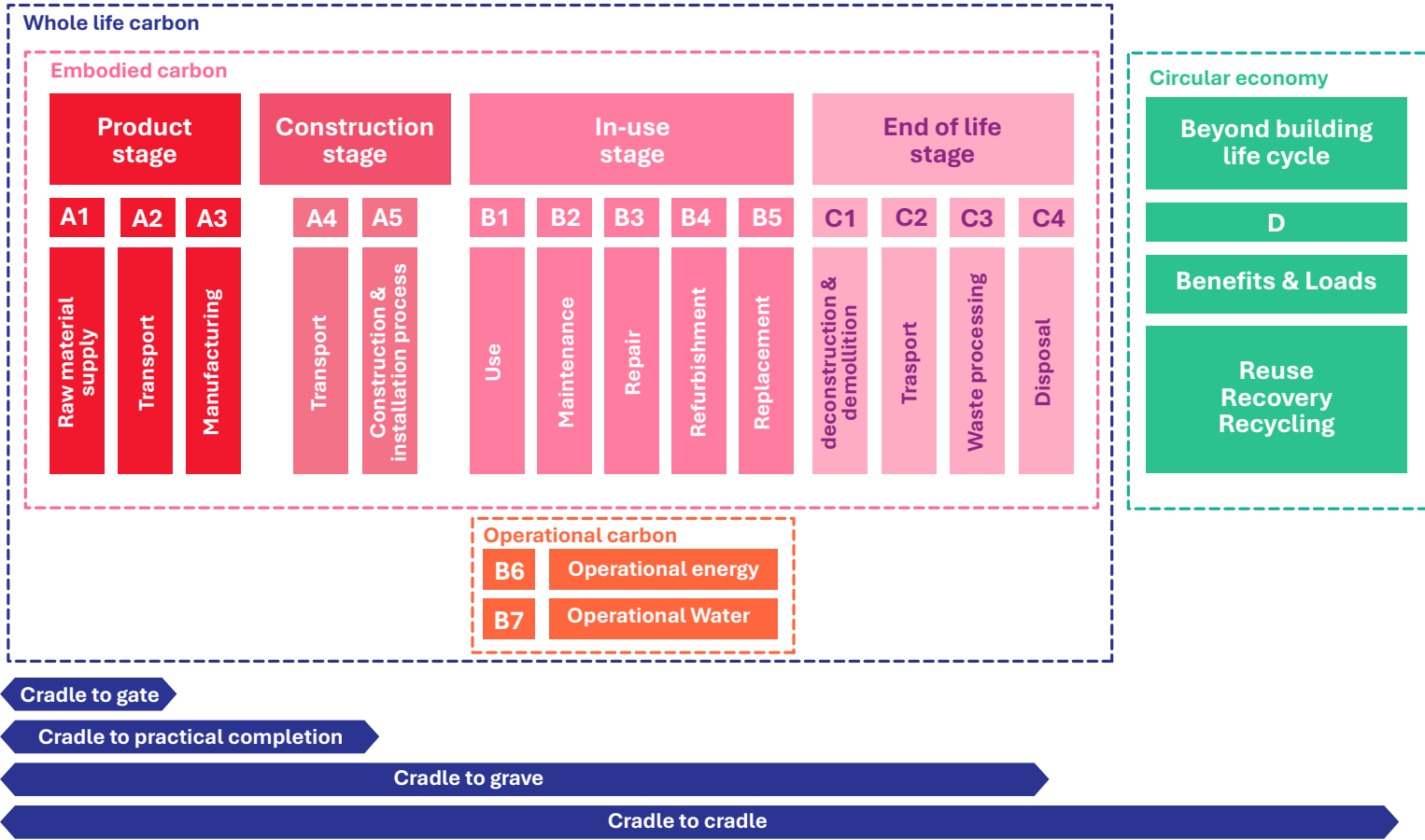


Figure 1 Phases of the building life cycle, broken down into modules according to EN 159785

The embodied carbon footprint covers a number of different emission sources spread over more than a dozen phases throughout a building's life cycle through which its value is influenced by many factors and assumptions. However, at its core, it is primarily based on what materials the building was constructed with. Example results for a typical building with an embodied carbon footprint of 1,000 kg CO₂e per square meter of total area are shown in Figure 2.

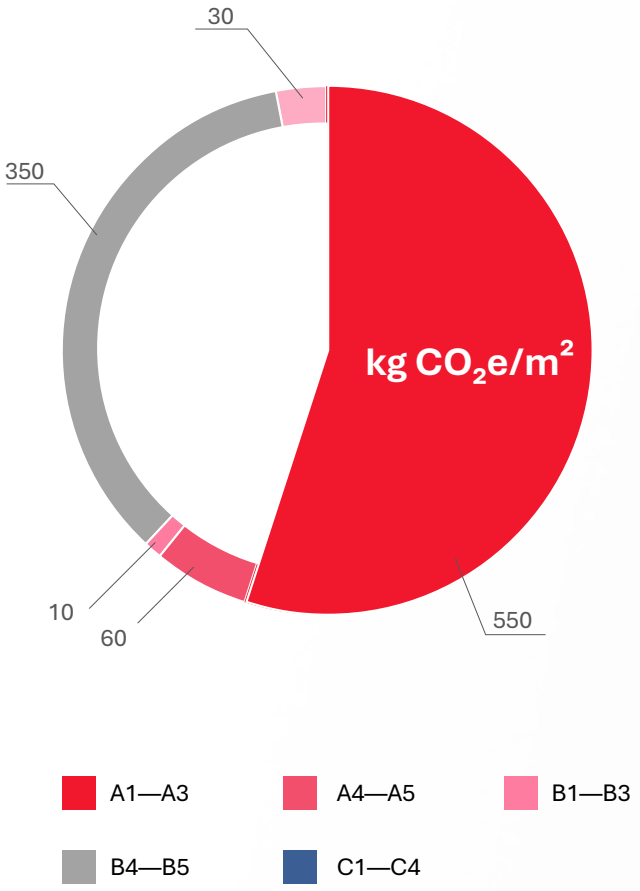


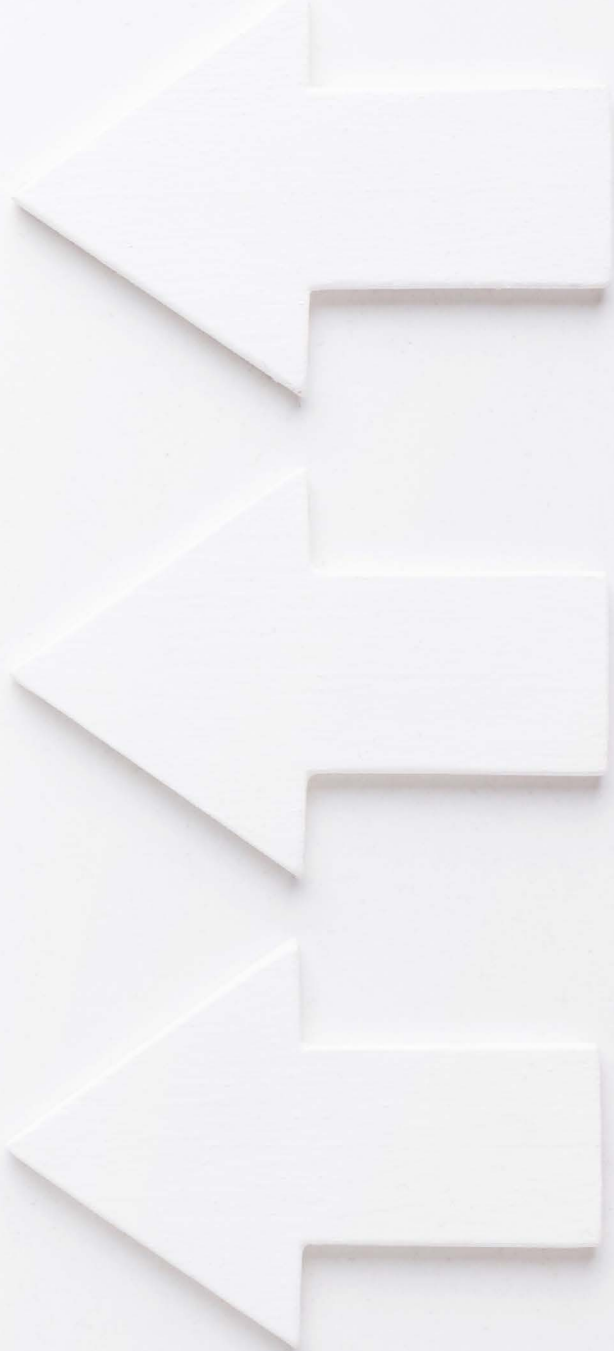
Figure 1 Example share of embodied carbon in different phases of the building life-cycle — based on “Estimating the Carbon Footprint of Buildings. Whole Life Carbon Roadmap for Poland 2050”.

Conducted own analyses showed that phases A1—A3 have the largest share, exceeding 50%, in the embodied carbon footprint, while phases B4 and B5 account for approx. 35—40% of the total embodied carbon footprint.

PERCEE's efforts are supporting European and national decision-makers in implementing regulations that reduce the carbon footprint of buildings. Under the revised Energy Performance of Buildings Directive (EPBD), global warming potential (GWP) monitoring will be required starting in 2028, and an assessment framework and limits must be established by member states by the end of 2027. Some European countries already regulate embodied CO₂ emissions, and a key step in this process has been the development of methodologies for estimating emissions and establishing baseline values for new building projects.

EU **Level(s) framework** provides, in terms of the implementation of Whole Life Carbon (WLC) regulations, an opportunity for greater consistency and comparability of methodologies across member states, eliminating discrepancies that hinder reporting and increase costs for the industry. Adopting a uniform approach to WLC will avoid the long-term fixation with different national standards. The development of life-cycle GWP methodologies and cutoff values is a gradual process, requiring overcoming considerable challenges.

Analyses to date indicate that the largest source of the embodied carbon emissions is the manufacturing stage of construction materials/products. While overall trends are consistent, differences in construction practices, emissions intensity or assessment methodologies make that specific values vary between countries. More accurate benchmarks, in line with the new EPBD requirements, will help assess average emissions and identify best practices.



2. CONTEXT

To effectively reduce emissions in the construction sector, all sources of emissions must be considered at every stage of a building's life-cycle. It is crucial to simultaneously increase energy efficiency and reduce emissions from materials and construction processes.

Over the past two decades, it has been possible to significantly reduce CO₂ emissions in the building industry through improved energy efficiency and the use of renewable energy sources. However, achieving climate neutrality requires further strengthening of efforts to reduce the carbon footprint of buildings. Actions are being taken for both new and existing buildings. In the European Green Deal's Renovation Wave strategy, the European Commission emphasizes the need to adopt "life-cycle and circular thinking."

A number of EU policies already address the supply of low-carbon materials. For example, the EU Emissions Trading Scheme (ETS) and the revised Construction Products Regulation (CPR) encourage transparency and the availability of products manufactured using lower carbon manufacturing practices. The recently recast Energy Performance of Buildings Directive (EPBD) introduces regulations that require the design of low-emission buildings, as well as the implementation of building-wide measures such as material and building reuse, material substitution and material efficiency through building life-cycle assessment (LCA).

2.1 Energy Performance of Buildings Directive (EPBD)

The May 2024 recast of the EPBD is a key EU policy tool to decarbonize Europe's building stock. It introduces a framework

for measuring and reducing WLC emissions, based on common standards and EU calculation methods. From 2028, member states will be required to calculate and publish the global warming potential (GWP) indicator data for new buildings with a floor area of more than 1,000 m², and from 2030 — for all newly constructed buildings, using an energy performance certificate (EPC). The calculation process, including the selection of data and scenarios, must comply with EN 15978, and the assessed building elements and technical equipment must meet Level(s) 1.2 of the life-cycle GWP indicator.

Annex III of the Directive, which contains the GWP assessment methodology, leaves some room for interpretation. As a result, the European Commission may adopt a delegated act by the end of 2025, establishing a uniform EU framework for national life-cycle GWP calculations for buildings. The unification of these rules is expected to increase transparency and consistency in the methodologies used in member states, making it easier to compare results and report WLC emissions. Current differences in WLC assessment methodologies make comparisons difficult, and further divergence could lead to regulatory chaos and increased costs for the building industry.

The EPBD also requires member states to develop national action plans that set total GWP limit values for all new buildings by the end of 2026. These plans should include a strategy for gradually tightening emission limits, effective from 2030. The European Commission plans to develop guidelines to help member states set minimum and target thresholds for WLC emissions, in line with the decarbonization path to achieve net zero emissions by 2050.

Transposition of the EPBD began in May 2024 and will take two years. This is a crucial period for implementing regulations at

the national level and refining the technical aspects of WLC assessment, data availability and setting emission limits. The [INDICATE project](#) supports this process by providing member states with the tools to effectively implement the regulations, build competencies, and develop baselines to help both shape policy and align industry action.

2.2 Construction Products Regulation CPR

The CPR regulation is a key piece of legislation aimed at ensuring a smoothly functioning market for construction products in the European Union. Its main task is to establish uniform assessment methods that guarantee reliable information on the performance of construction products, both in terms of basic technical requirements and key environmental aspects. In this way, the CPR plays an important role in reducing the carbon footprint of construction materials by influencing their evaluation at the production stage. The CPR does not set standards for product design but provides uniform information and methods for evaluating their performance, based on eight categories of "basic requirements." To ensure that harmonized assessment methods and updated environmental characteristics cover all groups of construction products, the so-called CPR Acquis process was introduced. Its goal is to gradually update EU standards, with priority given to high-density materials. The entire process could take several years for each product group, with full replacement of existing standards expected in 10 years.

The new CPR requires reporting of four GWP indicators in "declarations of performance" — total GWP, fossil fuels, biogenic fuels and land use/land use change — starting in mid-2025. Additional environmental indicators, such as ozone depletion, acid-

ification potential and abiotic depletion, will become mandatory 4 to 6 years later, facilitating more comprehensive LCA of buildings. Manufacturers will be required to provide product information through a digital product passport, which can help track materials, circularity and integration with LCA tools. Although assessment methods and the scope of declared information are standardized at the EU level, member states can set their own product requirements at the national level. CPR also plays a key role in providing high-quality environmental data on construction products that can be used in building life-cycle assessment.

2.3 EU Taxonomy

The EU's sustainable activities strategy is already having a significant impact on WLC reduction. It mobilizes capital and shapes the approach to the design, construction, management and operation of buildings, as well as their sale. Regulations such as the Corporate Sustainability Reporting Directive (CSRD), the Sustainable Finance Disclosure Regulation (SFDR) and the Corporate Sustainability Due Diligence Directive (CSDD) are integrating investment decisions with environmental reporting. As a result, banks and investors are increasingly demanding detailed emissions data related to financed construction projects.

The data is also relevant in the context of the EU Taxonomy for sustainable activities, which for new buildings defines criteria for assessing life-cycle greenhouse gas emissions, according to indicator 1.2 (GWP). As thresholds related to climate change mitigation tighten, the taxonomy is becoming more consistent with the recast EPBD, promoting building renovations at the expense of new developments and introducing uniform WLC limits and benchmarks.

Increasing reporting requirements are translating into unprecedented transparency on the climate impact of construction,

making data collection and disclosure crucial. This makes it possible to analyze investment portfolios in terms of their impact on emissions and identify actions needed to improve environmental performance. In other words, EU regulations on sustainable activities are already shaping investment decisions — favoring assets that comply with climate goals and limiting financing for facilities that do not. In addition, the Green Claims Directive will force companies to precisely justify environmental claims in the construction sector, based on life-cycle assessment (LCA) methodologies.

2.4 Life-cycle GWP in The Visegrad Group (V4)

Currently, in all of the V4 countries participating in the PERCEE project, there are no adopted regulations concerning approaches, requirements or benchmarks related to GWP indicator. Nevertheless, in all countries, initiatives are being undertaken by NGOs, communities, architects, engineers, and developers to reduce the impact of buildings on climate change.

2.4.1 Czech Republic

There are currently no direct legislative requirements in the field of life-cycle assessment of buildings in the Czech Republic. The current assessment of the energy performance of buildings is based on the calculated specific non-renewable primary energy. The assessment of GWP or CO₂ emissions at any stage of the life-cycle is not included.

Initiatives in the Czech Republic supported by international projects are based on obtaining data for calculations and benchmarking dozens of calculations of new and renovated buildings for the future setting of calculation methodology and limit values. Perhaps the most significant currently completed

project is INDICATE (a consortium of the UCEEB — the University Center for Energy Efficient Buildings, Ch4B — Chance for Buildings, CZGBC — Czech Green Building Council). Based on this project, an LCA analysis of about 50 buildings in variants was prepared. The main obstacles in Czech Republic at present are the lack of verified data on materials (for example, Environmental Product Declarations — EPDs) and the lack of a national calculation methodology that would define a suitable compromise between simplicity and accuracy of the assessment.

The subsequent current joint initiative of the INDICATE project and the INCIEN (Circular Economy Institute) is a position paper and an appeal for the need for a comprehensive national strategy focused on reducing the carbon footprint of buildings throughout their entire life-cycle using GWP indicator. The main points are the data acquisition processes, calculation methodology, case studies and initial WLC reference values for buildings in the Czech Republic (which are indicated by the results of the INDICATE project), as well as the legislative determination of the role of the circular economy in renovations and reconstructions with the aim of reducing the embodied carbon of buildings (from the INCIEN program).

As part of the New Green Savings subsidy program, there is a possibility to receive a bonus amount for the subsidy for thermally insulated construction or replacing windows with various materials. The assessment of the amount of bonus points is based on demountability, recycled content and, in particular, parameters from the EPD (Environmental Product Declaration) including GWP. The bonus amount is a maximum of EUR 1,200.

LCA assessment in practice is usually solved only on the basis of market demand for larger projects, especially new construction of administrative, logistics or other commercial buildings that undergo sustainability certification (e.g. LEED, BREEAM, etc.). In addition to the demand of clients (future tenants), the market motivator for these certifications is the effort of investors

to obtain better conditions for financing these projects through ESG reporting and EU taxonomy requirements. This LCA assessment, together with LCC, is carried out for both the operational phase and embodied emissions. Partial requirements sometimes appear in the green public procurement criteria.

One of the initiatives of private sector is the [Zero Carbon Roadmap](#) — Pathway to Climate-Neutral Buildings in the Czech Republic prepared by the Czech Green Building Council (CZGBC). The Council is a non-governmental association of the whole sustainable building value chain and is a part of both national and international initiatives that focus on supporting sustainable solutions in construction and operation of building. The Roadmap includes detailed recommendations for both government and market actors in relation to life cycle and GWP of buildings.

2.4.2 Hungary

Specific carbon dioxide emissions — new indicator in energy certificates

Since 2024, energy certificates in Hungary have been graded based on two criteria instead of one: in addition to the energy performance, the carbon dioxide emissions must also be indicated. The maximum carbon dioxide emission for new buildings is 20 kg/m²/year, referring to emissions resulting from the building's operation and usage (e.g., heating-related CO₂ emissions).

Currently, the embodied carbon associated with construction (including the production, transportation, and installation of building materials) does not need to be included in the certificate, and there are no requirement values set for it.

Environmental impact requirements for products in the Home Renovation Loan Program

In the national Home Renovation Loan Program launched in the summer of 2024, a product database was created, listing

products eligible for support under the program. To have their products included in the database, manufacturers must upload detailed information and documentation for their construction products and/or heating and hot water-producing equipment.

Based on the uploaded information, ÉMI Nonprofit Ltd. (Hungarian Building Quality Control and Innovation Nonprofit Ltd.) evaluates the products and issues a Simplified Environmental Certification (Egyszerűsített Környezeti Minőség). Only construction products that reach a predefined minimum environmental performance score are eligible for support under the program. A key factor in this evaluation is the transportation distance, reflecting the program's dual objective: not only promoting sustainability but also supporting the domestic industry.

INDICATE LIFE: Supporting WLC Policy Development in Hungary and Four Other EU Member States

Following the success of the INDICATE Pilot Project, which supported Spain, Ireland, and the Czech Republic in developing national databases and tools for Whole Life Carbon (WLC) assessments, the INDICATE LIFE project extends this work to five additional EU countries: Italy, Austria, Croatia, Luxembourg, and Hungary. The aim is to help these countries prepare for the implementation of upcoming EU-level regulations such as the revised Energy Performance of Buildings Directive (EPBD), by building the necessary data infrastructure and national methodologies.

In all five participating countries, including Hungary, the project promotes collaboration between policymakers, industry stakeholders, data providers, and researchers. Together, they work on developing national tools and benchmarks for WLC calculations in both new buildings and retrofits. The project also includes cost-benefit assessments to support policy decisions and aims to contribute to transparent, data-driven regulation for reducing carbon emissions in the building sector in line with national and EU climate targets.

2.4.3 Slovakia

There are currently no direct legislative requirements in Slovakia regarding the assessment of life-cycle global warming potential of buildings. As in the Czech Republic, the evaluation of building energy performance is based on the calculated non-renewable primary energy consumption.

Cross-sectoral collaboration and initiatives from non-governmental organizations are still in early, preparatory stages or are primarily focused on educational efforts. A notable example is the well-established Green Building Academy, organized annually by the Slovak Green Building Council. This lecture series, aimed at public servants, project managers, students, and others, addresses current topics in sustainable construction and relevant EU legislation. One module specifically focuses on the climate impact of construction materials, highlighting the concept of life-cycle GWP and showcasing products with Environmental Product Declarations (EPDs) that include GWP data.

In August 2022, as part of Slovakia's Recovery and Resilience Plan, a reform of the larger Waste Act framework introduced a new requirement: mandatory green public procurement for state-funded construction and renovation contracts exceeding €30,000. However, since no specific criteria are defined, contracting authorities are free to select any relevant methodology, including those that consider life-cycle GWP.

2.4.4 Poland

As of today, there is no obligation in Polish building legislation to comprehensively count and report the carbon footprint of buildings (both operational and embodied). However, Poland, as a member of the EU, is obliged to implement EU regulations, including:

- EPBD (Energy Performance of Buildings Directive) — the revised 2024 version stipulates mandatory calculation of

the life-cycle GWP of buildings > 1,000 m² from 2028, and from 2030 for all new buildings.

- Construction Products Regulation (CPR) — is to include a requirement to declare CO₂ emissions in so-called environmental product declarations (EPDs).
- EU Taxonomy — for investments qualifying as “green” it is required to demonstrate, among other things, a low carbon footprint.

Despite the lack of regulations at the national level, many bottom-up initiatives and activities implemented by construction sector stakeholders can be found in Poland. Some of them are presented below.

The Polish Green Building Council (PLGBC), a non-governmental organization dedicated to sustainable construction, is implementing two projects that focus on issues related to building decarbonization and carbon footprint.

#BuildingLife initiative is an international project focused on decarbonization of the built environment through development of national decarbonization roadmaps and implementation of actions by the industry and governments across the EU countries. Under the project PLGBC has developed a **methodology to estimate carbon footprint of buildings**, published as “[Estimating the carbon footprint of buildings. Whole Life Carbon Roadmap for Poland 2050](#)”. It consists of two approaches — simplified method (recommended as a starting point for Poland) and full method.

A: Simplified method — phases A1—A3 and B6

- 1.** It takes into account phases A1—A3 which represent embodied emissions in the product phase and phase B6 — operational emissions in use phase.
- 2.** The product phase, which is represented by modules A1—A3 in LCA, is the most significant contributor to a build-

ing's life-cycle's emissions and typically exceeds 50% of the embodied carbon footprint, so correctly estimating values for this phase is crucial to the accuracy of the results. The calculation of the emissions for these phases is very simple and comes down to summing the emissions for each of the building components included in the analysis. A quantitative summary of building materials and equipment should be used for the calculations, as well as averaged (generic) or detailed (specific — from EPD declarations) data for products.

3. In the B6 phase, operational emissions should be assumed on the basis of calculations of final energy demand according to the current methodology for developing energy performance certificates (EPCs) for the building, depending on the type of energy carrier. The emission value given as GWP must take into account all greenhouse gases and should be determined for one year, based on the most recent data on the energy carriers used.

B: Full method — phases A1—A5, B1—B4, B6, C1—C4

B. Takes into account phases A1—A5, B1—B4, B6, C1—C4 which cover embodied emissions in the product, use and end-of-life phases, and operational emissions.

C. Phases A1—A3 should be calculated the same as in the simplified method.

D. Phase A4 (transport-related emissions), should be calculated based on monitoring the distance between the factory and the construction site, the type of transport with the emission factor (kgCO₂/kg/km), the weight of the material transported, and the loading degree of the carrier.

E. Phase A5, which covers emissions from the construction process, should be determined by indicator.

F. Phase B1 includes emissions from building materials and equipment during the life of the building. Emissions related

to maintenance and refrigerant leaks from installations and equipment repairs should be included in the calculations.

G. Phase B2 refers to CO₂ emissions associated with maintenance of: the roof, exterior walls, windows, exterior doors, finishes and installations.

H. Phase B3 takes into account emissions from all activities related to repairing a building component including used products.

I. Phase B4 addressing the replacement of building components is related to the need to assume standard lifetime of the building component, installation or equipment.

J. Phase B6 (operational emissions) should be calculated the same as in the simplified method.

K. To calculate phases C1 (emissions from building deconstruction and demolition), C2 (emissions from waste transportation), C3 (emissions from reusing or recycling materials at the end of a building's life), and C4 (emissions from disposing of materials that are not recovered for reuse or recycling), emission factors developed at the national level should be used.

The implementation of the full method will require the development of national databases of unit emission factors for construction products, equipment and technical systems, including end-of-life phase, the type of transport of construction products and fuels used and average transport distances specific to the country, the phase of construction of different types of buildings taking into account the various energy carriers needed in the construction process to power machinery and construction facilities, and the share of construction waste for each group of materials, energy carriers.

The second important initiative is the **FoCA environmental analysis and educational platform** published in 2024, available in both Polish and English at <https://foca.plgbc.org.pl>,

which allows free assessment of a building's carbon footprint in phases A1—A3 (product phase), based on averaged (generic) data on products and materials, developed by the Building Research Institute (ITB) as part of the implementation of the FoCA — Free of Carbon Architecture project. This database allows comparing materials in terms of their environmental impact and selecting the most environmentally friendly solutions. The platform allows raising knowledge among students, and also supports stakeholders in the construction sector, especially architects and consultants, in making the right choices at the conceptual and design stages of a project.

Another example of a bottom-up effort in Poland is **the initiative group for the development of a national methodology for the calculation of the carbon footprint for the purpose of energy performance certificates (EPCs)**, initiated and led by **The National Energy Conservation Agency S.A. (KAPE)**. The group's work involved both experts from the private sector, representatives of academia, NGOs and numerous experts. The core guidelines assume that the basis for calculating the carbon footprint is the PN-EN 15978: 2012 standard and the European Level(s) Assessment and Reporting System — Indicator 1.2: Life Cycle Global Warming Potential, and that the calculation of the life-cycle GWP is done at the time of the development of the EPC. The proposed methodology assumes the calculation of life-cycle GWP in the scopes A1—A5 (product phase and construction phase), B4 (replacement) and B6 (energy consumption), C1—C4 (end-of-life phase) and D (reuse, recycling, recovery).



3. DESCRIPTION OF GOOD PRACTICES IN EUROPEAN COUNTRIES

Operational greenhouse gas (GHG) emissions (or operational carbon footprint) of buildings are regulated at the EU and national levels through energy efficiency requirements. In contrast, regulatory requirements for whole-life carbon (WLC) analysis, which also include GHG emissions from building products (or *embodied carbon footprint*), processes and end-of-life treatment, exist in only a few EU countries. The revision of the Energy Performance of Buildings Directive (EPBD), adopted in May 2024, introduced a provision making it mandatory for EU countries to calculate building life-cycle GWP (based on the adopted methodology) and include its values on the building's energy performance certificate (EPC) from 2028 for new buildings over 1,000 m² and from 2030 for all new buildings.

Currently, the most developed countries in Europe in this regard are Denmark, Finland, France, the Netherlands and Sweden. All of them have or are preparing operational and embodied carbon footprint reporting requirements for designed new buildings, along with mandatory limit values that set maximum thresholds for GHG emissions. **The example of these countries shows that legislation on the climate footprint of buildings beyond the operational energy or operational carbon footprint is possible and can be implemented in the legislation of EU countries.**

All of the aforementioned countries have a national framework for WLC calculations included in the building life-cycle assessment methodology based on the international standard EN 15978:2011, which is also the main reference standard of the European Level(s) framework for calculating the global

warming potential (GWP) indicator for buildings. However, EN 15978:2011 allows a great deal of flexibility in the evaluation of buildings, such as the choice of the phases of a building's life-cycle or emissions for which they are counted, the weight to be given to individual emissions, and the data that should be used to calculate the global warming potential.

This report compares five national policy models to show similarities, differences and best practices in approaches to LCA methodologies, reporting obligations, performance presentation requirements, governance and rulemaking processes.

3.1 Comparison of national legislative approaches

A detailed review of national legislative models shows the differences and similarities between the selected approaches in Denmark, Finland, France, the Netherlands and Sweden. Key features are presented in the form of differences and similarities in the characteristics of the national models:

- In all countries, the regulations always apply to **new residential and office buildings**, but in some countries sub-groups of these buildings may be exempted based on their size (Denmark, Finland) or the legal status of their developer (Sweden). Requirements and corresponding methods for other building typologies are so far scheduled for development and adoption in the future.
- There is considerable overlap in the **scope of building elements that is taken into account** across countries. Foundations, load-bearing structures, ceilings and facades are listed everywhere as major contributors to embodied carbon emissions and are required to be included in calculations in all countries. Internal installations can also produce high levels of GHG emissions and are often included as well — the scope of components is usually defined with reference to other requirements or tools, e.g., the level of detail often results from the construction permit application or is implemented through building information modeling (BIM).
- **Scope of life-cycle stages** varies from country to country. Sweden requires only embodied emissions to be calculated, while France and the Netherlands cover all life-cycle stages, but include operational emissions in other regulatory instruments. Denmark and Finland fall between the two countries, specifying certain modules to be calculated, taking into account (most likely in Finland's case) operational emissions. Figure 3 shows these differences.
- **The building area** used as the reference unit for calculating emissions per m² is determined based on different ranges. The most common is gross floor area (GFA), while Finland and France use heated or net habitable floor area, excluding dimensions of wall thickness and parts of the building maintained at outdoor temperature. However, GFA is also not calculated in the same way in other coun-

tries. Specific parts of the building, such as basements for non-residential use or exterior stairs and driveways, can be excluded, included (e.g. Sweden) or deducted according to different ratios (Denmark). This affects the area over which WLC emissions are distributed and makes it very difficult to compare them.

- **Databases of emission factors for construction products and processes** vary. They contain impact factors for all materials for which environmental product declarations (EPDs) are not used. The use of product-specific data increases the accuracy of calculations and also encourages the selection of materials with relatively low carbon footprints. In France and Sweden, the use of product-specific data is supported by a factor that corrects default average values. This is not the case in other countries. However, default values can vary between databases, which are often based on national product averages or specific assumptions. Most countries use such a national database, but Denmark (which uses Germany's ÖKOBAUDAT) and Finland currently do not.
- Consideration of **biogenic carbon intensity** varies from country to country. Denmark, Finland, the Netherlands and Sweden use a static approach, while in France a dynamic approach is used. The static and dynamic approaches are two different ways of thinking about the life-cycle of a building.
 - The static approach assumes that all features remain the same as at the time of the LCA. This means that changes in material end treatments, replacement material manufacturing technologies or improvements in operational energy consumption are not considered. This is the standard and most commonly used LCA approach, as it relies on fewer assumptions and emphasizes environmental impacts according to the current situation. Due to fewer assumptions, simplified

LCA methods based on the static approach can also be found.

- Dynamic approach is designed to reflect potential changes that may occur during the life-cycle of a building and to account for differences in how emissions are counted when they occur. One key issue in dynamic approach, therefore, concerns the treatment of the carbon content of biobased materials and the associated effects of carbon sequestration and release. Dynamic approach has the advantage of potentially greater accuracy and incentives to use materials that can sequester carbon during (re)growth, but the lack of uniformity in calculation methods and greater (computational) effort have limited the use of dynamic LCAs until recently.

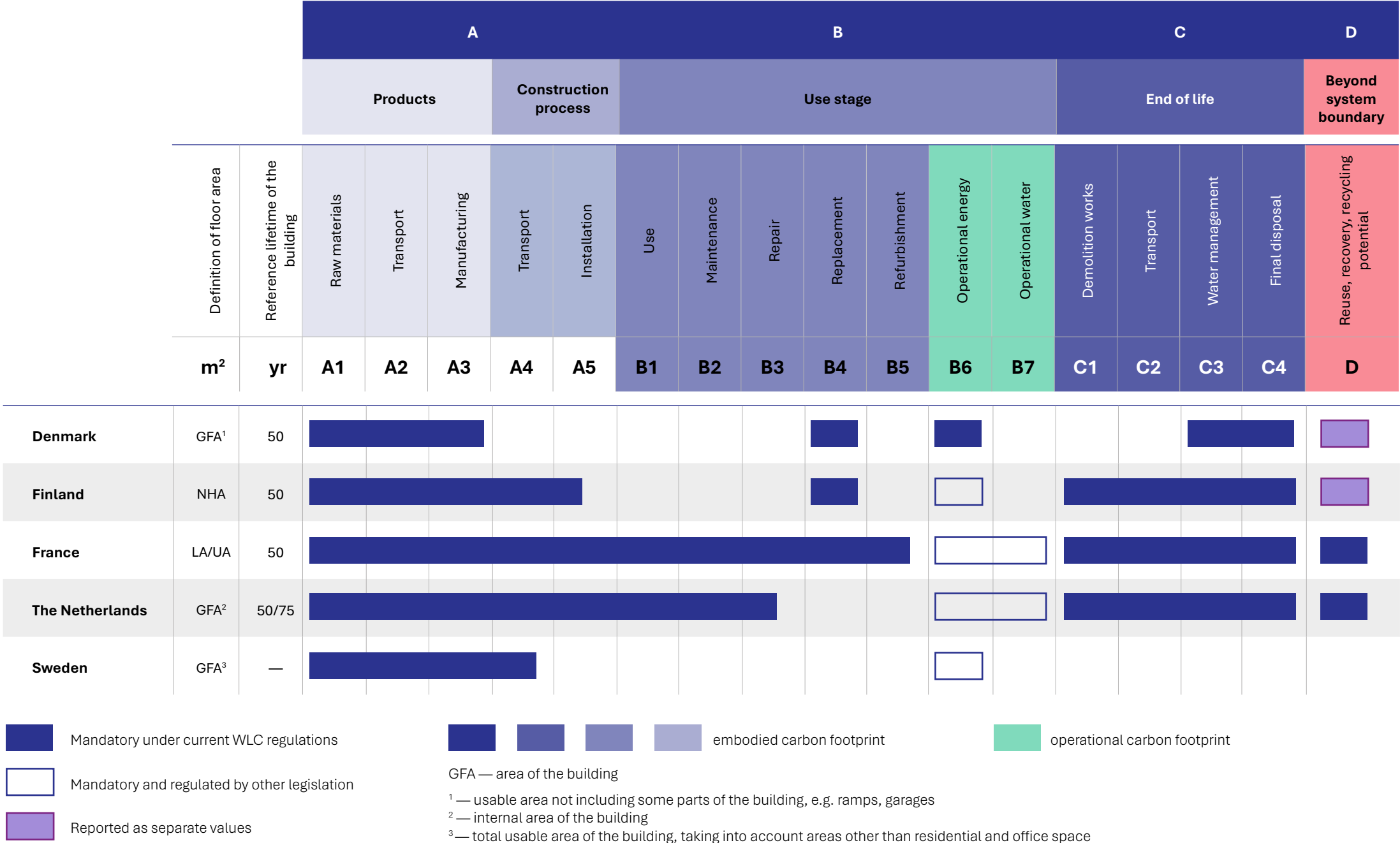


Figure 3. Differences between the LCA scope across the 5 countries — based on Ramboll (2022), Towards embodied carbon benchmarks for buildings in Europe

3.2 DENMARK

Regulatory framework

- In 2021 Danish government adopts widely supported national sustainable building strategy.
- Central to this strategy is the requirement in the building code to calculate the climate impact of buildings and comply with WLC limits.
- The regulations are in the form of a supplementary act to the building regulations and came into effect in January 2023.
- A new Danish regulation on mandatory calculation of the climate impact of new buildings applies to all types of buildings that are covered by the existing energy consumption regulation. However, buildings over 1,000 m² must meet the limits. For buildings less than 1,000 m², calculations must still be made, but they do not have to meet the limits.
- In practice, carbon footprint calculations are performed at all stages of the project and completed upon completion of the building, when aggregate quantities of materials used are available.
- The results are presented to local authorities and can be audited on the basis of a random sample.
- The consequences of exceeding the limits have not yet been determined and may vary between municipalities.
- LCAbyg is an optional calculation tool and accompanying guidance on how to perform the LCA of buildings.

LCA requirements

- **Life-cycle range:** A1—A3, B4, B6, C3, C4, D (D is mandatory for calculation, but is not included in the total, which is compared with the limits).

- **Climate impact assessment:** the climate impact assessment is made in accordance with EN15978 and includes GWP results.
- **Reference analysis period:** 50 years.
- **Definition of building area:** gross floor area within the meaning of § 455 of the Danish Building Act including all basement areas and with the following modifications:
 - All basement areas, waste disposal facilities at ground level and security rooms are included.
 - Exterior driveways, stairs, fire escape stairs and balconies are only included at 25%.
 - Integrated garages for single-family houses and terraced houses, etc. are only included at 50%.
 - Integrated sheds, outbuildings, roofs, sheds, etc. are only included at 25%.
 - Secondary buildings are not included.

Sources of environmental data

- The authorities provide a database with data sets to be used for calculations. The database is based on general Ökobaudat data and EPDs for the Danish building materials industry. EPDs of specific products that are not included in the database can also be used.

LCA calculation tool

- There is no mandatory tool or tool provided by the authorities. As long as the calculation method complies with the referenced standard and guidelines, any tool can be used. The Danish tool *LCAbyg*, developed by BUILD, is accepted as a possible tool for compliance. OneClickLCA has been accepted for LCA calculations for DGNB-DK certification in Denmark by Green Building Council Denmark (DK-GBC).

Execution framework

- Reporting of indicators in kgCO₂/m²/year
- The regulations set limits that refer to a building's WLC expressed in kgCO₂/m²/year. Both embodied and operational carbon emissions are included in the same limit.
- There is no differentiation by building type. For building types with special requirements or other non-standard circumstances that result in additional CO₂ emissions from materials, such as additional foundations required due to soil properties, the limit may be exceeded by a calculated project-specific value using a specific calculation method.
- Since its entry into force, the limit is 12 kgCO₂/m²/year. At the same time there is an optional level set as the low emission class with a limit of 8 kg CO₂/m²/year.
- Anticipated changes of lowering the limits and low emission classes
 - a. From 2025 — Limit of 10.5 kg CO₂/m²/year, low emission class 7 kg CO₂/m²/year
 - b. From 2027 — Limit of 9 kg CO₂/m²/year, low emission class 6 kg CO₂/m²/year
 - c. From 2027 — Limit of 7.5 kg CO₂/m²/year, low emission class of 5 kg CO₂/m²/year

These limits were established using a bottom-up method based on the report "KLIMAPÅVIRKNING FRA 60 BYGNINGER" (Climate impact from 60 buildings) published by BUILD. However, these figures may be adjusted based on experience and developments during the first two-year period and at each subsequent stage.

Sources

Government documents and websites:

- [National Strategy for Sustainable Construction](#)
- [Aftale om National strategi for bæredygtigt](#)

LCA byg:

- A. [LCA](#)

3.3 FINLAND

Regulatory framework

- Finland is aiming for carbon neutrality by 2035 and negative emissions by 2040. The building climate declaration (*Ilmastoselvitys*) and the low-carbon assessment method are a key part of future regulatory control of low-carbon building performance. In 2025, a major update to the Planning and Building Act is expected to come into effect, which is in line with the principles set forth in the industry roadmap from 2016.
- The obligation of climate declarations including WLC calculations will apply to all new buildings for which a construction permit is required, excluding detached single-family buildings, buildings where deep energy renovation will be carried out, or buildings with nearly-zero energy consumption (e.g., outbuildings for non-residential use). These exemptions were chosen to reduce the administrative burden for low-impact buildings.
- In addition, a carbon footprint quantifying climate benefits is part of the climate declaration. It includes benefits from the D module of the LCA, surplus energy generated on site, long-term carbon storage, and trees planted on site. A detailed methodology is still being developed for this.

LCA requirements

- **Life-cycle range:** A1—3, A4—5, B4, C1—C4, D
- **Climate impact assessment:** a "carbon handprint" will also be required, which takes into account the benefits of the D module of LCA, surplus energy generated on site, long-term carbon storage (e.g., biogenic) and other environmental benefits.
- **Reference analysis period:** 50 years.
- **Definition of building area:** net heated area.
- **Sources of environmental data:** possible different sources of environmental data.
- **LCA calculation tool:** no mandatory tool, but recommended some tools with high recognition and popularity (e.g. OneClickLCA).
- **Reporting indicator:** to be determined, most likely kgCO₂eq/m²/year

Execution framework

- Reference or limit values have not yet been set and are planned for 2026. According to the proposal, the carbon footprint of a new building should not exceed the limit value set by the use category, as proposed in a separate government regulation. The level of ambition for these limit values would be conservative to ensure industry acceptance.
- The concept of these limits has been determined through various studies, so that under the current plan the limits for new buildings would be set by 2025.
- Current planning is to adopt a single benchmark value that covers all elements of the WLC to keep the process simple. The benchmark values would be developed in accordance with the material compilation regulation and would be based on data collected during the previous Level(s) study stages.

- No carbon footprint limits ("carbon handprint") will be introduced at this stage.

Sources

- [Method for the whole life carbon assessment of buildings \(2019\)](#)
- [Ilmastoselvitys — summary of decree](#)
- [Lausuntoyhteenveto rakennuksen vähähiilisyysarviointimenetelmästä](#)

3.4 FRANCE

Regulatory framework

- France's WLC regulation, contained in the national *law Réglementation environnementale (RE2020)*, aims to reduce the overall environmental impact of new construction.
- RE2020 applies to new residential construction, office construction and educational buildings (primary and secondary education). It is expected to be extended to other types of buildings in the future.
- RE2020 is a national law that applies directly to new buildings and those designing and developing existing projects. It was adopted in 2021 and has been in effect since January 2022.

LCA requirements

- **Life-cycle range:** A—D
- **Climate Impact Assessment:** RE2020 is based on a dynamic LCA with an assessment of the impact of biogenic carbon storage. It was chosen because it emphasizes the immediate and short-term environmental impacts of materials and complies with national ELAN regulations.

- **Reference analysis period:** 50 years.
- **Definition of building area:** net area: living floor area (residential) or usable floor area (office), excluding thickness of walls, floor area of garages, areas maintained at outdoor temperature, ceiling height of less than 1.80 m.
- **Sources of environmental data:** INIES database (including specific EAPs supplemented by general datasets)
- **LCA calculation tool:** there is no standardized calculation tool, but a list of compatible tools existed under the E+C- program. Architects, certifiers and structural engineering companies have developed tools as a service to developers.
- **Reporting indicator:** kgCO₂/m².

Execution framework

- RE2020 sets mandatory GHG emission limits by operational carbon (OC) and embodied carbon (EC).
- OC values for benchmarks and building performance are expressed in kWh/m²/year and kgCO₂eq/m².
- EC values for benchmarks and building performance are expressed in kgCO₂eq/m².
- Further values are calculated for heating and cooling needs, non-renewable energy consumption and energy balance (including on-site energy generation).
- Limit values are not set at a standardized level. Only a baseline value is defined, which is adjusted for each specific building according to specific coefficients. These coefficients relate to geographic location (Migéo), underground construction (Miinfra), availability of infrastructure and utilities (Mivrd) and use of general environmental data (Mided). The formula is: $Ic_{construction_max} = Ic_{construction_maxmoyen} \times (1 + Micombles + Misurf) + Migéo + Miinfra Mivrd + + Mided$. underground construction (Miinfra), availability

of infrastructure and utilities (Mivrd), and use of general environmental data (Mided). The formula is: $Ic_{construction_max} = Ic_{construction_maxmoyen} \times (1 + Micombles + Misurf) + Migéo + Miinfra Mivrd + + Mided$.

Examples of embodied carbon footprint limits for residential buildings are shown below.

Limit values	Single-family residential buildings	Multi-family residential buildings
2022—2024 r.	640 kg CO ₂ /m ²	740 kg CO ₂ /m ²
2025—2027 r.	530 kg CO ₂ /m ²	650 kg CO ₂ /m ²
2028—2030 r.	475 kg CO ₂ /m ²	580 kg CO ₂ /m ²
From 2031.	415 kg CO ₂ /m ²	490 kg CO ₂ /m ²

- Three-year time intervals are set to allow collection of experience before the new value is applied. The required reduction is more excessive at the beginning, with a target of 17% in 2025 and 10% in 2028. The initial limits have been set to allow relatively easy compliance for construction projects, with the targets becoming more ambitious over time. Further adjustment of the values is not currently planned.

Sources

- [Décret no 2021—1004 du 29 juillet 2021 relatif aux exigences de performance énergétique et environnementale des constructions de bâtiments en France](#)
- [Guide RE2020](#)
- Summary report of the concertation committee on the ambition
- Website Energie Positive & Reduction
- Méthode d'évaluation de la performance énergétique et environnementale des bâtiments neufs (2017)
- [INIES](#)

3.5 THE NETHERLANDS

Regulatory framework

- In the Netherlands, calculating the environmental impact of buildings (in Dutch, "MPG") is mandatory for the construction of new residential buildings and office buildings larger than 100 m². For these buildings, there is a limit value expressed in EUR/m²/year.
- The regulations went into effect in January 2018 and are strongly linked to the Environmental Cost Index (MKI) regulations. The MKI is a nationally standardized calculation method in which the LCA result is translated into a monetary unit (EUR). This is done by assigning a monetary value to the 11 environmental impact categories in the LCA (including GWP, ozone depletion potential, acidification, etc.). The cost indicators for each impact category are determined based on the damage costs associated with a particular type of emission. The cost index is also referred to as the hidden cost of a building, e.g., 1 kgCO₂eq has a hidden price of €0.05.

- Buildings that fall within the scope of the analysis must obtain an environmental permit for construction. To do so, MPG must be calculated and kept below the limit. Data for LCA calculations are available in the national environmental database (NMD).
- In 2013, new building regulations stipulated that each environmental permit application for residential, non-residential and office building must be accompanied by a calculation of the building's environmental performance. Then in 2018, limits were introduced and the methodology was updated to comply with EN 15804 and EN 15978.
- The development process was accompanied by a stakeholder engagement platform in which public and private developers, the building materials industry and building designers were represented. Technical development was also carried out by the Building Quality Foundation (managing the NMD database), NIBE as a private consulting company, and the Dutch Green Building Council (DGBC).

LCA requirements

- **Life-cycle range:** A1—3, A4—5, B1—B4, C1—C4, D.
- **Climate impact assessment:** 11 environmental impact categories assessed and calculated in a single value, therefore the final value does not provide insight into WLC levels.
- **Reference analysis period:** 50 years or 75 years.
- **Definition of building area:** gross floor area defined as the gross area of all interior spaces in a building including thickness of walls.
- **Sources of environmental data:** NMD database of general and specific data.

- **LCA calculation tool:** a number of NMD-accredited calculation tools are available.
- **Reporting indicator:** EUR/m²/year.

Execution framework

- MPG regulations include a single standardized maximum limit for a building as an end-use component. Only embodied carbon emissions are included in this limit, while operational emissions are regulated through other policy measures.
- At the time of its introduction in 2018, the limit was at €1/m²/year. This limit value was set by analyzing representative buildings, which is a bottom-up approach.
- In 2021, the limit was tightened for residential buildings to €0.8/m²/year, but remained the same for office buildings.
- The limit is expected to tighten to €0.5/m²/year in 2030, thereby halving the emissions caused by buildings covered by the MPG.

Sources

- [Environment Performance Buildings](#)
- [Bepalingsmethode Milieuprestatie](#)
- [Nationale Milieu Database \(NMD\)](#)
- [Rekeninstrumenten \(NMD\)](#)
- [Environmental Cost Indicator \(MKI\)](#)

3.6 SWEDEN

Regulatory framework

- In Sweden, regulations requiring the development of mandatory climate declarations for buildings went into effect in January 2022. It is also proposed to introduce maximum limits for these declarations, which will take effect no later than in 2027. The goal of this gradual approach is to increase knowledge of the climate impact of new construction, while beginning to reduce the climate impact of buildings as a contribution to the national goal of climate neutrality in 2045.
- The Swedish climate declaration limits the requirement to the construction phase, so that emissions must be reported from the completed building and for individual building components. The climate declaration covers new buildings that require a construction permit. However, exemptions apply to private individuals who develop a building without a business purpose, certain industrial buildings such as agricultural (non-residential) buildings, and public construction projects for defense or transportation infrastructure. In addition, the scope of the regulations is limited to buildings over 100 m².
- The climate declaration can be completed at any time before the building is occupied. It must be submitted online to the National Council for Housing, Building and Planning, which verifies the declaration. In order to obtain a final building occupancy permit under the Planning and Building Act, the completion of the climate declaration must be submitted to the municipality. Since there are currently no limit values, this is the only requirement.
- The development of current regulations, as well as future limits, is being led by the ministry with strong support

from the National Housing, Construction and Planning Board (Boverket). The board has developed a database with relevant climate data for standard materials that can be used to calculate climate impacts in the construction of new buildings. However, a 25% penalty is included in these default values to encourage the use of specific EPD data. The Swedish Environmental Agency (IVL) provides an online calculation tool. From there, data can be directly transmitted to the Boverket. In addition, extensive information and guidance on calculating climate impacts is available on their website.

- The process began in 2019, when the government instructed Boverket to begin preparations to facilitate the introduction of climate declaration regulations for the construction of new buildings. In 2020 they presented a draft law on the climate declaration for new buildings. The focus on embodied carbon emissions only during the construction phase and the subsequent introduction of limit values means that the current regulations are building the capacity to lay the groundwork for more stringent regulations with more comprehensive life-cycle scope and mandatory limit values. Due to demands from the country's construction and real estate sectors, the original 2027 deadline for the introduction of limit values may be accelerated to create a sound policy framework.

LCA requirements

- **Life-cycle range:** A1—3, A4—5, in accordance with EN15978:2011
- **Reference period of analysis:** usually 50 years, but not applicable to the climate declaration, as only initial embodied emissions are calculated.
- **Definition of building area:** gross floor area (total area, including area not used for residential or office purposes).

- **Sources of environmental data:** a database of EPDs and general data is available from the Boverket. Values are set about 25% higher than the average value calculated for the product group to discourage the use of default values.
- **LCA calculation tool:** the Swedish Environmental Protection Agency (IVL) has developed a calculation tool with which LCAs can be submitted directly to the Boverket. However, the tool is not mandatory, so other tools or forms can be used.
- **Reporting indicator:** kg CO₂/m²/year.

Execution framework

The proposal to set limit values in the future provides the most relevant information:

- Climate emission limits for buildings should cover the construction phase (modules A1—A5) from 2027; an extension to further LCA modules and information on biogenic carbon storage could be considered, as well as net exports of locally produced electricity.
- The limits should cover a fuller range of building components from 2027 compared to the declaration requirement. Additional building components expected to be included are installations, interior surface finishings and room furnishings.
- The limits should be differentiated for single-family houses, multi-apartment buildings and non-residential premises.
- The level for the 2027 limit values should be set to achieve 20—30% lower climate emissions than the reference value to be established in the study of building climate calculations. This reference value is to be checked against registered climate declarations.

- Further tightening of the limits should occur in 2035 and 2043, and the goal is a linear reduction in the maximum values relative to the 2027 limit, with a 40% reduction suggested by 2035 and 80% by 2043.
- Assessments should be carried out well in advance of planned reductions to ensure that the limits do not cause development in an undesirable direction.

Sources

- [Regulation on climate declarations for buildings \(boverket.se\)](https://www.boverket.se/en/om-boverket/om-boverket/om-boverket/om-boverket/om-boverket/)
- [About the climate database from Boverket](https://www.boverket.se/en/om-boverket/om-boverket/om-boverket/om-boverket/om-boverket/)
- [Syftet med att klimatdeklarera byggnader — Klimatdeklaration](https://www.boverket.se/en/om-boverket/om-boverket/om-boverket/om-boverket/om-boverket/)
- [Meningen med att klimatdeklarera | Boverket.se \(infab.io\)](https://www.boverket.se/en/om-boverket/om-boverket/om-boverket/om-boverket/om-boverket/)
- [Questions and answers about climate declarations](https://www.boverket.se/en/om-boverket/om-boverket/om-boverket/om-boverket/om-boverket/)
- [Klimatdeklaration för byggnader — DS2020](https://www.boverket.se/en/om-boverket/om-boverket/om-boverket/om-boverket/om-boverket/)

4. CHALLENGES AND OPPORTUNITIES

Previous pilot projects and the results of WLC analyses as part of the BREAM, LEED and DGNB certification processes have not only identified common challenges and solutions to setting WLC benchmarks, but have also highlighted a number of additional benefits beyond just carbon reduction. WLC assessments have measurable effects for a wide range of stakeholders, including by fostering innovation, increasing transparency, improving operational and material efficiency, leading to reduced capital expenditures and lower costs throughout the building life-cycle.

Conducting the analysis, regardless of the method adopted or the final result, provides designers with new perspectives and prompts them to consider both short- and long-term efficiency early in the design process.

Despite the existence of proven international practices and efforts, there is still much work to be done to fill the gaps in carbon data at the building, process and product levels. It is also important to further develop the data infrastructure and identify training needs in this area.

The strategies and benefits of this experience provide valuable guidance to other member states, offering them a ready path to follow and accelerate the decarbonization of the construction sector.

As part of the activities required in developing the methodology for estimating WLC of buildings, it is necessary:

- Engaging stakeholders in the construction sector: architects, designers, building product manufacturers, contractors, developers.
- Introducing a validation method to ensure the quality and accuracy of the calculations.
- Engaging data providers to unify guidelines and reporting templates.

Estimating life-cycle GWP is key to identifying major sources of carbon emissions and meeting decarbonization goals in the construction industry. In addition to the obvious benefit of reducing emissions, the process has other, less recognized but equally

important advantages. Many of these, are sometimes overlooked due to concerns about costs, administrative burdens, inconsistent data or uncertainty associated with projections.

Decarbonizing buildings not only reduces climate transition risks, but also has a positive impact on the real estate and finance sectors. Reducing emissions contributes to greater energy security by reducing dependence on fossil fuel imports or changing the energy mix, mainly in countries where coal is the dominant carrier. In addition, implementing such assessments prepares the industry for upcoming regulations, saves money in the long term, and increases the competitiveness of construction companies by promoting innovation and the development of environmentally friendly technologies. Key benefits:

- Increase of awareness of building carbon performance. Details of WLC analyses allow identification of the most carbon-intensive stages of a building's life-cycle, which will allow appropriate optimization of the selection of building products, construction or material processing.
- Highlight and provision of evidence of the carbon value of preserving existing building stock, prioritizing renovation and preservation of building materials and elements over new construction.
- Increasing innovation toward low-carbon buildings. Scaling up emerging technologies for low-carbon buildings, creating solid medium- and long-term business cases for material and design innovation. By quantifying the end-of-life impacts of building products and their benefits and burdens beyond system boundaries, WLC assessments support circular and prefabricated industrial construction solutions.
- Creation of jobs and building the "green" skills in construction sector. The growing demand for zero-carbon buildings throughout their life-cycle is opening up new employment opportunities in the construction sector, particularly in the area of low-carbon projects and services. This phenomenon is also linked to growing demand for key skills, data and digi-

tal tools. The shift from traditional building practices to more energy-efficient buildings that combine innovative design solutions and smart technologies is challenging, but also creates exciting opportunities for new competencies, business models and diverse careers. Implementing a life-cycle approach in construction can also benefit local industries such as forestry, agriculture and animal breeding. In this way, the construction sector can spur broad development of regional economies, combining environmental goals with social and economic benefits.

- Cost minimization potential. Integrating life-cycle assessment (LCA) with life-cycle cost (LCC) analysis can lead to significant savings, both in terms of capital costs and optimization of operating and replacement expenses. This approach will lie in the selection of sustainable materials and solutions. By considering future climate change and adaptation strategies during the design process, the construction sector can improve the resilience of buildings and minimize negative impacts related to carbon emissions and waste. Reducing the whole-life carbon impact of buildings is often associated with more efficient use of resources, which can offset the higher costs associated with using sustainable materials. In addition, transparency in WLC disclosure can increase the attractiveness of properties on the market and facilitate access to more favorable financing. Moreover, performing LCA can accurately determine the residual value of materials after demolition, which supports more precise financial planning and strengthens sustainability efforts.
- Improvement of the health and comfort of users. The use of natural materials in construction can positively affect indoor air quality, improving the health, well-being and productivity of users, as they emit less harmful volatile organic compounds. Combined with the reduction of noise, emissions of harmful pollutants, better living conditions for users are created.

5. CONCLUSIONS

The pursuit of climate neutrality also in the construction sector through, among other things, the EPBD 2024 obliges EU member states to develop and implement a life-cycle GWP calculation methodology for buildings. This action is a gradual process that requires overcoming common difficulties. The transposition of the EPBD is done by developing WLC benchmarks and generating relevant analysis and stakeholder support to establish national WLC methodologies. The undisputed value in this process is the experience and lessons learned from countries that have already implemented relevant measures or have introduced regulations that oblige the building sector to report WLC.

5.1 Recommendations for developing a methodology for life-cycle GWP calculation.

Governments should begin developing a national methodology for assessing WLC as soon as possible, in cooperation with relevant stakeholders from the construction and academic sectors. This process is a key step in establishing appropriate benchmarks and regulations. Setting benchmarks identifies major sources of carbon emissions by analyzing which building components have the greatest impact on emissions. By focusing on those materials and building elements that have the greatest impact, the assessments can be expanded to a larger scale.

Adopting simplifications as part of life-cycle GWP analyses by introducing default/representative values for less emissive building elements saves time and costs. WLC analysis should be conducted early in project stage while ensuring consistency in the methodology and data used to establish WLC benchmarks. It is important that the same assumptions, reporting templates and default data are used across all projects. Prior-

itizing consistency and transparency in methodology early in the process is more important than achieving immediate accuracy in carbon data that can be corrected later.

Recommendations

In the context of assessing carbon emissions over the life-cycle of buildings, it is worth considering several key elements that can improve the efficiency of the process and contribute to more accurate and reliable emissions reporting:

- **Making it mandatory to calculate the life-cycle GWP on the basis of an accepted uniform methodology**
 - For new buildings the obligation to perform LCA should be harmonized to the guidelines of existing legislative documents and approved in the near future as part of the revision of the EPBD.
 - In the case of building renovations or conversions/expansions, analyses should include the carbon footprint within the scope of the renovation measures, without taking into consideration data on the building in its existing state.
- **Separate reporting of embodied and operational carbon emissions:** Emissions related to building materials (embodied) and emissions from building use (operational) have different characteristics, requiring a separate analysis and reduction plan. It is important that these two categories of emissions are treated separately so that neither is overlooked, and an appropriate level of reduction is implemented for each.
- **Use of relative and absolute indicators:** It is recommended to use both relative indicators, such as $\text{kgCO}_2\text{e}/\text{m}^2$, which allow comparison with other indicators (e.g.,

energy intensity), and absolute emission values (kgCO_2e), which allow normalization of results, such as per capita. This approach can be particularly important for larger buildings, where the total building area can lead to significant differences in results.

- **Application of international standards:** Alignment of LCA methodologies with internationally recognized standards (e.g., EN 15978, ICMS, IEA EBC) and collaboration with life-cycle assessment initiatives can help standardize practices and improve data quality and comparability of results globally.
- **Verification of national EPD data:** Helpful for more accurate estimation of emissions related to building materials. However, it is important to carefully evaluate the origin of these data, taking into account geographic, technological and temporal representativeness.
- **Development of a national database containing unit emission factors for:**
 - construction products, equipment and technical systems including the end-of-life phase,
 - type of transport of construction products, fuel, and average transport distances specific to Poland,
 - phases of the construction of different types of buildings, taking into account the different energy carriers needed in the construction process to power machinery and construction facilities, as well as the share of construction waste for each group of materials,
 - energy carriers.

- **Development of a central generic database for building products, equipment and technical systems.** This data can be successfully used in calculating the carbon footprint at the conceptual stage of development of a building. To create the database, it may be helpful to use the range of building elements listed in LEVEL(s) to rank materials within given categories/subcategories.
- **Establishment of a national database of construction products with EPD declarations,** designated according to a uniform methodology. The specific database will allow for accurate assessment of the impact of a building throughout its life-cycle on the basis of the adopted methodology in second stage - construction or detailed design, and third stage — after-implementation.

5.2 Recommendations for data collection

In order to effectively implement a building life-cycle GWP assessment, a key step is to establish a robust infrastructure to collect, store and analyze the data. Such infrastructure should include:

- **National life-cycle GWP database.** It should contain general, default, and building-specific product data. Such databases provide a foundation to collect and share information on CO₂ emissions associated with various building materials and technologies.
- **Life-cycle GWP repositories at building level.** They should contain emissions data from the entire life-cycle of a building, from design, construction to use and demolition. They can help collect and analyze data specific to certain building types to better understand their carbon impact.
- **Life-cycle GWP calculation tools:** These tools, such as computational programs for building LCA perfor-

mance, should, to the extent possible, be integrated with existing BIM (Building Information Modeling) systems and commercial LCA programs used in the market (e.g. OneClickLCA). This will make it easy to process data and integrate the results of the life-cycle GWP assessment into the design and construction process.

- **Integration with Energy Performance Certificate (EPC) systems.** The 2024 EPBD recast requires that the whole-life carbon footprint of new construction should be disclosed in EPCs. As a result, it is important to ensure that the life-cycle GWP assessments are fully compatible with EPC certification systems, allowing the life-cycle GWP data to be integrated into the energy certification process.
- **Synergies between software systems.** It is critical to combine data from different systems and integrate them to improve the life-cycle GWP assessment process. Sharing data between platforms, such as BIM, LCA and EPC, allows for more complete use of the information collected, resulting in more accurate assessments and better building life-cycle management.
- **Monitoring and evaluating data quality.** Continuous monitoring of data quality and benchmark robustness is essential to ensure the reliability of life-cycle GWP assessments. High-quality data increases confidence in the results and encourages further information collection. This will ensure effective policy-making that supports rapid carbon reduction.
- **Accurate benchmarks.** Life-cycle GWP benchmarks are essential for comparing different building solutions and establishing best practices. They should be based on representative case studies in different building types to create effective and data-driven recommendations to help reduce CO₂ emissions in the building sector.

5.3 Stakeholder engagement

The transformation of the building and real estate sector is crucial and requires profound changes in the way building assets are managed and in the entire value chain associated with them. An important part of this transformation is the recognition that all stages of the building life-cycle are closely interconnected, which means that decisions made at each stage must be informed and support decarbonization goals across the value chain.

A key aspect is to intensify the involvement of relevant stakeholders from different sectors. In line with the principle that "every participant in the value chain must contribute to the transformation of resources to net zero," it is required that both designers, manufacturers, developers, contractors and property managers work together to achieve carbon reduction targets.

Recommendations

- Harmonize collaboration, processes, and joint action at the strategic and operational levels to effectively implement sustainable solutions.
- The transition to zero-carbon building resources and practices will not be possible without the involvement of all participants in the value chain and the creation of consistent policies that support these changes at all stages of the building life-cycle.
- Develop guidelines, raise awareness, and educate — create guidelines for data collection, materials inventory, and develop report templates to facilitate the work of LCA practitioners. Such guidelines should make it possible to standardize the approach to LCA, which will help more accurately track the emissions and efficiency of materials at different stages of the building life-cycle.

- Policy makers, with the support of civil society, professional organizations and academia, should launch intensive awareness campaigns on the importance of life-cycle GWP assessment. Such efforts will build widespread awareness of the impact of construction on climate change and the benefits of implementing sustainable building practices.
- Develop upskilling programs and training materials to cover various aspects of the construction value chain, such as life-cycle GWP assessment, material efficiency, new construction and renovation technologies, innovative materials, and circular concepts. These trainings should target a wide range of stakeholders in the construction sector, including engineers, architects, contractors and developers, to ensure that they have the right knowledge and skills to implement sustainable construction practices.
- Promote stakeholder cooperation, as only through the joint action of various actors (construction companies, material suppliers, policy makers, NGOs) it will be possible to achieve the goals of sustainable development in construction.
- Motivate manufacturers of construction materials and products to develop EPDs for their products. In addition, the creation of a national emission database of construction products with emission classes will allow differentiation of construction products in terms of their environmental impact.

5.4 Recommendations for defining life-cycle GWP limits.

The basis for developing limit values of embodied and operational emissions for different building types is to first **adopt a consistent and uniform methodology for estimating the carbon footprint over the entire life-cycle** and to **develop case studies that include a representative sample of the national building stock**. It is important that these additional cases are evaluated on the basis of consistent data and assumptions to produce results that are comparable between different building types. Only in this way will it be possible to build a strong foundation for further analysis and development of life-cycle GWP standards to compare different building projects in terms of their carbon impact.

Addressing the incomparability of existing life-cycle assessments. Differences in the emission factors used, material replacement rates or deconstruction scenarios often lead to difficulties in comparing the results of different analyses. To address this, a unified approach to assessing materials and construction processes that incorporates the same standards and assumptions should be developed.

In addition, **integration of life-cycle GWP assessments with national regulations and policies** is key. Well-designed policy instruments should go beyond building regulations to include low-carbon procurement policies and decarbonization roadmaps. Integrating life-cycle GWP assessments into legislation will enable the development of reliable benchmarks that support the introduction of carbon limits. Such a system will allow effective monitoring of progress in reducing emissions in the construction sector and enable the achievement of climate goals at the national and EU levels.

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B.

TECHNICAL ASSISTANCE

1. PROBLEM STATEMENT: WHY ARE ONE-STOP-SHOPS (OSSs) AN IMPORTANT TOPIC IN THE CONTEXT OF C4E'S BROAD FOCUS ON ENERGY EFFICIENCY?

The motivation to consider the topic of OSS involvement as a distinct approach to building stock decarbonisation comes from a combination of factors at the national and EU levels. Universally, OSSs are regarded as an enabler of measures increasing the energy efficiency of buildings by closely linking the demand and supply side within fragmented renovation value chains into centralised hubs of expertise.

To this end, the recast EED¹ [Article 22(3)] and EPBD² [Article 18] directives formally embed the OSS concept as a part of building renovation policy.

Specifically, Article 18(1) EPBD states that

Member States shall, in cooperation with competent authorities, and, where appropriate, private stakeholders, ensure the establishment and the operation of technical assistance facilities, including through inclusive one-stop shops for the energy performance of buildings, targeting all actors involved in building renovations, inter alia, homeowners and administrative, financial and economic actors, such as SMEs, including microenterprises.

These centralised hubs are established with the intent of streamlining the building renovation process, with special attention to households, including those at an elevated risk of energy poverty or buildings with an above-average age with respect to the national building stock. Importantly, the delivery of the services is

to be undertaken by both public authorities and private entities. [1] Article 18(2)(b) EPBD furthermore recognises that one-stop shops operated by a private sector actor may be able to focus more precisely on particular building segments, offering more cost-effective and specialised services due to established expertise. Nonetheless, the public and private-based provision of OSS services should be thought of as complementary, not exclusive.

Member States have until May 29th, 2026, to transpose the EPBD directive into national law.³ The transposition deadline also extends to the requirement to establish a OSS network.

Although the EU-based targets and directives provide essential direction, the core value of a OSS framework for individual Member States lies elsewhere. Namely, by operating a network of centralised hubs offering holistic renovation assistance, Member States can enhance their ability to overcome barriers to building renovation. These barriers are context-dependent and will differ by Member State and by region.

For Slovakia, a concise summary of challenges to building renovation is presented in the national Long-Term Renovation Strategy from 2020. The list extends further, but some of the key barriers in building construction and renovation include [2]:

- Legally complex ownership structures of certain buildings complicating renovations (e.g.: in mixed-purpose buildings with a residential and a non-residential part).

- Absence of a lifelong learning programme for selected professions (e.g. project designers).
- Administrative complexity of applying for assistance from available support schemes.
- Building renovation service providers do not effectively communicate the support they can offer to building owners throughout the whole renovation process.
- Lack of quality assurances for some of the building renovation work, due to the prevalence of low-cost renovation service provision.

In a 2025 homeowner survey, B4F inquired about the persisting barriers to renovations from the perspective of homeowners. The most significant barrier was the inability to pre-finance the renovation measures from personal savings.⁴ Between 2023 and 2025, the share of homeowners citing personal savings as their main source of finance for renovations rose from 53 % to 74 %. In contrast, the share of homeowners relying on consumer loans from a bank or a building society decreased from 31 % to 18 %. [3] [4]

Against this backdrop, a viable OSS network with a capacity to provide homeowners with low-interest loans and grant support before the completion of renovation works is thus essential to unlocking renovation benefits, particularly for households facing difficulties in covering the large upfront costs of building renovation.

¹ Energy Efficiency Directive (EU/2023/1791)

² Energy Performance of Buildings Directive (EU/2024/1275)

³ As stated by Article 35 EPBD which concerns the transposition of the directive into national law.

⁴ Slovak support schemes (e.g.: the *Obnov dom* programme) only allow for a post-hoc reimbursement of the expenses associated with renovation measures.

On the other hand, in the all-inclusive/ESCO-type models, the customer base tends towards homeowners who prefer that the OSS provider carries liability for the renovation. This type of a OSS provider charges a fee for the service and is usually able to drive economies of scale by bundling geographically varied projects together and leveraging access to attractive loans. [7]

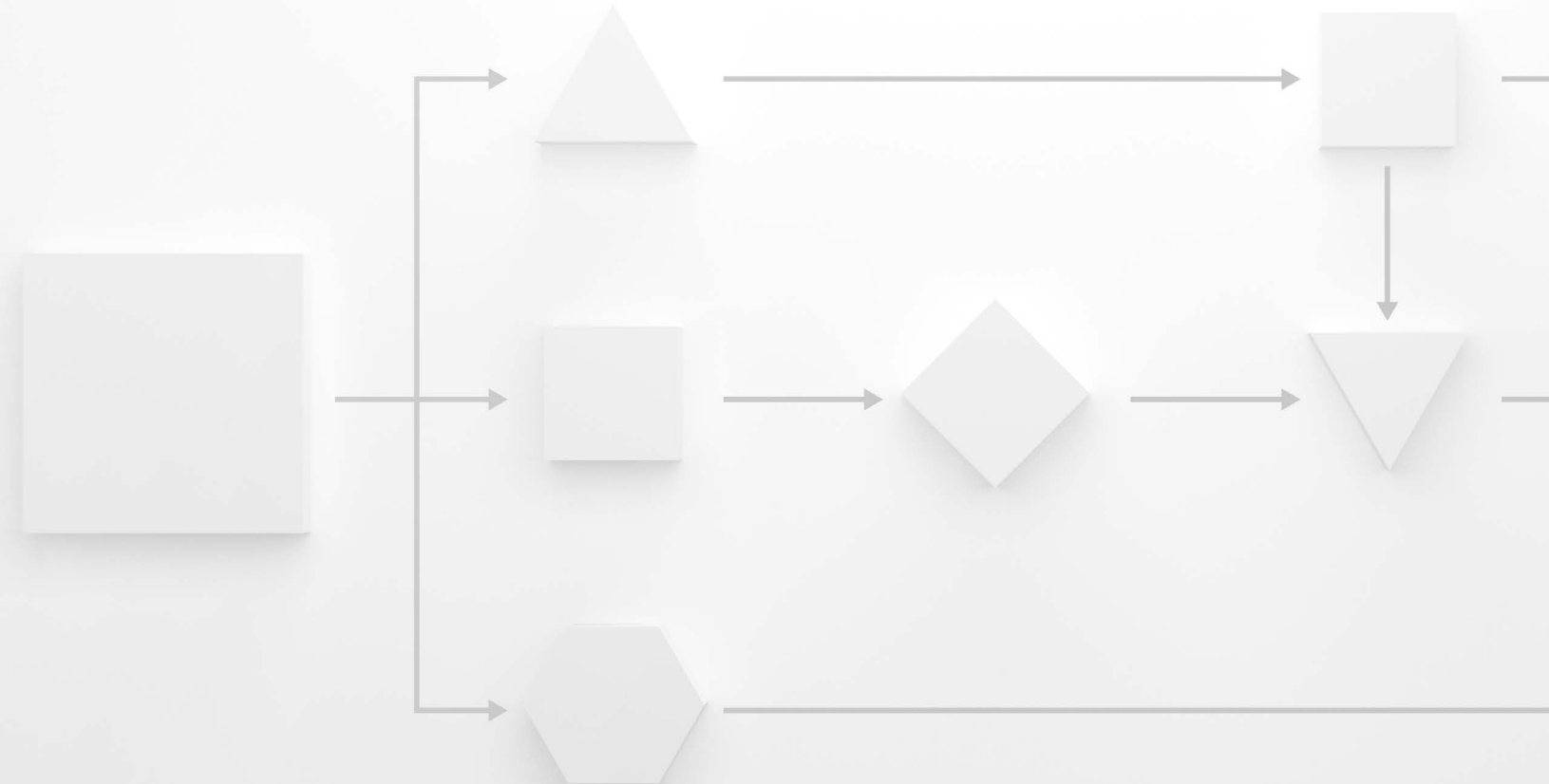
It is also important to establish the link between individual models and steps in the renovation process. According to Elgendy et al. (2024), the renovation can be divided in four consecutive phases, namely: [8]

- **onboarding phase** (related to the first approach between the OSS provider and the customer and provision of general advice),
- **in-depth phase** (related to a feasibility assessment and further financial planning),
- **transaction phase** (related to access to finance and financing of the renovation process),
- **implementation and utilisation phase** (related to the installation of technologies and/or application of measures improving energy efficiency of the building; also includes the post-renovation evaluation of actual energy performance).

Certain models perform better across some phases than others. Employing a comparative analysis, Elgendy et al. (2024) found that the public/government-driven OSSs tend to do comparatively better in increasing public awareness on renovations and efficiency-increasing measures (e.g. through awareness campaigns or public events) than private-driven OSSs. This is a natural consequence of the fact that the OSS providers following the facilitation model are usually set-up by a public authority with the intent to provide a public service the provision of

which fits into broader environmental or social targets. On the contrary, private-driven OSSs were more efficient at overcoming barriers in the later stages of the renovation process. [8] [9]

The authors' analysis suggests that public-private OSS providers were successful in unifying the strengths of government-driven and private-driven approaches in their service provision, in terms of overcoming barriers present at each renovation phase. This was perhaps most evident in their ability to integrate diverse financial solutions.⁵ Importantly, this research strengthens the case for public-private partnerships in OSS on the grounds of empirical evidence.



⁵ These include pre-financing subsidies and regional subsidies.

3. GOOD PRACTICES

3.1 The Czech Republic

Country overview

Within the V4 and CEE regions, the Czech Republic is a forerunner in terms of retrofits and home renovations, as evidenced by the outreach of its very successful subsidy programme “The New Green Savings Programme” aimed at carrying out measures improving energy efficiency of buildings. In its 15-year history, about 320 thousand households have been renovated, including 150 thousand single-family homes (SFHs), making it a positive example for renovation efforts in the CEE region.

Description of good practices

Author’s note:

The EKIS network described below was discontinued *during* the time of writing of this brief (in February 2025), following a decision by the hitherto responsible Ministry of Industry and Trade of the Czech Republic (MIT CR), after government funding for the energy advisory services was not extended. [10] [11]

At present, the MIT CR, the Ministry of the Environment of the Czech Republic (MoE CR) and the State Environmental Fund of the Czech Republic (SEF CR) are engaged in discussions on the reform of the network of energy advisory services. The institutional responsibility for the coordination and delivery of energy advisory services is being moved to the MoE CR.

Despite the circumstances, the Czech example is still included as a good practice in this policy brief, with the primary intent to showcase it as a long-running, systematic and policy-supported model of a public provision of energy advisory services. There

are valuable lessons from the design and operation of the EKIS network to be drawn and applied for the establishment of OSS networks elsewhere.

As a consequence of the above stated facts, sections of the policy brief focusing on planned updates of the original EKIS design have been omitted from this brief. Instead, the brief offers comments on the intent of the ongoing reform, and its emphasis to the need to ensure high public trust in the providers of energy advisory services and to safeguard continuity through an effective knowledge transfer from the former network.

Content

The Czech Republic (CR) does not currently operate a functioning network of OSS providers in the sense of the recast EPBD directive. Nonetheless, three types of providers of Integrated Home Renovation Services (IHRS) have been established there:

- **EnKoMAS**/Místní akční skupiny (“Energy Coordinators of the Local Action Groups”)
- **EKIS**/Energetická konzultační a informační střediska (“Energy Consulting and Information Centres”)
 - **i-EKIS** (the internet-based equivalent of the service)
- **M-EKIS**/Mobilní energetická konzultační a informační střediska (“Mobile Energy Consulting and Information Centres”)

All these elements fall under the broad network of EKIS, or the Energy Consulting and Information Centres. The **services** provided by all elements within the EKIS network are **free at the point of use**.

In parallel to these centres, the MIT CR also runs a call-centre at “1212” which provides a more general overview of available support through funding, and the website www.jaksdileten-ergii.cz, offering information on energy savings and the concept of energy communities.

Scope

None of the EKIS services are explicitly national. The network is (trans-)regional and local in nature, since:

- EnKoMAS are tied to Local Action Groups (LAGs)⁶, of which there are 176 in total across the country.
- EKIS are found on fixed physical locations, according to the central database of the MIT CR, there are 28 of these dispersed across various cities — with at least 1 per each of the 13 self-governing regions.
- M-EKIS represent the trans-regional element; the energy advisors travel to customers in multiple administrative districts across one or multiple self-governing regions.

Implementation Process

Originally, the EKIS network of experts assisting in building renovation was set up in the 1990s under the auspices and coordination of the MIT CR. Later, in 2001, this service was broadened to include internet-based provision of advice via the i-EKIS online

⁶ LAGs consist of municipalities/public authorities, NGOs, businesses and trade associations which cooperate on projects in regional development with the aim of securing EU-sourced financial support for these projects. Additional information is accessible at: <https://www.nsmascr.cz/o-nas/co-jsou-mas/>

advisory platform, where those interested in renovations could pose question on ongoing renovation programmes. It had been operating for roughly 15 years in its modern institutional form. [12]

The EKIS were established within the framework of the state programme EFEKT⁷ to support energy savings, which is announced by the MIT CR with the intention to participate in the implementation of the State Energy Policy.

In February 2025, the MIT CR ceased funding for EKIS from 2025 onwards. The agenda had been moved to the MoE CR. [10]

The implementation of present-day EKIS is closely tied to the New Green Savings Programme, aimed at the reduction of energy consumption in residential buildings and at the adoption of energy efficient renovation technologies. [13]

Utilised financial instruments and allocations of funds

The operation of EKIS was financed through multiple mechanisms, such as the EFEKT III programme, and the National Recovery Plan (Národní Plán Obnovy ČR).

Key outcomes and results

- Between 2022 and Q3 2024, EKIS has offered about 40 thousand individual consultations on energy efficiency mazurem. [14]
- Importantly, the provision of services by EKIS is free at the point of use.

Challenges and Solutions

- The current model is dependent on public finance and thus vulnerable to inconsistencies in renovation support schemes.
- The current design falls under the facilitation model of IHRS/OSS provision, with primary attention to technical

advice, rather than providing the full legal, financial and administrative service.

- Lack of human resources to carry out the services associated with the provision of information on the energy renovation process and measures increasing energy efficiency. [14]
 - Primarily an issue for smaller municipalities.
 - Between 2022 and 2024, the EnKoMAS-based advisors have undergone additional training on the legal and financial frameworks, thus they provide information on available support schemes and subsidies. [15]

Planned reforms and changes [11]

- An upcoming public information campaign around June or July 2025⁸, targeting owners of SFHs, owners/manages of apartment buildings, and municipalities.
 - The aim is to inform them about the impact of consumer behaviour on energy consumption and about the benefits and opportunities of building renovations.
- Preparation of data and methodological guidance to be used in the provision of advisory services for households, enterprises, and the public sector. The methodological guidance shall include a module on energy poverty and how to advise vulnerable households.
 - To be achieved by Q2 or Q3 2025.

Lessons learned for potential replicability

Key takeaways

It is beneficial to run a unified support scheme for building renovations (such as the Czech NZÚ scheme)

- Simplifying and standardising support mechanisms facilitates the training of experts hired by OSS service providers, as a single scheme makes the benefits easier to access.
- In the case of individual homeowners, additional transparency from having a single support scheme may contribute to positive attitudes to home renovations, as the complexity of the process of applying for financial assistance is often cited as a barrier to renovation.

Scalability and transferability

The Czech EKIS network and its three pillars are a result of long-term policy-driven efforts by public authorities to fill the gaps in the general awareness of energy savings and measures increasing the energy efficiency accessible to households, businesses, schools and public administration bodies alike. Thus, it may be conducive to set long-term policy objectives for the replication of such models in a structured manner. Therein, attention should be paid to ensuring continuity and complementarity of new network elements — rather than creating multiple parallel networks for overlapping functions, which may strain resources and reduce impact.

Importantly, the scalability of this practice relies on the presence of domestic expertise on the technical, financial and legal dimensions of the building renovation process. We see that beyond the in-person EKIS offices, the network has grown to include mobile energy advisors with additional flexibility vis-à-vis the customer, and lastly a network of energy coordinators who assist municipalities, businesses, educational institutions and the civil society actors in applying for support from EU grant instruments.

⁷ More on the programme is to be found here (in Czech): <https://efekt.gov.cz/cz/>

⁸ This is an indicative date mentioned in private correspondence with a member of the Chance for Buildings alliance.

3.2 Hungary

Country overview

Hungary currently runs two one-stop shop designs for building renovations and energy efficiency improving measures. RenoPont, the first complex OSS design in Hungary, was established through the EU-funded RenoHUB project. The grant funding terminated in 2023, prompting the OSSs to ensure financial viability on their own.

The other one is operated by the Hungarian Chamber of Engineers (MMK), providing free government-funded advice to the public and businesses. The Parliament amended Act LVII of 2015 on Energy Efficiency (Ehat.)⁹ namely incorporated energy consulting services for households and small businesses into the organisational scope of the MMK.

According to section 21(4) of Ehat., the MMK:

- Provides free energy advice to businesses and monitors the level of energy savings achieved thereafter;
- encourages small and medium-sized enterprises to conduct energy audits and implement the recommendations contained in the audits;
- provides free energy advice to the public and monitors the level of energy savings achieved thereafter;
- provides information on available energy efficiency applications;
- provides information on energy efficiency certificates under the Government Decree on the certification of the energy performance of buildings, their purpose and objective, cost-effective measures, financial instruments for improving the energy efficiency of buildings within the framework of renovation advice.

MMK-based OSS service provision is not considered further in this brief, as we focus on the RenoPont OSS instead.

Description of good practices

Content

The services offered by RenoPont fall under the facilitation-coordination models of OSS provision. RenoPont OSSs provide technical assistance, as well as general information on the renovation process and available financial support programmes. Current model of service provision is aimed at “coordinat[ing] the actors participating in the energy efficiency renovation process and bring them into contact with renovators”. (RenoHUB, 2023, p. 9) [16]

The objective of the RenoHUB project was to trigger an upscale in energy retrofits of the Hungarian building stock. [17] The means to attain that objective was to implement a Renovation Hub model through the foundation of the first Hungarian OSS for energy renovations — the RenoPont Energy Home Renovation Centre.

Within the service customers are liable to get technical, financial and legal assistance related to the entirety of the renovation process. Altogether 8 physical offices were established by the conclusion of the first stage of the project in May 2023.

To this end, the offices followed two frameworks of cooperation with partners [16]:

THE PARTNERSHIP MODEL

- The RenoPont office space is hosted by a third-party non-professional partner (could be a local government, a chamber of commerce or a utility company).
- In practice, partner municipalities ought to have wide enough client base for the OSS, which means large cities and counties are over-represented.
- The most viable and replicable modality of this model is one where an external professional offers consultancy services.

- By being hired (usually by the local government) at market price, the expert can offer services on

behalf of the OSS. His/her availability is dictated essentially by the interaction of supply and demand.

- The alternative approaches are:
 - the local government provides both the office space and a member of staff as a consultant, or
 - the local government provides the office space, whilst MEHI supplies a member of its staff as a consultant.

- An example for this model was the Budapest office established by MEHI in the 11th district, as well as the office in Szentendre.

THE ENTREPRENEURIAL MODEL

- The RenoPont office works with a for-profit host organisation which possesses technical knowledge and is typically active in a particular part of the building renovation value chain. The office becomes a part of the company’s organisational structure. Multiple companies can operate their own OSS offices, but under a united visual identity.
- The general information and first advice on the renovation process is offered by internal employees of the for-profit organisation, whilst in-house professionals or contracted consultants take over the latter stages of the renovation process
- The RenoHUB closing report lists an advantage of this model: the for-profit host organisation can leverage its position on the market to advertise the OSS with more impact than a local government, plus it has the means to pay a monthly franchise fee (for operating as a part of the RenoPont franchise).

⁹ Full text of the Act LVII of 2015 on energy efficiency (in Hungarian): <https://njt.hu/jogszabaly/2015-57-00-00>

- By operating thusly, they will pool funds used toward the maintenance of the RenoPont website, the central coordination of the RenoPont franchise and improvement of its services.
- A forerunner to this model was established in Budapest (by MCSTE) and in Nagykanisza (by IMRO-DDKK).¹⁰

Scope

The network of physical RenoPont OSS is an initiative at the level of individual cities and counties, with the ambition to become a fully nation-wide initiative as the business model shifts more towards the entrepreneurial type and attracts more private for-profit actors. [16]

Implementation Process

Research and Preparation (2019—2020)

In Hungary, the “Integrated Services to Boost Energy Renovation in Hungarian Homes” project was launched in November 2019, as a part of the European Union’s Horizon 2020 research and innovation programme, under which it received funding. Also referred to by its acronym “RenoHUB”, the project represents a consortium of 5 organisations, namely [18]:

1. Energiaklub Climate Policy Institute and Applied Communications Association
 - an NGO focused on sustainable energy solutions
2. AACM Central Europe Kft.
 - an environmental consultancy firm providing guidance on financial support for the green transition
3. Hungarian Energy Efficiency Institute (MEHI)
 - a non-profit professional advocacy organisation

aimed at promoting conscious energy consumption and investments in energy efficiency in buildings

4. IMRO-DDKK Nonprofit Kft.

- a non-profit focused on awareness-raising programmes and providing energy advice through the renovation process

5. The Association of the Hungarian Family Homeowner (MCSTE)

- an initiative aimed at promoting energy retrofits in the single-family house segment.

At the start, the participating organisations conducted desktop research of about 30 OSS projects to put together a catalogue on good practices from abroad. To better understand homeowners’ needs, a market research phase which included the appraisal of real estate values¹¹ and a more qualitative element on the motivations and drivers of renovations and barriers preventing people from having their dwelling renovated. The latter part consisted of running a 3-day online blog, where people could detail their experiences and needs at length and conducting four focus group interviews. The findings painted a clearer picture of what potential customers expect from the provider of complex renovation services.

Pilot Phase and OSS development (2021—2022)

Starting from 2021, a network of physical offices opened to the public. The first office opened in February 2021 in Nagykanisza (arranged by IMRO) and the second one in December 2021 in Budapest (arranged by MEHI). The office network expanded to eight across the country as these gradually reached operational capacity by 2022. In parallel, RenoHUB launched the official website for the OSS in November 2021.

As the first OSSs became operational, RenoPont provided training for the consultants which would be assisting in the renovation process. To ensure compatibility of their knowledge with the required level, they took part in a 4-day training course. In later trainings the learning materials for the consultants were accessible in a video format. According to the RenoHUB closing report, consultants have since then regularly met monthly to be up to speed on technical and non-technical knowledge concerning the renovation process. [16]

The RenoPont website introduced a customer relationship management (CRM) system, which the consultants can use to track renovation journeys and optimize service delivery. [16]

Expansion and Optimisation (2022—2023)

This stage was about the integration of experiences and practices gained from running the pilot offices. OSS collected feedback through online and offline questionnaires which regarded both the technical or financial performance of the installed technologies/recommended measures and the engagement of OSS service providers with homeowners.

The network of certified experts assisting homeowners during the renovation process was expanded through the Partner Program, which serves a dual purpose of expert training and quality assurance. In July 2022, 23 experts participated in the training via the Partner Program. RenoPont achieved this by partnering with the Calm Construction Information Office (*Nyugodt Építkezés Információs Iroda*) and its Calm Building Information Framework (*Nyugodt Építkezés Információs Keretrendszer*)¹², which is a qualification system performing background checks and certification for businesses and professionals in the construction sector.

The RenoPont website introduced a customer relationship management (CRM) system, which the consultants can use to track renovation journeys and optimize service delivery. [16]

¹⁰ See Section 2.3 on the Implementation Process.

¹¹ Together with the Central Statistical Office, a database is being maintained that offers quantitative insights into how renovation affects the market value of residential properties/buildings, enabling to look at direct financial returns, but also how the resource is valorised in increasing the value of the property. [19]

¹² More information available on the official website (in Hungarian): <https://vedelem.nyugodtepitkezés.hu>

Utilised financial instruments and allocations of funds

The primary financial instrument used in the operation of the RenoPont OSS network, and the project website was the EU's Horizon 2020 research and innovation programme. The funding was concluded under grant agreement No 845652 and amounted to EUR 1.56 million.¹³

In May 2023, the EU grant funding for the programme ceased, concluding the first phase of OSS operation. As of now, RenoPont does not receive any direct government or municipal subsidies for operating and does not charge homeowners or renovation professionals for its services.

In terms of generating income to cover operational expenses, OSSs and the RenoPont website largely depend on sponsorships and grants. [19]

Key outcomes and results [16] [20]:

- 240 renovators had access to free consultancy and altogether 600 homeowners were supported in the renovation process.
- RenoPont online platform
 - The website <https://renopont.hu> hosts multiple interactive tools to help homeowners associate themselves with the home renovation process:
 - Prior examples of renovation measures resulting in substantial energy savings;
 - Energy savings calculator;
 - Energy performance certificates;
 - Database of qualified experts and contractors assisting with renovations;
 - Tips for altering energy consumption patterns.
- RenoPont assessed the financial solutions which worked the best for the local environment.

- Loan-grant schemes developed by international financial institutions (EBRD, EIB).
- Mobilisation of ELENA funding (EIB) in the multi-apartment building segment.
- Energy efficiency mortgage/Green mortgage loans.
- On-bill financing.
- Façade leasing.

- Social media campaigns can have a significant outreach, if they feature well-known public figures, rather than a community of experts.
- RenoHUB project report mentions the success of videos shot in cooperation with a video blogger and a stand-up comedian. [16]
 - The viability of such approach is largely a question of selecting the correct target audience.

Challenges and Solutions [16]

- Access to finance (discontinuation of EU-sourced funding stream and lack of national subsidy schemes).
 - Substituting grants for market-based solutions (development of the entrepreneurial model for OSS service provision).
 - Potentially looking at the EU Social Climate Fund (2026—2032), LIFE PDA project grants, and the ELENA grants to address the lack of access to finance — an attempt to couple these sources of finance and their target uses with the opportunity to reinvigorate OSS-supported building renovations.
- Government-subsidised energy prices for the residential sector.
 - They have the effect of delaying or discouraging altogether the perceived need to invest in measures improving energy efficiency of homes.
 - The generally long payback periods for renovations compound the problem.
- Lack of public awareness and/or motivation to take up home renovations.

Lessons learned for potential replicability

Key takeaways

- The presence of a stable state or municipal financial support is vital where the OSS provides its services at no cost to the customer.
 - Alongside with EU contributions to, the OSS provider should foster partnerships with local municipalities, so that sustainable financing is secured.
- Government interventions in the energy market by setting artificially low energy prices reduce incentives to renovate in the residential sector.
 - High upfront costs and long payback times for energy saving measures render retrofits unpopular especially among homeowners, if households expect energy prices to be subsidised by the state.
- Customers are in demand of more integrated services in building renovations.

Scalability and transferability

As of May 2025, MEHI refers to the RenoPont OSS as an *initiative* for which sustainable financing is currently missing. After the conclusion of the RenoHUB project financing from EU-sourced grants, five of the OSS providers had to close offices. The future

¹³More information available at: <https://cordis.europa.eu/article/id/450524-support-hubs-boost-building-renovation-in-hungary>

of the RenoPont OSS network is contingent on the existence of partnerships with local municipalities. Otherwise, OSS offices are likely not going to be able to cover their operational costs or provide the basic services free of charge.

The following section presents an additional example a good practice for the mitigation of information barriers in building renovation provided by the MEHI Institute.

Energy Performance Certificates in Hungary

Energy Performance Certificates (EPCs) were introduced as a policy tool to improve the energy efficiency of buildings and to provide transparency about their energy performance. Their origins trace

back to the early 2000s, when the European Union adopted the **Energy Performance of Buildings Directive (EPBD)** in 2002. This directive required member states to establish certification schemes for buildings, recognizing the significant role the building sector plays in energy consumption and carbon emissions. The aim was to make energy efficiency a key consideration in real estate transactions, renovations, and new construction.

Since 2009, Hungary has gradually expanded the requirements for energy performance certificates (EPCs). Initially, EPCs became mandatory for new buildings when obtaining an occupancy permit. From 2012, the requirement was extended to property sales and rental agreements exceeding one year. In 2016, the energy

certification requirements were tightened: while previously an energy certificate was only required for renting out standalone buildings, from that point onward, it also became mandatory for renting out apartments.

At the end of 2023, Hungary introduced significant changes to its energy certification regulations, making the Energy Performance Certificate (EPC) clearer, more informative, and easier to understand. Complex formulas were replaced with visual illustrations to enhance comprehension, and the certificate now includes more structured and detailed renovation recommendations. The amendment has also extended the requirement for an EPC, making it mandatory not just for the above-mentioned cases, but also for all rental agreements, regardless of their duration. A further step forward is the requirement to display the building’s energy rating in real estate advertisements, although it remains unclear whether non-compliance will result in any penalties.

The Hungarian energy certification system categorizes buildings based on two criteria: the overall energy performance and the specific carbon dioxide emissions. Each category consists of 12 classes, ranging from the most efficient (A+++) to the least efficient (I).

All new buildings must comply with the near-zero energy standard, which means achieving at least an A rating on both scales, with a maximum energy consumption of 76 kWh/m² per year and a maximum CO₂ emission of 20 kg/m² per year.

The certificate first presents the current state of the building: the building envelope and mechanical systems are evaluated on a five-level scale: poor, weak, medium, good, or excellent. For the building envelope, the thermal transmittance (U-value) and the surface area must also be specified. Additionally, the certificate provides a breakdown of energy consumption, first by energy source (e.g., gas, biomass) and then by usage type (e.g., heating, ventilation, lighting).

Rating	Requirement	Consumption kWh/m ² /year	CO ₂ emission kg/m ² /year
A+++	≤ 0	≤ 0	≤ 0
A++	0<...≤ 50	0<...≤ 38	0<...≤ 10
A+	50<...≤ 90	38<...≤ 68	10<...≤ 18
A	90<...≤ 100	68<...≤ 76	18<...≤ 20
B	100<...≤ 130	76<...≤ 99	20<...≤ 26
C	130<...≤ 160	99<...≤ 122	26<...≤ 32
D	160<...≤ 200	122<...≤ 152	32<...≤ 40
E	200<...≤ 250	152<...≤ 190	40<...≤ 50
F	250<...≤ 310	190<...≤ 236	50<...≤ 62
G	310<...≤ 390	236<...≤ 296	62<...≤ 78
H	390<...≤ 500	296<...≤ 380	78<...≤ 100
I	500<	380<	100<

A key feature of the certificate is its modernization recommendations. For each element (building envelope and mechanical systems), it must propose two types of upgrades: one to reach a "good" level and another to achieve an "excellent" level.

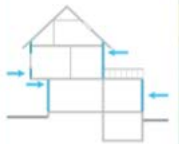
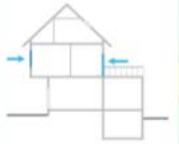
To aid understanding, the certificate includes a drawn example building, with each structure individually marked to show its location within the property.

The certificate also provides information on the expected classification and energy savings if the recommended improvements are implemented.

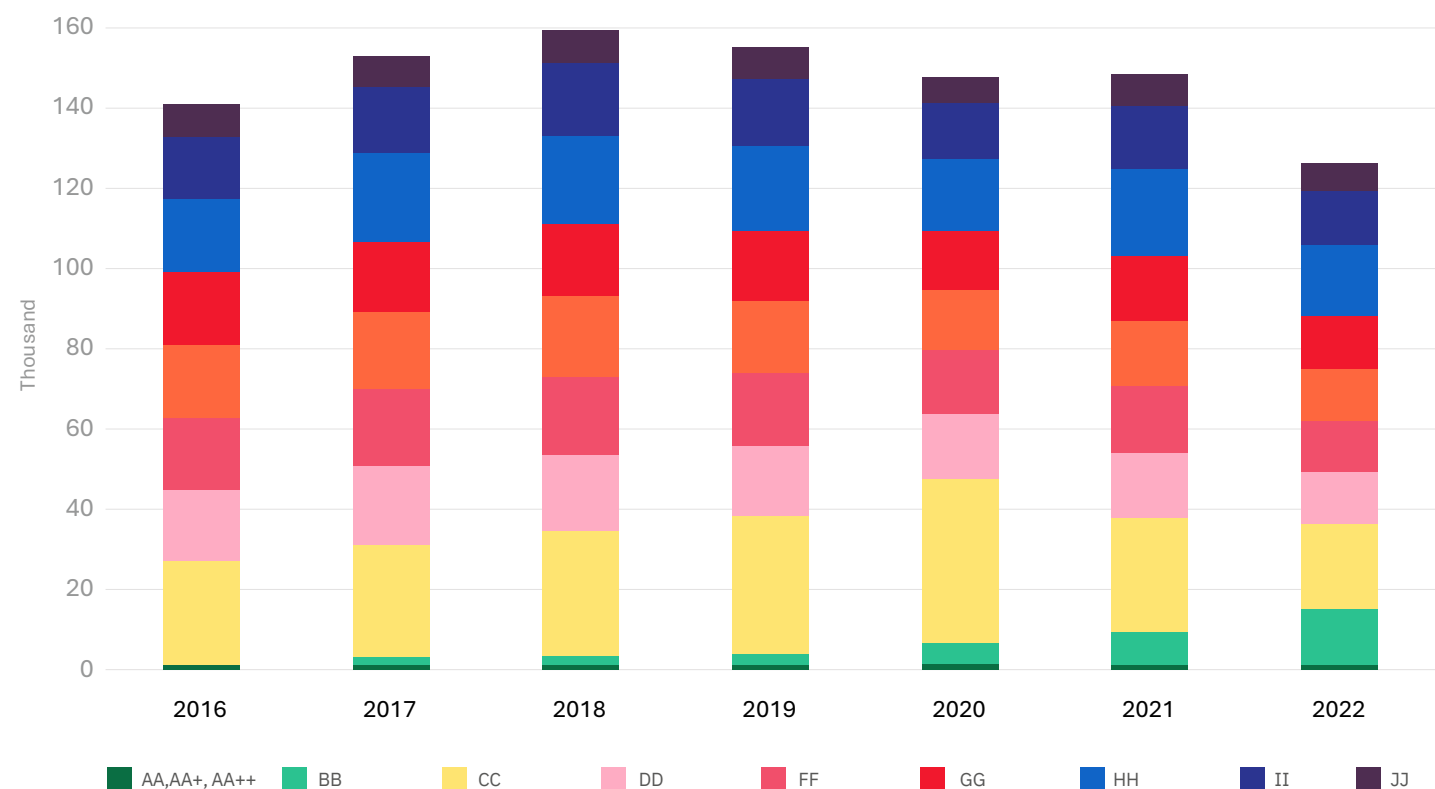
The validity period of the certificate has been reduced from 10 years to 5 years. Additionally, an on-site inspection and photographic documentation, which were previously recommended, are now mandatory, while the option for certification based on measured energy consumption has been eliminated.

Overall, these changes represent progress both in terms of content and format. The use of visual tools such as illustrations and colour coding enhance clarity, while the detailed renovation recommendations provide practical guidance for homeowners. Moreover, the introduction of carbon dioxide emission requirements supports Hungary's decarbonization goals.

The chart below shows the number of energy performance certificates issued for residential buildings (and accommodations) between 2016 and 2022, broken down by rating category. In total, over one million certificates were issued during this period, meaning that around a quarter of the Hungarian residential property stock received an energy certificate during this time.

HITELES ENERGETIKAI TANÚSÍTVÁNY						
A tanúsítvány az e-tanúsítás elektronikus alkalmazásában azonosítóval vagy QR kóddal ellenőrizhető és megtekinthető. www.e-epites.hu/e-tanustitas						
Energetikai besorolás:	CO ₂ kibocsátás:	Azonosító:	Érvényesség dátuma:			
A+++	A+++	HET-1002-1000	2029.02.05.			
KORSZERŰSÍTÉSI JAVASLATOK						
Homlokzati fal		Külső fal 244.51 m ²				
		SZERKEZET ENERGETIKAI MINŐSÉGE (U-érték*, W/m ² K)	MEGJEGYZÉS			
rossz 0,9 <	gyenge 0,45 < ... ≤ 0,9	közepes 0,24 < ... ≤ 0,45	jó 0,16 < ... ≤ 0,24	kiváló ≤ 0,16		
JELENLÉGI ÁLLAPOT		0,196				
JAVASOLT U-ÉRTÉK ÉS AZ UTÓLAGOS HŐSZIGETELÉS VASTAGSÁGA*		0,16 (4,6 cm)				
Fa vagy PVC keretstruktúrájú homlokzati üvegezett nyílászáró		Nyílászárók 12.51 m ²				
		SZERKEZET ENERGETIKAI MINŐSÉGE	MEGJEGYZÉS			
LÉGTMŰRSÉG		gyenge X	közepes jó magas			
JELENLÉGI ÁLLAPOT (U-érték*, W/m ² K)		rossz 3 <	gyenge 1,6 < ... ≤ 3	közepes 1,1 < ... ≤ 1,6	jó 0,8 < ... ≤ 1,1	kiváló ≤ 0,8
NYÍLÁSZÁRÓ CSERE JAVASLAT		1,18	1,1 0,8			

Energy performance certificates for residential buildings



In Hungary, the EPC system has proven to be a successful tool for promoting energy efficiency in buildings. However, its effectiveness could be further enhanced through regulatory improvements and stronger enforcement mechanisms. Stricter compliance checks, better oversight, and the introduction of meaningful sanctions for non-compliance would help ensure that the system not only provides valuable information but also drives real energy-saving actions. Strengthening these aspects would maximize the impact of EPCs in achieving national and EU energy efficiency goals.

3.3 Ireland

Country review

Ireland is especially relevant for our case, because the private sector plays a much more direct role in the renovation process. Upwards of 10 national OSS providers and 9 credit institutions are involved at various stages of the building renovation value chain.

The OSS scheme implemented in Ireland aims to significantly contribute to the government's broader priorities in decarbonising the building stock. To this end, the Irish Climate Action Plan 2021 sets a target for retrofitting the equivalent of 500 thousand homes, or about 25 % of Ireland's housing stock, to a BER14 rating of B2 or other cost-optimal rating for the worst performing buildings.

Description of good practices

Content:

In contrast to the Czech Republic and Hungary, in Ireland, the home renovation process is brought together under the Sustainable Energy Authority of Ireland (SEAI). The SEAI, a government agency is responsible for ensuring that supply-side actors in home renovations meet the necessary industry standards. To par-

ticipate in state-supported renovation schemes, the supply-side actors must be approved and listed in the national register, overseen by SEAI. The OSS providers registered with the agency manage the whole renovation process, from the initial assessment of the dwelling, through applying for support schemes, assigning contractors installing the energy upgrades, up until assessing the end-product.

SEAI administers two schemes on home renovations, namely [21]:

- Better Energy Homes and Solar PV, whereby grants are available for individual, targeted energy efficiency upgrades (e.g. attic insulation, heating controls upgrade or the installation of a heat pump system).
- National Home Energy Upgrade Scheme, or the “One-Stop Shopscheme” which is aimed at homeowners interested in more complex and deep retrofits.

The National Home Energy Upgrade Scheme is managed by a SEAI-certified OSS provider.

There are multiple conditions the dwelling must meet before the homeowner, private landlord or the Approved Housing Body (AHB) can apply to access grants from the OSS service [22]:

- The dwelling was built and occupied before 2011;
- Its BER¹⁴ rates as B3 or worse; the dwelling must achieve a minimum rating of B2, with a 100kWh/m²/year or better improvement;
- The dwelling had not previously received grants for the same energy upgrade measures.

The ability to access grants for deep retrofits is explicitly tied to filing an application with the registered OSS provider, a private business. The OSS handles the grant application and claim process, deducting the grant amount from the customer's final quotation. Services offered by registered OSS providers hence fall under the

ESCO-type model of OSS provision. The grants are managed, and their funds are distributed by the SEAI.

Scope

In Ireland, there is a clear distinction between OSSs servicing only a few regions versus those with nationwide activity. Altogether, there are 13 nationwide OSSs registered with the SEAI. These all participate in the National Home Energy Upgrade Scheme and can access grants and loans provided by the SEAI and credit institutions for the purpose of undertaking energy efficiency improving measures. Registered OSS providers can carry out the renovation works themselves or they can find SEAI-registered subcontractors who undertake renovations on their behalf. [23]

Implementation Process

This successful Irish example dates to early 2022, when the first OSSs were registered under the auspices of the SEAI. Creation of the One-Stop Shop scheme relates to two main factors.

First, the home renovation value chain was perceived as fragmented on the supply side, lacking effective coordination among service providers, as perceived by the beneficiaries. The scheme was devised to elevate this roadblock by offering an integrated service model under a single access point.

Second, the creation of the scheme was propelled by clear and ambitious policy targets of the central government in its National Retrofit Plan from February 2022. The Long-Term Renovation Strategy of Ireland (2020) highlights the need for progress toward the national decarbonisation targets, given that average household energy consumption in Ireland exceeds the EU average by 7 %, coupled with on average 58 % higher CO₂ emissions due to substantial reliance on fossil fuels (e.g.: oil, coal, and peat). [24] [25]

To alleviate persisting financial barriers to homeowner access to OSS services, the Irish government introduced the Home Energy Upgrade Loan Scheme in April 2024. The next subsection pro-

¹⁴BER refers to the Building Efficiency Rating, which is a standardised measure for evaluating energy efficiency of buildings on a like-for-like basis, meaning it evaluates a building's *theoretical* (rather than real-world) energy performance, given a set of assumptions about its occupants, such as consistent energy needs for indoor lighting and heating in buildings of similar size and material composition. More information is available at: <https://www.seai.ie/ber/understand-a-ber-rating>

vides an overview of the scheme. A more recent addition to the OSS scheme is the traditional homes pilot, launched in November 2024, which offers grants for deep retrofits of 100 traditionally constructed homes. It aims to assess the feasibility of scaling up targeted renovation support for this specific building segment, which accounts for roughly 12 % of the national building stock.

Utilised financial instruments and allocations of funds

In addition to grant-based financing, the Home Energy Upgrade Loan Scheme enables the homeowner access to low-interest loans which cover the remaining costs of the upgrades that the grant does not pay for.

The Home Energy Upgrade Loan Scheme is managed by the Strategic Banking Corporation of Ireland (SBCI). As of May 2025, several commercial banks and credit unions participate in this scheme:

- Allied Irish Bank (AIB)
- Avant Money (in cooperation with An Post Money)
- Bank of Ireland
- PTSB
- Clonmel Credit Union
- Connect Credit Union
- First South Credit Union
- Listowel Credit Union
- Naomh Breandan Credit Union
- Progressive Credit Union
- North Midlands Credit Union

These banks and credit unions offer unsecured loans for energy efficiency upgrades to homeowners at favourable below-market rates. The loan amounts per applicant range from a minimum of

EUR 5 000 to the maximum of EUR 75 000. Loan repayment periods range from 1 year up to 10 years. The condition being that the deep retrofit project is supported by SEAI grants and achieves at least a 20% improvement in the building's energy performance. [26]

- Since April 2024, the interest rates are subsidised by the Irish government and have backing by the EIB which participates in a risk-sharing mechanism.¹⁵ The loan scheme is presently scheduled to run until the December 2026. The total amount of funds available in the scheme amounts to EUR 500 million. [27] [28]

Key outcomes and results

- Over 600 private homes and close to 400 AHBs¹⁶ have been upgraded through OSS services through Q3 2024¹⁷.
- The median rolling 12-month cost for renovation works to homeowners stood at approx. EUR 40 thousand, whilst grants covered the remaining EUR 20 thousand (about a 1/3 of the total works cost). [17]

Challenges and Solutions

- The relatively recent adoption of the Home Energy Upgrade Loan Scheme (April 2024) means that by Q3 2024, the acquired access to lower-interest loans did not yet translate into a large uptake in deep retrofits for private homes
 - SEAI expects that as more financial institutions take part in the scheme, this will provide an impetus for a new renovation wave
 - 7 new credit unions have become a part of the scheme in April 2025, which the interim SEAI report on OSSs did not account for

- Previously, traditional homes (i.e. built with solid wall, stone, clay, lime-based materials) were excluded from access to finance under the scheme
 - Includes stone-built cottages or old buildings incompatible with modern energy standards
 - In November 2024, SEAI launched a pilot project to retrofit 100 traditionally constructed homes
 - Large potential
 - If the pilot project is deemed successful, it could bring a substantial section of the buildings segment to comply with targets in the national retrofit plan
 - About 270 thousand homes were built before 1945, most of which are traditionally constructed — today they represent about 12 % of the building segment [29]

Lessons learned for potential replicability

Key takeaways

- **Homeowners' access to finance is central to the large-scale implementation of this scheme**
 - As commented on in the interim SEAI report, a higher uptake for home renovations is linked to a broader participation from financial institutions.
 - A more competitive lending environment with a larger number of banks and credit unions may improve the amount of available finance and thus loan accessibility.
- **For the OSS providers cooperating with subcontractors, product neutrality must be at the core of their value proposition**

¹⁵ Meaning that were the homeowner to default on the loan provided as a part of the scheme, the EIB covers a portion of the lender's losses which reduces the credit risk for banks.

¹⁶ An AHB, or an approved housing body is an organisation operating in the sector of social rented housing and manages and coordinates co-owners of the housing units.

¹⁷ As per the National Retrofit Plan Quarterly Progress Report, released in December 2024.

- With a scheme this extensive and ambitious, it is crucial to ensure that the OSS selects from registered contractors and technologies transparently and without favouritism or bias toward certain suppliers or brands
- OSSs should be able to demonstrate that all recommended measures are based on objective performance criteria, cost-effectiveness, and suitability for the beneficiary's needs, rather than on commercial arrangements

Scalability and transferability

With regards to the transferability and implementation of this scheme, it is important for national policymakers to work on setting ambitious but deliverable targets. The LTRS of Ireland, as a key planning document, sets out a coherent plan for action for driving forward home retrofits. It specifically foresees a creation of a one-stop-shop scheme to this end.

Notwithstanding, government ambition alone is not sufficient for the success of similar schemes. An enabling environment in terms of financial institutions willing and able to provide accessible renovation finance is consequently essential for an effective implementation of such scheme. It is equally important to maintain a skilled workforce that adheres to industry standards and delivers high-quality renovation work.

3.4 Slovakia and its adoption of a OSS network

What are the takeaways for Slovakia in its design and structure of OSSs? What instruments could be enhanced or repurposed to provide streamlined support to building owners for deep renovations?

The “ŽIT ENERGIU” Project

In Slovakia, the Slovak Innovation and Energy Agency (SIEA), a professional organisation under the Ministry of Economy of the Slovak Republic operated a network of energy advisory services under the Project ŽIT ENERGIU („Live energy“). Launched in January 2009, the project was implemented in two phases before ultimately concluding in December 2023. Its implementation was closely associated with the programme *Zelená domácnostiam* (“Green for households”), aimed at the promotion and installation of renewable or clean energy technologies (e.g.: heat pumps, solar PV or biomass boilers).

Three modalities of service provision were included in the project:

- in-person assistance in physical offices (5 in total, found in major cities);
- a free-of-charge infoline;
- internet-based resources including podcasts, webpages, and infographics with detailed information on energy saving measures

This project was co-financed by the European Union through the European Regional Development Fund. After the conclusion of the second project phase¹⁸, the offices managed by SIEA for the purpose of the provision of energy advisory services were closed down. As of 2025, there is therefore no longer an active network of physical offices providing advisory services operating under the ŽIT ENERGIU project.

These offices operated in line with the facilitation model of OSS service provision, meaning that the service would be free at the point of use. Expert energy advisors of the SIEA would provide guidance to individuals, homeowners, municipalities and public authorities, as well as to businesses.

The consultations would cover technical advice on measures improving energy efficiency of buildings and the mutual compat-

ibility of said measures. This includes exploring options for building owners to integrate renewable energy technologies within existing building systems. The project sought to raise homeowners' awareness on possible ways of tracking and managing their energy consumption. Furthermore, advisors would provide information on available financial support schemes for building renovations.

The internet-based resources are still freely available for homeowners and other interested parties to consult.¹⁹

To transform the network of physical offices into EPBD-compliant OSSs, it would be necessary to scale up their internal capacities (e.g.: in terms of assigned staff and available administrative resources) and expand the network to achieve broader geographical coverage. In addition, ensuring stable and predictable financing would be essential to sustain a continuous provision of services.

The Obnov dom programme and its regional offices

Using means available at the present time, there is an option of repurposing a network of energy advisors providing tailored information to homeowners tied to the *Obnov dom programme*, managed by the Slovak Environment Agency (SEA), a professional organisation under the Ministry of the Environment of the Slovak Republic. The range of provided services includes guidance on the support programme, consultations on suitable measures to decrease fuel and energy costs, assistance with the submission of grant applications, and oversight during on-site renovation work as well as post-renovation quality assurance. Consultations on suitable measures are limited to those supported by the programme and do not substitute assistance by the certified energy specialist (engineers, chartered energy performance certificates specialists).

SEA's advisors for the programme generally work from one of the ten in-person regional offices, located in key regional hubs. SEA

¹⁸ The second project phase lasted from January 2016 to December 2023.

¹⁹ More information is accessible on the following websites: <https://www.setrimeprenas.sk> (summarises potential energy saving measures at the level of households); <https://www.siea.sk/bezplatne-poradenstvo/> (the podcast, video-based advice and a Q&A section on renovation measures are found here)

employs around 200 people for the Obnov dom programme in total. Some of the staff members review applications for the home renovation grants and provide basic advisory services to homeowners. Additionally, external collaborators of SEA working at the municipal offices provide local support with the Obnov dom MINI programme, partial renovation support scheme targeted at low-income households. Roughly 200 municipalities have become engaged in providing localised support for the programme, though the levels of engagement may still vary across different regions.

At last, the advisors assist homeowners with the grant application process and provide guidance on which measures are eligible for funding under the programme. However, they are not qualified to assess the technical feasibility or effectiveness of individual solutions. The meetings with this latter group of advisors usually take place at the municipal office and according to a schedule announced ahead of time on the official websites of the municipality and the SEA.

To transform the system of regional centres and expert advisors into an EPBD-compliant OSS network, the regional offices would have to scale up their internal capacities (e.g.: in terms of assigned staff and available administrative resources) and expand the network to achieve broader geographical coverage. By institutionalising and expanding the cooperation with municipalities, the Obnov dom programme/prospective OSS centres might better reach populations currently dependent on occasional visits by advisors, thereby bridging access gaps. On top of that, it is essential to recruit certified energy specialists, as the SEA currently only employs a limited number of such professionals. Most of them are devoted to methodological work at the central office, hence they do not directly interact with homeowners.

Closer engagement with municipal staff is more likely to yield positive results in terms of renovation uptake. Merely assigning staff for the programme in every municipality, including smaller or less populated ones, would not be financially sustainable without leveraging private finance, nor would it be operationally feasible given the limited administrative capacities on both the national and municipal levels.

Transitioning the regional offices to a facilitation-coordination OSS model could be achieved by adapting their existing structure and enhancing support to assist building owners in selecting and directly connecting with supply-side actors involved in the renovation process.

What are the challenges in implementing the OSS design?

- **According to B4F homeowner survey results from 2023 and 2025, in Slovakia, perceived financial barriers to renovations might mean that unless favourable loans or grants for renovation projects are available, most homeowners might forgo deep renovations completely**
 - The share of homeowners who financed their home renovations primarily from personal savings increased over the last 2 years from 53 % to 74 %
 - Conversely, loans from a bank or a building society slightly were the primary source of finance for only 18 % of respondents in 2025, as opposed to 31 % in 2023
- **The long-term success of a OSS network critically hinges on several broader structural factors, namely**
 - The presence of state and/or municipal financial support (to complement EU contributions) is vital where the OSS provides its services at no cost to the customer
 - If the government has introduced a long-term price cap on energy prices for households²⁰, the incentive to renovate the dwelling is weakened due to high upfront costs for renovation and longer payback periods from measures increasing energy efficiency
 - The OSS design which should consider the underlying domestic policy context and its potential impacts on financial viability of the OSS, especially if the OSS in question runs on public funding through grants

- **Running a unified support scheme for building renovations is beneficial (e.g.: the Czech NZÚ scheme)**
 - Simplifying and standardising support mechanisms facilitates the training of experts hired by OSS service providers, as a single scheme makes the benefits easier to access
 - In the case of individual homeowners, additional transparency from having a single support scheme may foster positive attitudes to home renovations, as the complexity of the process of applying for financial assistance is often cited as a barrier to renovation
- **Dependence on EU funds for driving forward building renovations is proving to be challenging**
 - Until a viable substitute for EU funding is found, Slovakia could explore the options to couple special-purpose EU sources of finance and their target uses with the opportunity to encourage building renovations supported by the upcoming OSS network
 - These sources of finance include, but are not limited to:

**EU SOCIAL CLIMATE
FUND (2026—32)**

ELENA GRANTS

**LIFE PDA
PROJECT GRANTS**

²⁰ This happens to be the case in Hungary, for instance.

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C.

**FINANCING FOR BUILDING
RENOVATION**

EXECUTIVE SUMMARY

Achieving the European Union's climate targets requires deep energy renovations of buildings across member states, particularly in Central and Eastern Europe where inefficient building stock remains widespread. This policy brief draws on the experience of the V4 countries—Czechia, Slovakia, Hungary, and Poland—to assess financial mechanisms that support building renovations and identifies transferable lessons for national governments. Key recommendations include expanding grant-based programs, creating hybrid financial instruments, reducing administrative burdens, and strengthening partnerships with local governments and private banks.

Each country presents unique financing models: Czechia's New Green Savings program emphasizes long-term calls and digitalized subsidy administration system; Slovakia's Renovate your house or Green for Households supporting complex renovations including renewables; Hungary's experience includes historic savings schemes and the Panel Program; Poland's Clean Air Program and TERMO fund offer comprehensive public support. This brief highlights effective strategies and offers a framework for replicating success.

Introduction and Policy Context

The European Union has placed the energy renovation of buildings at the core of its decarbonization strategy. Buildings account for nearly 40% of final energy consumption and 36% of CO₂ emissions in the EU. Key legislative initiatives such as the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED) provide the policy framework to drive change. Nevertheless, financial and administrative barriers, especially in Central and Eastern Europe, continue to hinder progress.

This policy brief provides a comparative analysis of renovation financing in the Visegrád Group countries: Czechia, Slovakia,

Hungary, and Poland. It outlines existing financial schemes, highlights key outcomes, and provides targeted policy recommendations for government officers tasked with meeting renovation and energy targets.

The renovation of building stock in the EU is a key element of the EU's efforts to meet its ambitious climate goals, as outlined in the European Green Deal and the Fit for 55 package. These initiatives strive for a 55% reduction in greenhouse gas emissions by 2030, with a long-term goal of achieving carbon neutrality by 2050. Energy efficient renovations are a significant means of contributing to these reductions, while also as mentioned above, improving energy security, reducing energy poverty, and promoting economic growth through job creation in the green sector.

The EU has developed a robust policy framework to improve energy efficiency in buildings, of which the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED) are key components. These directives guide member states on how to improve energy performance in buildings, which represents nearly 40% of energy consumption and 36% of energy-related CO₂ emissions across the EU.

- **Energy Performance of Buildings Directive (EPBD):** The EPBD is central to the EU's efforts to improve the energy performance of its building stock. The directive sets requirements for energy performance certificates (EPCs) for buildings, establishes minimum energy performance standards, and encourages member states to develop long-term renovation strategies. The most recent revision of the EPBD, in 2021, emphasizes the need for ambitious energy-efficient renovations, particularly in the context of the European Green Deal, with the ultimate goal of achieving a carbon-neutral building stock by 2050.

- **Energy Efficiency Directive (EED):** The EED is another pillar of the EU's energy policy, establishing binding energy efficiency targets for member states. It sets out a collective target to improve energy efficiency by 32,5% by 2030. The EED promotes energy efficiency across various sectors, including buildings, by mandating measures such as energy saving obligations, public sector energy efficiency, and the development of financing mechanisms for energy efficiency projects. Government-owned buildings have to undergo renovation in scope of at least 3% of the total floor area per year.

Both directives strongly advocate for financing mechanisms to support energy efficient renovations. This includes promoting energy performance contracting, access to EU funding programs, and national schemes to ensure that renovations are financially viable for homeowners, businesses, and local authorities.

In terms of specific initiatives, the Renovation Wave launched in 2020 aims to double the rate of building renovations in the EU by 2030. This initiative highlights the need for enhanced financial support, particularly for low-income households and vulnerable sectors, to make energy-efficient renovations affordable. Financial mechanisms such as low-interest loans, subsidies, and energy performance contracts are essential tools to help address the investment gap.

Regarding the V4 countries, while they have all committed to implementing the EPBD and EED, the progress and challenges vary across the region. The V4 countries share a similar post-communist history, which has influenced the state of their building stock and the challenges they face in terms of energy efficiency. The implementation of EU directives on energy efficiency often faces hurdles related to financing, bureaucratic inefficiencies, and limited access to green finance instruments.

1. CASE STUDY: CZECH REPUBLIC

The Green Savings Program is a major national long-lasting subsidy program oriented on renovation of residential buildings, both single family houses and multi-family buildings. Its long existence, continuous upgrades based on practical experience and volume of projects administered make the program one of the most successful in the region.

1.1 Program Overview

The New Green Savings Program (Nová zelená úsporám, NZÚ) is a flagship Czech government initiative providing direct subsidies to homeowners for energy-saving renovations. Since its inception in 2009, the program has evolved through multiple phases, expanding in scope, digital accessibility, and targeting capacity. Administered by the State Environmental Fund, NZÚ is funded primarily through EU structural funds and revenues from emission allowances.

As part of the Czech Republic's efforts to modernize its building stock, this program has helped accelerate the adoption of energy efficient renovation technologies, thus contributing to the country's energy and climate goals. Besides this, the program helped to increase public awareness about the energy efficiency. By offering financial support, the program also serves as an example of how EU member states can make energy renovations more accessible and affordable to the population. The program was originally named as The Green Savings Program.

1.2 Program timeline and upgrades

Start in April 2009: The Program Green Savings (ZÚ) using financing from sold AAU units has started in April 2009. Partial or complex renovations of both single-family houses and multi-family buildings, change of inefficient high-emission heat sources and new beyond-standard “almost passive” houses. Original criteria were very strict, calculation of subsidy amount was based on square meters of heated floor area with some other specifics. It was complicated and easy to artificially increase. Education of energy experts was needed, calculation methodology offered several possibilities to manipulate the calculation. Official list of approved contractors and approved materials has been introduced. Overall system was complicated and manipulable.

October 2010: Acceptance of subsidy applications suspended due to lack of allocated money.

May 2011: Increased allocated funds, but still more than 100 M EUR missing for applications.

December 2013: Acceptance of subsidy applications suspended due to lack of allocated money.

August — December 2013: In parallel **New Green Savings 2013 (NZÚ 2013)** runs in this period, using own financial sources of State Environmental Fund to subsidize single family houses renovations.

April 2014: The **New Green Savings 2014+ (NZÚ 2014+)** started. Newly there was a partial digitalized administration introduced. Applications went through an electronic admin

system, but design documentation, filled forms and energy calculations had to be delivered still in paper.

October 2015: A continuous call for applications introduced instead of short-term calls. Home installations of PV introduced too.

October 2018: New simplifications and clearer rules for applicants. DIY works involved, costs of material is eligible cost when applying for a subsidy. Technical supervision of professional authorised person requested.

October 2021: Official end of the New Green Savings 2014+, but next day started the **New Green Savings 2021+ (NZÚ 2021+)**. The program changed to fully digitalized administration using e.g. e-banking identification security. The program included immediate energy solutions in the energy crisis and other non-energy related measures support, e.g. green roofs, rainwater and greywater use, or e-vehicle charging station.

January 2023: As an option, the **New Green Savings Light** program has been launched. It includes social aspects and offers advanced payment of the subsidy to seniors and those at risk of energy poverty.

June 2023: Short, in advance announced stop for a summer due to lack of allocated money and need for legislative changes to use other sources of financing.

September 2023: The **New Green Savings 2023+ (NZÚ 2023+)** has been launched, with slightly updated target groups and restructured rules. Sub-program “**Repair grandma's house**” introduced. It offers subsidy for complex renovation

Supported Measures in Single Family Houses (status in 2025)

of single-family houses with possibilities to ask additional bonuses for children and receive the subsidy in advance. Further, a connection with banks and building societies, which can also be a place of advice and can provide preferential loans.

Since this moment, there were 3 main lines of Green Savings program:

- common line of **New Green Savings 2023+** for renovations, new passive buildings, exchange of heat source, renewable sources installations, heat recovery, green roofs, grey- and rainwater use, e-vehicle charging etc.,
- **New Green Savings Light** as a simplified version for low-income households doing mostly partial measures with a possibility to get subsidy in advance, and
- complex program **“Repair grandma's house”** with a possibility to get subsidy in advance as well.

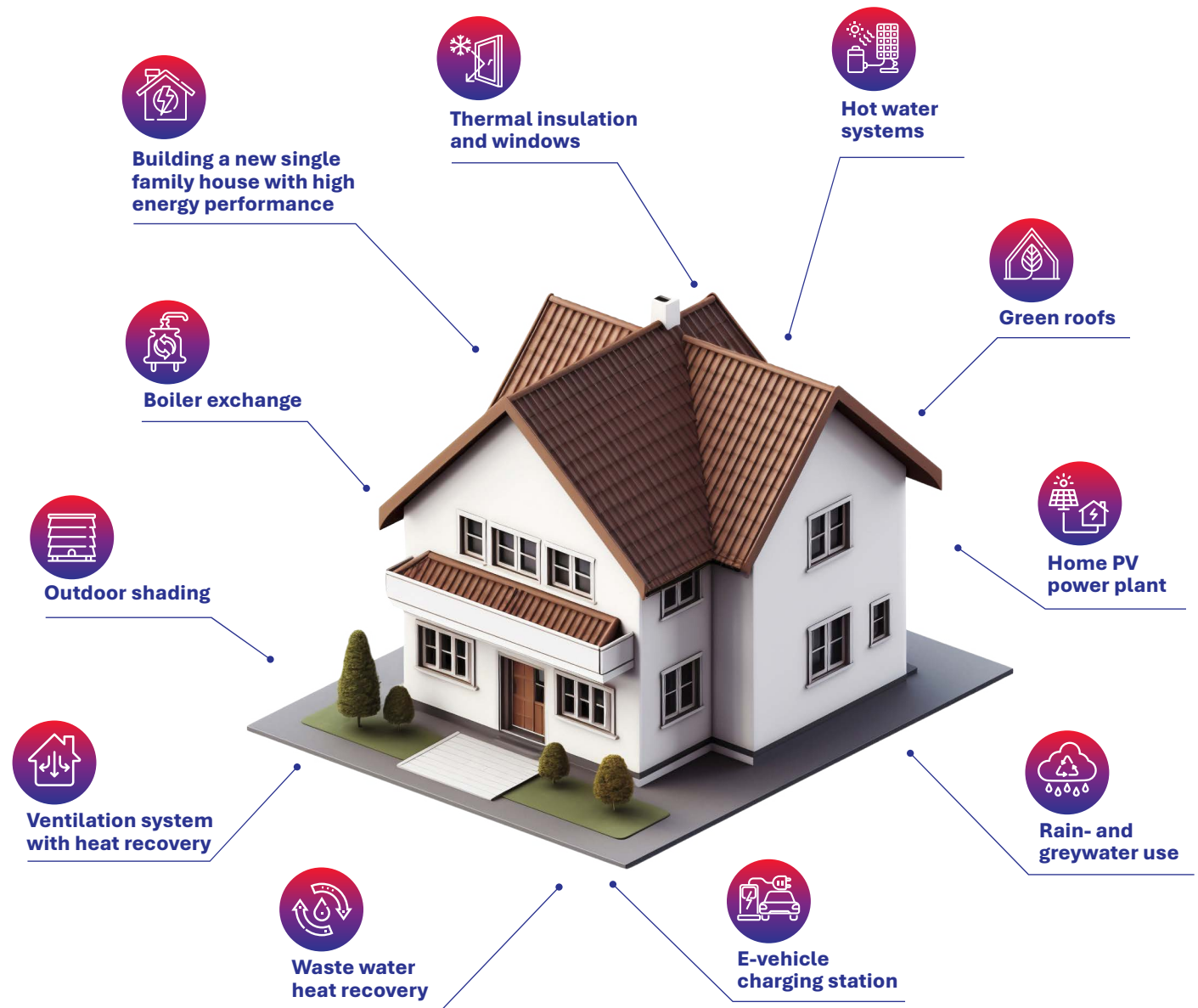
December 2024: Acceptance of subsidy applications for single-family houses only suspended due to lack of allocated money, but soon continuation announced at the same time. Shortage of finance came after extreme demand for subsidies for photovoltaics.

February 2025: New restart called the **New Green Savings 2025** (for single-family houses) with simplified structure in two lines:

- the **New Green Savings Light** for partial renovations and
- the **“Repair grandma's house”** for complex renovations and new buildings.

Both programs now contain:

- a possibility to get subsidy in advance,
- a connection with banks and building saving banks, which can also be a place of advice and can provide preferential loans.



Supported Measures in Apartment Buildings (status in 2025)



1.3 Benefits of the Green Savings and New Green Savings programs (2009—2024)

The Green Savings programs and its continuation, New Green Savings, have brought significant benefits to the environment and the economy of the Czech Republic.

The program is one of the most successful subsidy programs in the EU in the field of energy savings with a significant synergistic effect:

- environmental (climate and environmental protection)
- economic and social (savings in energy consumption, multiplier effect of investments, assistance to households at risk of energy poverty)

1.4 Environmental benefits

- **Reduction of greenhouse gas emissions, especially CO₂**
 - CO₂ emission savings reached more than 4 million tCO₂ during the duration of the program.
 - The program significantly contributed to reducing the carbon footprint of the Czech Republic.
- **Energy savings**
 - Thanks to the supported energy-saving measures, savings reached 42,000 TJ during the duration of the program.
 - Reduced energy consumption of buildings means lower fossil fuel consumption, which leads to reduced air pollution. The savings are equivalent to 27 thousand wagons of coal.

- **Support for renewable energy sources**

- The installation of photovoltaic systems, solar collectors and heat pumps contributed to reducing dependence on non-renewable energy sources.

- **Adaptation measures**

- The combination of energy savings with adaptation measures (rainwater management, green roofs, etc.) helped to better prepare buildings for climate change.

1.5 Economic and social benefits:

- **Employment support**

- The program supported the creation of jobs in various sectors, especially construction, energy (e.g. manufacturers of windows, insulation materials, solar technologies).

- **Reduction of energy costs**

- It helped households and public sector entities reduce heating and energy costs. Thermal insulation and modernization of houses brought long-term savings of billions of crowns.

- **Assistance in times of energy crisis**

- The program became a tool for immediate assistance in the energy crisis for households and local governments, including those most at risk of energy poverty (targeting low- and middle-income households).

- **Investments in infrastructure**

- The programs brought tens of billions of crowns in investments in buildings, energy systems and renewable energy sources, from which the local economy benefited.

- **Improving energy self-sufficiency**

- Reduced consumption of fossil fuels and greater use of renewable sources have the potential to reduce the Czech Republic's dependence on energy imports.

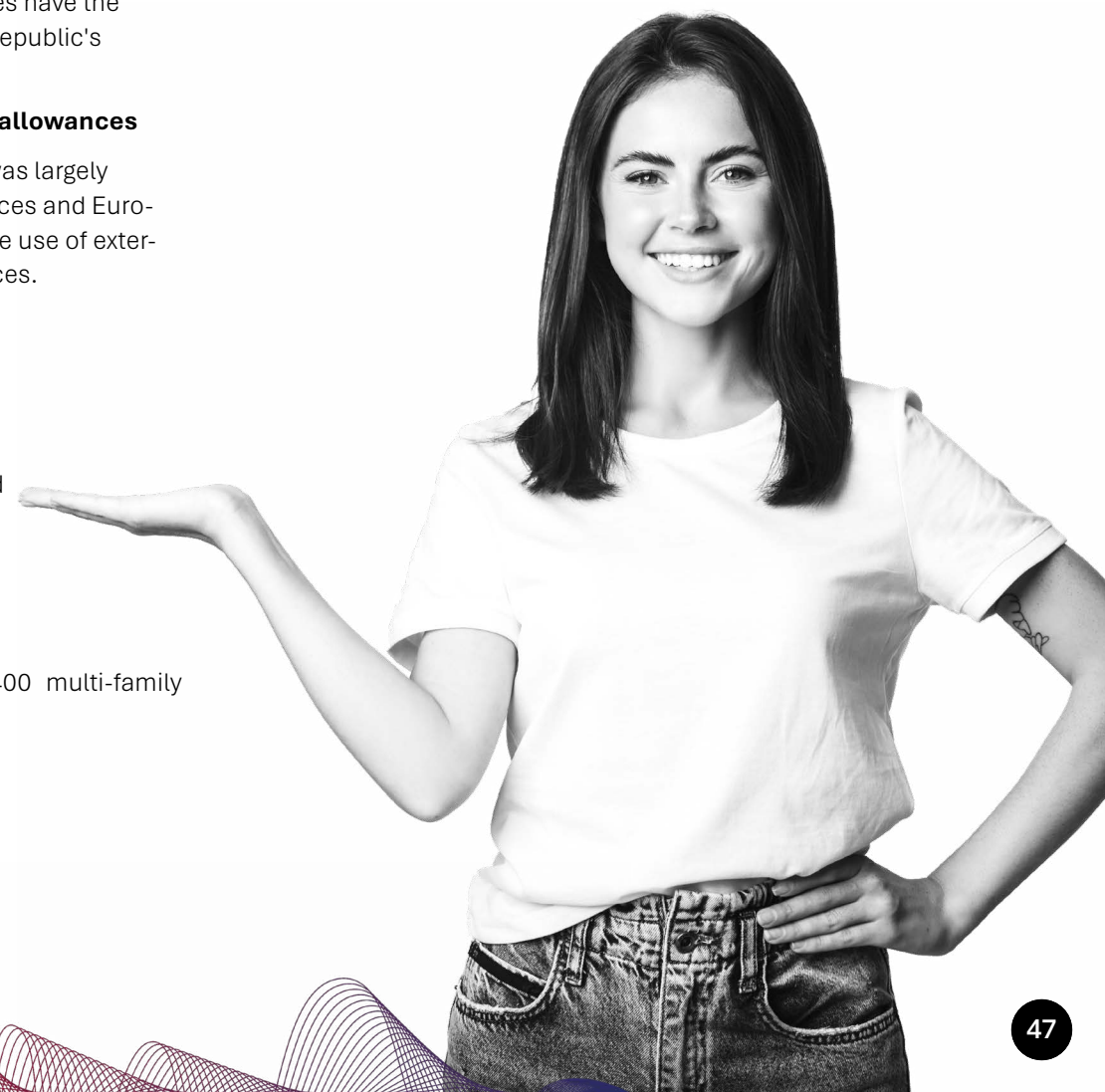
- **Use of European funds and emission allowances**

- The financing of the programs was largely secured from emission allowances and European funds, which is an effective use of external (European) financial resources.

1.6 Achievements

Key results of the program (2009—2024):

- CZK 106 billion (EUR 4.2 billion) invested
- Over 322,000 households renovated
- 4 million tonnes of CO₂ avoided
- 42,000 TJ of energy saved
- 153,000 single-family houses and 9,400 multi-family buildings modernized



1.7 Subsidies and Projects by Program Phase

Summary of approved applications and disbursed funding:

Program Phase	Approved Applications	Approved Subsidy (EUR)	Paid Subsidy (EUR)
Green Savings	74,053	814,204,111	814,204,111
New Green Savings 2013	3,751	22,349,282	22,349,282
New Green Savings 2014+	70,529	593,286,322	593,092,187
New Green Savings 2021+	154,442	1,323,954,037	1,188,157,346
New Green Savings 2023+	94,031	1,103,080,949	722,535,455
New Green Savings Light	87,356	414,154,794	398,226,382

1.8 Main Lessons Learned and Potential for Replication

Following lesson learned can be understood as inspiration for other countries when working on new or updating existing incentive programs.

- Searching for a good compromise between simplicity and accuracy, or simplicity and reliability (controllability) takes time and needs a discussion of the fund representatives with experts and listen to feedback from applicants.
- In 2015, a continuous call instead of short-term ones. It helped applicants to prepare better (better quality of design), for lower costs when prepared without short deadline pressure. Lower pressure for administrative officers.
- To involve more applicants, clear message and rules and simplicity of application are more important than height of the subsidy. At present, the subsidy is usually significantly lower than 50% of total initial investment of the renovation.
- Financial resources are not infinite. It is necessary to inform the public in a timely manner about the approaching end of the application period and at the same time inform about further developments and continuation. It is necessary to prevent panic when submitting applications.



2. CASE STUDY: SLOVAKIA

Slovakia is actively addressing the dual challenge of energy poverty and an aging, inefficient housing stock. The country's evolving portfolio of renovation financing mechanisms—largely underpinned by EU resources—offers valuable insight into effective programme design, particularly in aligning social, energy, and climate goals. This case study outlines key national schemes and derives actionable lessons for public authorities pursuing similar objectives.

2.1 Renovate Your House (Obnov dom): Large-Scale Grant Programme for Family Houses

The *Obnov dom programme* is Slovakia's flagship initiative for the renovation of single-family homes, launched under the **National Recovery and Resilience Plan (RRP)** in 2022. The programme aims to improve energy performance in over **25,000 family houses** by **June 2026**, with total investments exceeding **€500 million**.

Key Features:

- **Eligibility:** Private owners of single-family homes.
- **Grant Amounts:**
 - Up to **€15,000** for renovations achieving **30—60%** primary energy savings.
 - Up to **€19,000** for deeper renovations exceeding **60%** energy savings.

- **Supported Measures:** Thermal insulation, new windows and doors, HVAC modernization, rooftop photovoltaic systems, solar collectors, rainwater systems, and green roofs.
- **Bonuses:** Additional incentives for integrating multiple measures or targeting vulnerable areas.

The scheme applies a **tiered financing model** that encourages deeper renovations by offering higher subsidies for greater energy savings. It also allows applicants to combine renovation grants with renewable energy investments, promoting an integrated approach.

Implementation and Uptake:

- Administered by the **Slovak Environment Agency (SAŽP)**, the programme has employed **decentralized implementation via regional offices**, providing localized technical and administrative support.
- Demand has **exceeded initial projections**, with application windows reaching capacity within days.
- To date, thousands of projects have been approved, and monitoring mechanisms are in place to verify achieved energy savings.

This programme addresses a critical policy gap: historically, Slovakia offered limited support to single-family homes, which comprise nearly **50%** of the residential stock. *Obnov dom* demonstrates how structured national financing can unlock this segment's renovation potential.

2.2 Obnov dom MINI: Renovations for Low-Income Households

Launched in **2024** under the REPowerEU initiative, the **Obnov dom MINI** programme provides **targeted support for energy-poor households**, recognizing that traditional schemes often exclude vulnerable populations due to co-financing barriers or bureaucratic complexity.

Highlights:

- **Budget:** €40 million for the first implementation phase.
- **Target:** Renovation of at least 4,080 homes by September 2025.
- **Financing Terms:** Up to 95% grant coverage for basic energy-saving measures (e.g., insulation, heating upgrades, window replacement).
- **Advance Payment:** 50% pre-financing provided upfront to eliminate liquidity barriers.
- **Simplified Procedure:** Minimal documentation requirements, assisted application processes via regional coordinators.

This programme reflects a growing EU-wide emphasis on **just transition policies**, ensuring that climate mitigation efforts do not exacerbate social inequality. It also sets a precedent for integrating energy efficiency goals with **anti-poverty strategies**.

2.3 Green for Households (Zelená domácnostiam): Renewable Energy Incentives

The long-standing **Zelená domácnostiam** programme complements renovation efforts by incentivizing the **adoption of renewable** technologies in households. Funded through the EU's **Operational Programme Quality of Environment (OP QE)** and national sources, it has operated since 2015 and is now extended through **2029**.

Programme Scope:

- **Supported Technologies:** Solar thermal systems, biomass boilers, rooftop photovoltaic panels, and heat pumps.
- **Form of Support:** Non-refundable vouchers covering up to 50% of eligible costs.
- **Bonus Criteria:** Additional support (e.g., 15% uplift) for installations in areas with high air pollution.
- **Delivery Mechanism:** Vouchers issued to certified installers, simplifying the process for homeowners.

By **2024**, the programme had financed nearly **60,000 installations**, contributing to national targets for **renewable energy deployment** in the residential sector.

2.4 Green Solidarity (Zelená solidarita): Socially Inclusive Clean Energy

Zelená solidarita, introduced in **October 2024**, builds on the Green for Households programme but targets **low-income and socially excluded populations**. It provides grants of up to **90%** of the cost of renewable installations, ensuring that energy transition benefits are **equitably distributed**.

Funded by **national recovery instruments** and implemented via the same administrative structure as its parent programme, this initiative enhances **inclusion and outreach**, especially in marginalized rural areas.

2.5 State Housing Development Fund (ŠFRB): Revolving Loans for Apartment Buildings

Operating since 1996, the **State Housing Development Fund (ŠFRB)** is a critical financing tool for multi-family apartment buildings. It provides **low-interest loans** for comprehensive renovations, with tenors of up to **20 years**.

Eligible Measures:

- Thermal insulation,
- Replacement of heating systems,
- Modernization of elevators,
- Installation of LED lighting or heat metering systems.

Since its inception, the fund has financed improvements in over **400,000 housing units**. In **2023**, a new feature was introduced allowing for partial grant conversion of loans—linking financial benefit directly to **post-renovation energy performance**.

ŠFRB is widely regarded as a **financially sustainable model** due to its **revolving character**, and as such, it provides a useful blueprint for other EU countries considering long-term financing facilities.

2.6 Policy Insights and Recommendations

From the Slovak experience, several key policy lessons emerge:

- **Graduated Incentives Promote Ambition:** Linking subsidy levels to energy savings encourages deeper renovation without excluding smaller-scale projects.
- **Dedicated Instruments for Vulnerable Groups:** Tailored programmes such as Obnov dom MINI and Zelená solidarita prove essential for addressing energy poverty and ensuring fair access.
- **Administrative Decentralization Works:** Regional offices and support centers improve applicant trust and programme visibility.
- **Hybrid Financing Models Increase Flexibility:** Combining grants and loans ensures broader coverage and financial resilience.
- **Stable Long-Term Frameworks Encourage Market Development:** Slovakia's multi-year strategies (e.g., ŠFRB and Zelená domácnostiam) have helped develop a skilled installer base and increase uptake of new technologies.

3. CASE STUDY: HUNGARY

For many years now, there are few financial support programs available in Hungary. Residential building modernization programs serve mainly housing and social policy objectives (e.g. village CSOK, formerly Home Renovation Program — these have no energy requirement).

3.1 The Housing Savings Scheme (LTP)

The Housing Savings Scheme (Lakástakarékpénztár or LTP) was introduced in Hungary in 1997 to encourage long-term savings for housing-related investments, including renovations and energy-efficiency improvements. The scheme provided a 30% annual state subsidy (up to HUF 72,000) on savings with a contract period between 4 and 10 years. Funds could be used for home purchase, renovation, modernization, or energy upgrades. It was especially popular among families who could combine multiple contracts. Condominiums and housing cooperatives were also eligible to use LTP funds for common property renovations, such as facade restoration, roof replacement, or heating system upgrades. The subsidy was abolished in 2018, leading to a sharp decline in participation. Though some providers like Fundamenta continued to offer alternatives, the lack of state support made them less attractive.

3.2 The Panel Program

Launched in the early 2000s, the Panel Program focused on the energy modernization of prefabricated buildings, primarily in urban areas. The cost-sharing model (one-third from residents, one-third from municipalities, and one-third from the state)

helped renovate nearly 190,000 housing units by 2008. The program expanded in 2009 (Panel II), using carbon credit revenues to allow higher subsidies for projects meeting stricter energy performance standards. Typical measures included insulation, window replacement, and HVAC upgrades. The program ended in 2017, leaving a gap in support for multi-family housing renovations.

3.3 Home Renovation Program (2024—2025)

This EU-funded program targets approximately 20,000 single-family homes. It combines non-refundable grants with interest-free loans. A 30% reduction in primary energy use is mandatory, verified through energy performance certificates. Initially limited to homes built before 1990, it was later extended to those built before 2006. Eligible upgrades include insulation, window/door replacement, and HVAC modernization. From 2025, only air-to-water heat pumps are eligible for heating system upgrades.

3.4 The Energy Efficiency Obligation Scheme (EEOS)

In place since 2021, the EEOS obliges energy providers to achieve annual savings among final consumers. Initially effective in industrial and transport sectors, the scheme was extended to households in 2024 following the publication of a standard measures catalogue. This temporarily enabled free attic insulations in rural areas. The conditions were later recalibrated, and in 2025, obligations were raised again to support partial residential retrofits. Whether the EEOS will be suitable for deep renovations will become clear in the coming year, when the standard catalogue and the rules for accounting for energy savings will be further refined. The EEOS is Hungary's most successful market-based energy savings mechanism to date and will be operational until at least 2035.

3.5 Summary Table: Hungary's Renovation Financing Tools

Program	Period	Target Group	Key Features
Housing Savings Scheme (LTP)	1997—2018	Individuals & families	30% state subsidy on savings; ended in 2018
Panel Program	2000s—2017	Multi-family prefabs	1/3 state-municipality-resident model; focused on insulation, window replacement and HVAC
Home Renovation Program	2024—2025	Single-family homes	Grants + loans; 30% energy savings requirement
Energy Efficiency Obligation Scheme (EEOS)	2021—2035	All energy end-use sectors	Market-based; so far supports partial retrofits

4. CASE STUDY: HUNGARY

Energy renovation of Poland's existing building stock will require a huge amount of financial resources. Therefore, it is crucial for the decarbonization of the construction industry in Poland to ensure the access to financial support.

4.1 Clean Air Program (Czyste Powietrze)

The Clean Air Program is Poland's flagship initiative to support energy renovation of single-family houses and replace outdated heat sources with modern, cleaner systems. The program offers non-repayable support of up to PLN 136, 200 (around EUR 31,600) for comprehensive energy renovations. Eligible interventions include insulation, window and door replacement, and installation of efficient heating systems (e.g., heat pumps, biomass or gas boilers).

Environmental benefits of the program include CO₂ reduction, lower particulate and gas emissions, and improved air quality. The program helps reduce the use of fossil fuels, increase use of renewables (e.g. photovoltaics), and improve public health by reducing respiratory disease risks.

The main environmental effects of the program include:

- Reduction of CO₂ and other pollutants.

Replacing old furnaces and boilers with modern heat sources (e.g., heat pumps, gas boilers, biomass boilers) reduces emissions of carbon dioxide (CO₂), sulfur oxides (SO_x), nitrogen oxides (NO_x) and particulate matter (PM10, PM2.5). This improves air quality, especially during the heating season, which reduces smog.

- Improvement of energy efficiency of buildings

Energy renovation of buildings (insulating walls, replacing windows and doors, upgrading heating systems) leads to lower energy consumption, which means less combustion of fossil fuels. Lower energy consumption translates into lower greenhouse gas emissions.

- Reduction of fossil fuels consumption

Implementation of renewable energy sources (e.g., heat pumps, photovoltaics) reduces the need for coal, gas and fuel oil. This reduces the exploitation of natural resources and reduces the carbon footprint.

- Improving the quality of life and health of people

Less pollution of the air translates into a reduction in respiratory and cardiovascular diseases and allergies. Better air quality reduces pollution-related premature deaths.

- Protection of ecosystems

Reducing sulfur and nitrogen emissions prevents acidification of soils and water reservoirs. Less particulate matter translates into less soil and vegetation pollution.

The program is currently on hold for upgrades.

4.2 Energy Renovation Tax Credit

Poland also offers an energy renovation tax deduction that can be applied to income or revenue tax. A taxpayer may deduct up to PLN 53,000 (EUR 12,300) in eligible renovation expenses. Deductions not fully applied in one year can be carried over for up to six years. This measure supports gradual renovations over time and benefits those with moderate incomes who pay taxes.

4.3 TERMO Modernization Program

The TERMO Program, introduced through the 2008 Act on Thermal Modernization and Renovation, provides bonuses and grants for renovation and thermal modernization. Types of support include:

- A 26% bonus on thermal modernization project costs.
- A 31% bonus if combined with a RES installation (at least 10% of project cost).
- A 50% bonus for structural reinforcement of large-panel system buildings.

4.4 RES Grant

The RES (Renewable Energy Source) grant covers 50% of the net cost of installing or upgrading renewable energy systems. Eligible applicants include housing communities, cooperatives, local governments, and individuals. Installations must be new or, if upgraded, achieve a 25% capacity increase.

By March 2024, TERMO had supported 52,400 projects, disbursing PLN 3.2 billion (EUR 750 million) in subsidies and PLN 14.7 billion (EUR 3.5 billion) in loans. Total project value was PLN 18.6 billion (EUR 4.5 billion).

4.5 Summary Table: Poland's Renovation Financing Tools

Program	Support Type	Eligible Entities	Key Conditions / Benefits
Clean Air Program	Non-repayable grant (up to PLN 136,200)	Owners of single-family houses	Comprehensive renovation incl. insulation, RES, heating
Energy Renovation Tax Credit	Tax deduction (up to PLN 53,000)	Individual taxpayers	Deductible over 6 years; only for renovation costs
TERMO Bonus	Subsidy (26—31%)	Various legal entities	Bonus for modernization or RES + structural upgrades
RES Grant	50% grant on RES systems	Housing associations, LGUs, individuals	Must be new or achieve $\geq 25\%$ capacity increase



5. POLICY RECOMMENDATIONS

Policy recommendations to enhance stable financing for energy-efficient renovations of buildings.

5.1 Strengthen Institutional Frameworks and Strategic Coordination

- **Establish a Central Renovation Finance Coordination Body:** Create or designate a national-level authority responsible for aligning renovation finance policies, overseeing implementation, and ensuring consistency across programs and funding sources. This body should act as a central contact point for municipalities and private actors.
- **Enhance Inter-Ministerial Cooperation:** Foster tighter collaboration between ministries of finance, environment, regional development, and energy to align fiscal, climate, and housing strategies. Shared targets and cross-sector planning will streamline funding mechanisms and avoid fragmentation.
- **Develop Long-Term Renovation Strategies with Integrated Financing Plans:** Ensure that national long-term renovation strategies (LTRS) explicitly include financing roadmaps. These should integrate public, private, and EU-level funding streams, clearly define targets, and provide cost estimates and investment needs.
- **Ensure Long-Term Programs Stability:** Avoid abrupt policy changes, such as sudden subsidy withdrawals, which can erode public trust and undermine uptake. Maintain clear program timelines and announce transitions in advance, using multi-year funding commitments to encourage market stability.

5.2 Improve Access to and Design of Public Financial Instruments

- **Simplify Access to Subsidies and Grants:** Streamline application procedures for public funding, particularly for municipalities and low-capacity regions. Introduce digital one-stop-shops for administrative support and transparent guidance on eligibility.
- **Simplify Administrative Processes:** Streamline application systems and move to fully digital platforms. Reduce documentation requirements and allow third-party assistance (e.g., authorized energy advisors) to guide applicants through procedures. Continuous calls are preferable to short-term windows.
- **Strengthen Pre-Financing and Bridge Financing Options:** Many beneficiaries, especially municipalities and households, face liquidity challenges. Develop mechanisms such as revolving funds, guarantees, or bridge loans that enable upfront investments and support absorption of EU funds.
- **Implement Performance-Based Incentives:** Link subsidies or financing conditions to energy savings achieved. Introduce bonus mechanisms for deep renovations that exceed minimum standards or integrate renewable energy sources.
- **Increase Co-Financing Flexibility:** Adjust co-financing rules to reflect local capacities and socio-economic contexts. For vulnerable groups or poorer municipalities, allow lower co-financing shares and offer technical assistance as part of the funding package.

5.3 Foster Development of Private Financing Markets

- **Support Green Mortgage and Loan Market Development:** Incentivize banks to offer favorable terms for energy-efficient renovation loans. Collaborate with financial regulators to integrate energy performance into credit risk assessments and asset valuations.
- **Establish Guarantee Schemes for Private Loans:** Mitigate risk for lenders by introducing state-backed guarantees for green home loans or third-party financed renovation models, especially in the residential sector.
- **Promote Energy Performance Contracting (EPC):** Facilitate wider uptake of EPCs by standardizing contracts, developing model templates, and providing project development assistance to municipalities and SMEs. Consider legislative changes to ease accounting and procurement constraints.
- **Develop Aggregation Mechanisms and Standardization:** Bundle small renovation projects into larger investment portfolios to attract institutional investors. Develop standardized documentation and certification schemes to enable securitization of green assets.

5.4 Support Local Capacity Building and Technical Assistance

- **Create Regional Renovation Support Hubs:** Establish regional or local technical assistance centers to support municipalities and homeowners with project preparation, financing applications, and contractor engagement.
- **Fund Project Development Assistance (PDA):** Use national and EU funding to expand PDA mechanisms, especially for small municipalities and homeowners' associations. Integrate PDA with financial support instruments to improve absorption.
- **Invest in Skills and Workforce Development:** Implement national training programs to increase the availability of qualified professionals in energy auditing, building renovation, and green finance. Link these initiatives with job creation and social inclusion goals.

5.5 Ensure Social Inclusivity and Fairness in Renovation Financing

- **Introduce Targeted Support for Energy-Poor Households:** Design specific financial schemes for vulnerable households, such as grants with no co-financing, social leasing models, or municipal-run renovation support programs.
- **Include Social Criteria in Funding Allocation:** Prioritize funding allocation based on energy poverty indicators, regional development disparities, and housing quality. Integrate social goals into renovation targets and reporting frameworks.
- **Protect Tenants and Promote Collective Renovation Models:** Establish legal safeguards against rent hikes

after renovations and promote inclusive models for multi-family buildings, where landlords and tenants share benefits fairly.

5.6 Optimize Use of EU and National Funds

- **Align EU Funds with National Priorities:** Ensure that Cohesion Policy, Recovery and Resilience Facility (RRF), and other EU funds are strategically used to leverage long-term investments, with a clear national co-financing strategy and absorption plan.
- **Encourage Blended Finance Approaches:** Combine public grants with private capital to enhance investment leverage. Use EU funds to de-risk private investment via guarantees, junior tranches, or interest rate subsidies.
- **Improve Monitoring and Evaluation Frameworks:** Track financial flows, renovation outcomes, and energy savings to evaluate the effectiveness of public support schemes. Use data to adjust programs dynamically and report progress transparently.



6. REFERENCES

Project partners' reports

Czechia:

- <https://novazelenausporam.cz>
- <https://www.sfzp.cz/dotace-a-pujcky/nova-zelena-usporam>
- <https://sanceprobudovy.cz/index.php/archiv-clanku/120-nova-zelena-usporam-je-po-duk-ladne-revizi-zpet-jednodussi-vyhodnejsi-a-dostupnejsi-nez-kdy-driv>

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New Green Savings Light:

- https://novazelenausporam.cz/files/documents/storage/2025/02/19/1739966588_NZ%C3%9A-RD_Light_2025_ver_2025-02-12.pdf

New Green Savings (for multi-family buildings):

- https://novazelenausporam.cz/files/documents/storage/2024/08/26/1724662240_2024-09-01_ModF-HOUSEnerg-NZ%C3%9A-BD_Standard-n%C3%AD-v%C3%BDzva_2.verze.pdf

Slovakia:

- www.obnovdom.sk
- <https://zelenadomacnostiam.sk>
- <https://www.sfrb.sk/o-fonde/vyroczne-spravy>

Hungary:

- <https://net.jogtar.hu/jogszabaly?docid=99600113.tv>
- www.mnb.hu/letoltes/ltp-gyik-111214.pdf
- <https://2010-2014.kormany.hu/hu/nemzeti-fejleszt-esi-miniszterium/hirek/megujulo-lakasok-kiteljese-do-panelprogram>
- https://www.palyazat.gov.hu/programok/szechenyi-terv-plusz/kehop-plusz/kehop_plusz-4.1.7-24/alapadatok
- https://www.palyazat.gov.hu/programok/szechenyi-terv-plusz/kehop-plusz/kehop_plusz-4.1.8-24/alapadatok
- <https://enhat.mekh.hu/ekr>

D.

**THE DECARBONISATION
OF HEATING SYSTEMS**

1. PURPOSE AND BACKGROUND

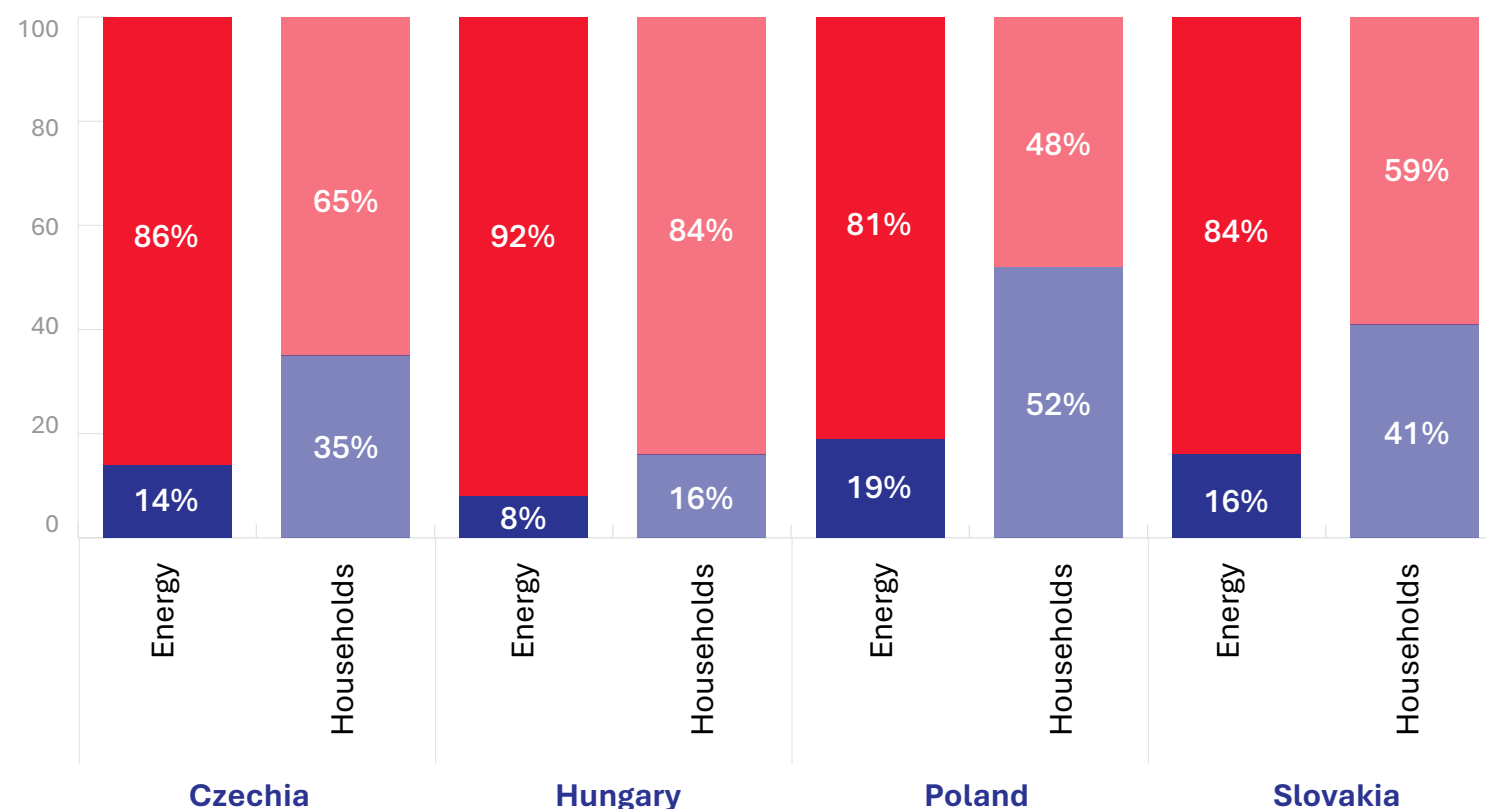
Heating decarbonisation is a cornerstone of Europe's broader energy transition, essential for achieving the ambitious climate neutrality targets set by the European Union under the European Green Deal.

The heating and cooling sector accounts for around half of the EU's total gross final energy consumption and about 27% of Europe's overall carbon emissions²¹, with two-thirds of this energy still coming from fossil fuels²². Transforming this sector is therefore crucial for combating climate change and reducing dependence on non-renewable sources.

The urgency of this transition is enhanced by current geopolitical and economic pressures, including fluctuating energy prices and the need to enhance energy security, considering the Central and Eastern European (CEE) region's reliance on imported fossil fuels. Transitioning to low-carbon heating solutions offers a dual advantage: reducing carbon emissions while simultaneously decreasing vulnerability to external energy market shocks. Moreover, it aligns with the EU's broader goals of fostering innovation, creating green jobs, and improving the quality of life through cleaner, more sustainable energy systems.

In the V4 countries, however, the heating sector presents unique challenges and opportunities. The share of household energy used for heating is higher in the V4 countries than the EU27 average (63,5%), particularly in Hungary (71.9%), Slovakia (70.1%), and Czechia (69.2%), while Poland is slightly below the EU average at 62.8%.²³ Fossil fuels, especially nat-

Share of district heating in final energy consumption and number of households in the v4, 2021



Source: REKK (2023), Decarbonisation of the household heating sector in the Visegrad countries

²¹ <https://www.ehpa.org/news-and-resources/campaigns/decarb-heat/>

²² https://eur-lex.europa.eu/legal-content/HU/TXT/HTML/?uri=OJ:L_202401275

²³ https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_consumption_in_households#Source_data_for_tables_and_graphs

ural gas and coal, dominate the energy mix for residential and district heating.

The share of district heating (DH) in final energy consumption and the number of households connected varies in the V4 countries: in Czechia, 14% of energy consumption and 35% of households are linked to DH; in Slovakia, the figures are 16% and 41%; and in Poland, 19% and 52%. In comparison, Hungary has the lowest share, with 8% of energy consumption and 16% of households using DH. The difference between the energy and household shares can largely be explained by the fact that DH networks primarily serve multi-apartment buildings, which generally have lower individual heating demand compared to detached houses.

District heating in the V4 remains heavily reliant on fossil fuels. Poland and Czechia are coal-dependent (with 47—82% share), while Slovakia and Hungary rely mostly on natural gas (44—69%), with Hungary showing modest renewable integration (~11%).

There is growing recognition of the need for change, with individual countries taking steps to integrate renewable energy technologies such as heat pumps, geothermal energy, and biomass. Despite this progress, the adoption of low-carbon solutions remains uneven, hindered by economic, social, and regulatory barriers.

The primary purpose of this policy brief is to highlight effective policies, successful examples, and best practices that support the decarbonisation of heating systems across the V4 countries. By showcasing innovative approaches, scalable solutions, and already implemented policies, this brief aims to foster mutual learning, inspire further action, and facilitate knowledge exchange. Despite existing challenges, these examples demonstrate tangible pathways toward a low-carbon heating transition, encouraging policymakers and stakeholders to adopt and adapt solutions that align with their specific contexts and drive progress toward shared climate goals.



2. POLICY CONTEXT

Heating decarbonisation is a key focus of the European Union's climate and energy policies, embedded in several regulatory frameworks aimed at reducing greenhouse gas emissions, increasing energy efficiency, and promoting renewable energy. Three cornerstone directives underpin these efforts:

The **Energy Efficiency Directive (EED)** focuses on reducing energy consumption across all sectors, including heating and cooling, by improving system efficiency and reducing energy waste.

The revised Energy Efficiency Directive sets out key measures to reduce energy consumption and accelerate the decarbonisation of heating and cooling. It includes a binding 11.7% energy consumption reduction target by 2030 and introduces gradually increasing annual energy savings obligations (up to 1.9% by 2030).

Public buildings must undergo renovation to become zero-emission, while municipalities over 45,000 inhabitants are required to develop local heating and cooling plans. The directive also mandates a decarbonisation pathway for district systems, promotes financial support schemes, and emphasises the reuse of waste heat and the role of heat pumps in national planning and cost-benefit analyses.

The latest revision of the Energy Performance of Buildings Directive (EPBD), adopted in May 2024, places strong emphasis on the decarbonisation of heating systems. One of the key measures is the phasing out of fossil fuel boilers: as of January 1, 2025, subsidies for standalone fossil fuel boilers will no longer be permitted, encouraging the transition to renewable

heating technologies. In addition, the directive requires Member States to establish a national roadmap for the complete phase-out of fossil fuel boilers by 2040, after which such systems will no longer be allowed to operate in buildings.

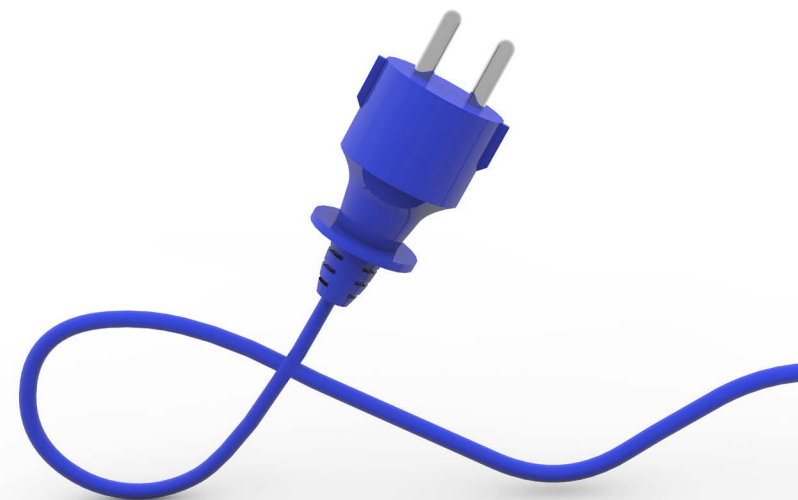
The EPBD also introduces zero-emission building requirements, mandating that new buildings comply with high energy performance standards that minimise or eliminate the use of fossil fuels in heating. Furthermore, the directive promotes the integration of renewable energy sources into buildings' energy supply, reducing dependence on fossil fuels and supporting the shift towards a climate-neutral building stock. It also encourages the deployment of modern, energy-efficient heating and cooling systems that deliver the same level of comfort with significantly lower energy consumption.

The revised **Renewable Energy Directive (RED III)** sets binding targets for the share of renewable energy in the EU's overall energy mix and places particular emphasis on decarbonising the heating and cooling sector. It encourages the deployment of renewable technologies such as biomass, geothermal energy, and solar thermal systems.

In 2023, the share of renewable energy in heating and cooling continued to rise, reaching an EU average of 26.2%, which represents an increase of 1.2 percentage points compared to 2022. In the same year, the renewable share stood at 27.8% in Czechia, 22.3% in Hungary, 20.4% in Poland, and 18.8% in Slovakia.²⁴

Under RED III, EU Member States are required to increase the share of renewable energy in the heating and cooling sector by at least 0.8 percentage points annually between 2021 and

2025, and by 1.1 percentage points annually from 2026 to 2030. Additionally, Member States must ensure an average annual increase of at least 2.2 percentage points in the share of renewables used in district heating and cooling over the period 2021 to 2030.²⁵



²⁴ https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN__custom_15599719/default/table?lang=en

²⁵ https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en#recommendations-and-guidance-notes

3. PROBLEM STATEMENT: A MOVE AWAY FROM FOSSIL FUEL DEPENDENCY IS NECESSARY

The transition to low-carbon heating systems in the V4 countries faces a range of interconnected challenges that hinder progress and limit the adoption of sustainable solutions. These challenges are deeply rooted in the historical reliance on fossil fuels, economic constraints, and the varying depth of political engagement and pace of policy implementation across the region.

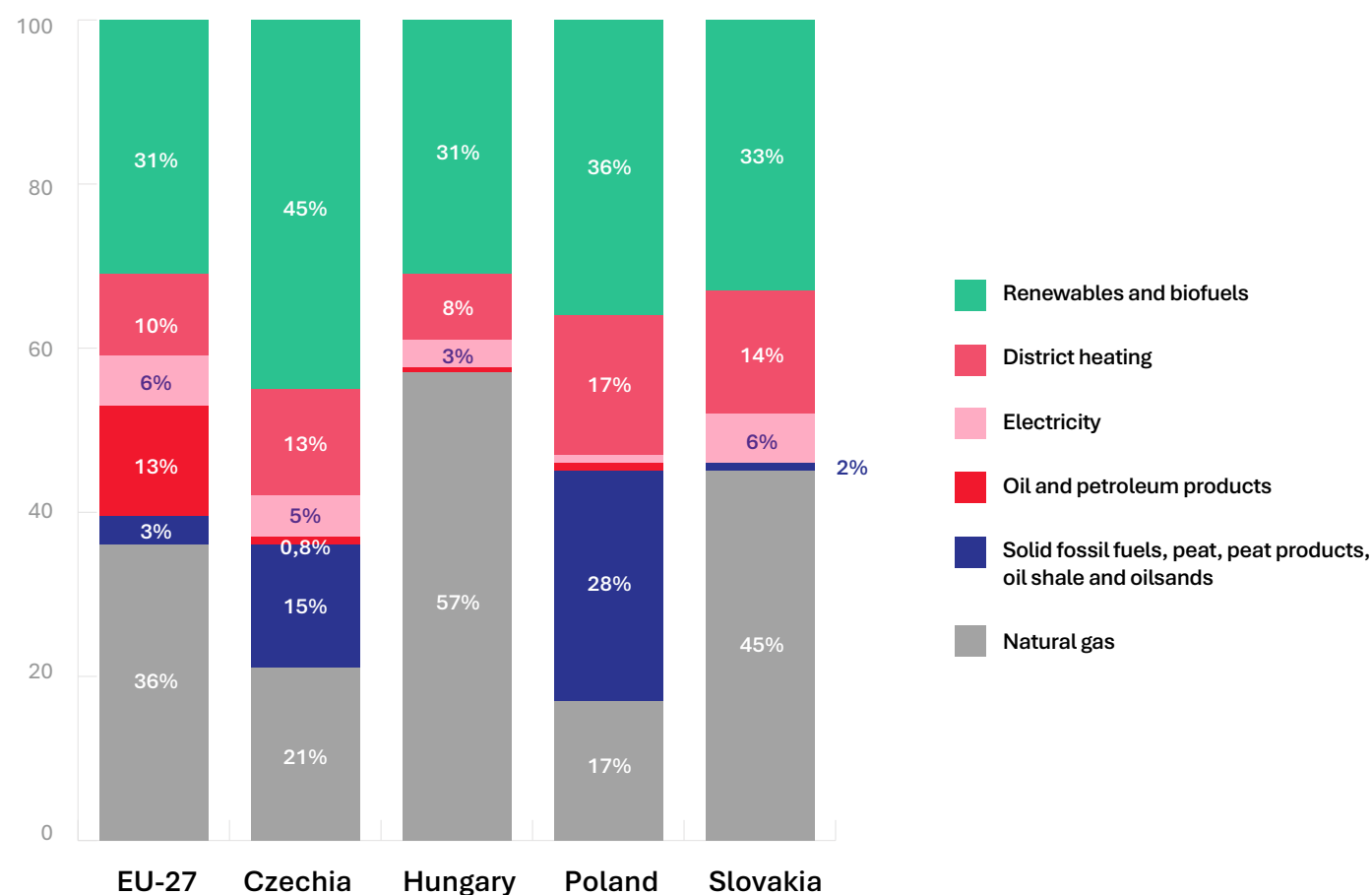
Fossil Fuel Dependency

A significant portion of heating systems in the V4 region continues to rely on fossil fuels, such as natural gas and coal, reflecting the region's historical dependence on these resources. This is especially evident in residential and district heating networks, which represent a large share of the region's energy consumption and greenhouse gas emissions.

Hungary and Slovakia primarily rely on natural gas for residential space heating, with shares of 57% and 45%, respectively. Biofuels and renewables also play a notable role in these countries, accounting for 31% in Hungary and 33% in Slovakia. In contrast, the share of natural gas is much lower in Czechia (21%) and Poland (17%), which rely more heavily on biomass (fuelwood) and coal. In Poland, biofuels and renewables account for 36% of residential heating, while solid fossil fuels make up 28%. In Czechia, the share of biofuels and renewables is 45%, with solid fossil fuels representing 15%.²⁶

²⁶ https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_consumption_in_households#Source_data_for_tables_and_graphs

Fuel mix of household space heating in the V4, 2022



Transitioning away from these fossil sources requires substantial investments in renewable technologies and infrastructure, a process that is both costly and time-consuming.

Many existing networks in the CEE region remain inefficient and dependent on fossil fuels. District heating and cooling is expected to be a key technology of decarbonisation and a promising solution for reducing reliance on Russian natural gas. Large-scale heat pumps can contribute to stabilizing electricity grids and facilitating the integration of renewable energy sources. The technology is mostly in place to scale up clean district heating solutions, but more is needed. Studies on best practice examples underscore the high energy saving and decarbonization potential in clean district heating solutions, which require bold policies not only to modernize, but to expand district heating networks.

Aging Infrastructure

Much of the existing heating infrastructure in the V4 countries is outdated and inefficient. District heating systems suffer from high energy losses due to aging pipelines and obsolete technologies. Modernizing these systems is a complex task, requiring not only technical upgrades but also a rethinking of energy supply chains and integration of renewable sources.

Economic Barriers

The financial burden of decarbonising heating systems is a major obstacle for both governments and individual households. While EU funding and national subsidies are available, they are often insufficient to cover the high upfront costs associated with renewable heating technologies, such as heat pumps, solar thermal systems, and biomass boilers. Additionally, energy poverty remains a significant concern in parts of the V4 region, further complicating efforts to promote low-carbon heating solutions.

Regulatory and Policy Gaps

Although the V4 countries have made progress in aligning their national policies with EU regulations, inconsistencies in enforcement, limited long-term planning, and fragmented approaches remain prevalent.

Public Awareness and Acceptance

Another key challenge lies in the limited public understanding of low-carbon heating technologies and their benefits. Resistance to change is often fuelled by concerns over costs, lack of information, and the perceived complexity of adopting new systems. Without effective communication and awareness campaigns, widespread acceptance of these solutions remains a significant hurdle. Addressing these challenges requires coordinated action at both the national and regional levels, leveraging the strengths and experiences of each V4 country.



4. ALTERNATIVES TO FOSSIL-BASED HEATING

For both individual heating systems and district heating (DH), the V4 countries must prioritize energy efficiency improvements as a first step. This is crucial to ensure that subsequent electrification and renewable energy integration deliver optimal performance, particularly in light of the aging building stock. Once residential renovations are complete, fossil-fuel-based heating, whether individual or centralized, should be phased out.

For individual systems, this transition can be achieved through electrification or the use of biomass. In the case of district heating, the shift may involve either moving from coal to high-efficiency combined heat and power (CHP) plants fueled by natural gas, or — ideally — directly adopting renewables such as geothermal and solar.

4.1 Heat pumps

Heat pumps are the primary alternative to fossil boilers because they offer a highly efficient and sustainable way to generate heat by transferring thermal energy from the environment—such as air, ground, or water—into buildings. Heat pumps operate using electricity, often delivering three to four units (or more) of heat for every unit of electricity consumed. This efficiency reduces overall energy demand and greenhouse gas emissions. Moreover, heat pumps can be powered by renewable electricity, further lowering their carbon footprint. Additionally, they offer heating, cooling, and domestic hot water production making them a versatile and future-proof solution for decarbonizing buildings.

There are three main types of heat pumps, classified by their heat source and output. In the Visegrád countries, where winters are cold and heating demand is significant, air-source heat pumps (air-to-water) are generally the most suitable option. They provide space heating, cooling, and domestic hot water, and perform well in cold and moderate climates, making them a practical and increasingly popular solution in the region.

Air-to-air heat pumps, which offer space heating and cooling but not domestic hot water, are less suitable for most V4 contexts. Their lower heating comfort and lack of hot water supply make them more appropriate for milder climates, such as Southern Europe. In the V4 region, they may only be viable in well-insulated buildings with low heating demand or as part of hybrid systems.

Ground-source heat pumps are the most energy-efficient, but their high installation cost and technical complexity make them less common in residential applications across the V4 countries. They are typically used in larger buildings or new developments with sufficient space and upfront investment capacity.

4.2 Heat pump penetration in the V4

Heat pump penetration, measured as the number of heat pumps (HPs) in stock per 1,000 households in 2023, varied widely across Europe. Northern countries like Norway (635) and Finland (512) had by far the highest levels of penetration, reflecting years of consistent market growth. Within the V4 region, Czechia led with approximately 60 heat pumps per

1,000 households, followed by Poland (47), Slovakia (27), and Hungary, where the stock remained below 10 per 1,000 households. This substantial gap highlights the limited diffusion of heat pump technology in the region compared to Northern and Western Europe.²⁷

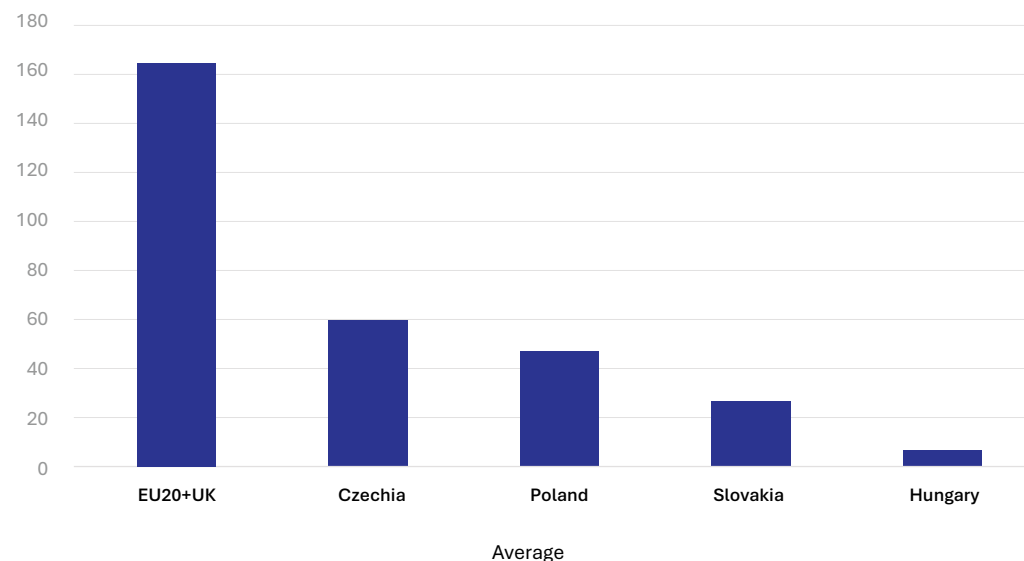
4.2.1 Barriers to Heat Pump Deployment in the V4 Region

Heat pump penetration in the Visegrad Four is relatively low compared to Western European countries. Although many barriers are like those experienced across Europe, their relative importance and impact vary due to regional energy systems, policy environments, and consumer behaviour. The main barriers include the still high investment and running costs of heat pumps, consumer information barriers about the transition to clean heating, and a lack of knowledge and skilled labour in clean technologies.

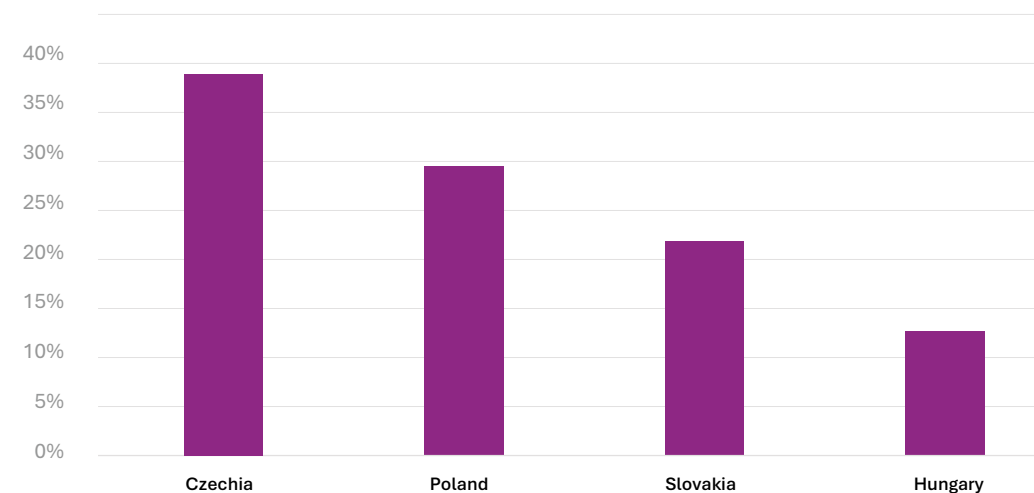
One of the most pressing barriers in the V4 region is the unfavourable electricity-to-gas price ratio, which significantly affects the running cost of heat pumps. In countries like Hungary and Slovakia, where natural gas is heavily subsidized and dominates residential heating, households are often discouraged from switching to electric-based heating solutions due to higher operational costs. This price distortion undermines the competitiveness of heat pumps, especially when compared to traditional gas boilers or biomass-based heating.

²⁷ www.ehpa.org/wp-content/uploads/2024/08/Executive-summary_EHPA-heat-pump-market-and-statistic-report-2024-2.pdf

Heat pump units stock per 1 000 households, 2023



Heat pump market shares, in % of combined sales of gas boilers and heat pumps



Source: EHPA: European Heat Pump Market and Statistics Report 2024countries

4.2.2 Barriers to Heat Pump Deployment in the V4 Region

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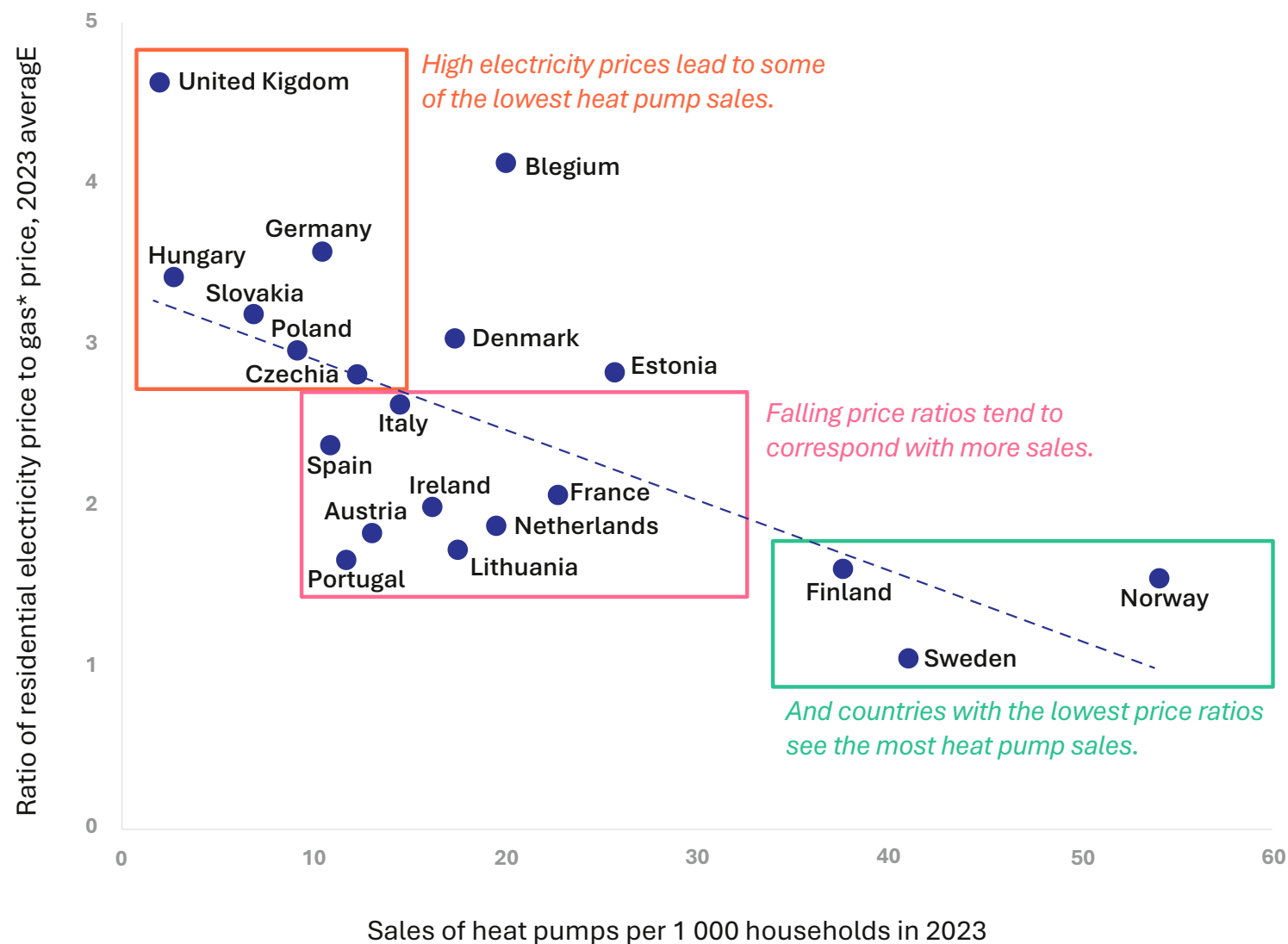
High upfront costs remain another major hurdle. While heat pump prices are universally high, the relative income levels in the V4 countries mean that the initial investment is especially burdensome for most households. In Central Europe, the affordability of air-source heat pumps and gas boilers varies significantly by country. In Hungary and Slovakia, the cost of an air-source heat pump is equivalent to approximately six months of average salary. In the Czech Republic, it's around four months, while in Poland, it's less than three months' worth of wages.

In contrast, gas boilers are considerably more affordable. In Hungary and the Czech Republic, a gas boiler costs just over one month's salary. In Slovakia, it's about two months' worth, and in Poland, it's less than a month's salary.²⁸

The length of the payback period—determined by both initial investment and ongoing running costs—is another key factor that influences decision-making. From the above, it follows that heat pumps are typically characterized by a long payback period. While air-to-air heat pumps tend to have shorter payback times, they are not ideally suited to the Central European climate as a primary heat source, although they can serve well as supplementary heating solutions.

The low awareness and public trust in heat pump technology is also a notable issue. In many cases, consumers are unfamiliar with how heat pumps work, what benefits they offer, or

²⁸ www.coolproducts.eu/wp-content/uploads/2023/10/Green-Heat-for-All-2-Final.pdf



whether they are compatible with older buildings—a common feature in the housing stock of all four countries. Past experiences with underperforming installations or poor-quality workmanship also contribute to scepticism.

In addition, the shortage of skilled installers significantly slows down market development. The European Heat Pump Association has estimated that a minimum of half a million skilled employees are needed in Europe for the heat pump rollout as required by the RePower EU plan.²⁹ In all V4 countries, there is a lack of training and education tailored specifically to heat pump technology, leading to a limited installer base and occasional quality issues with installations. This not only affects consumer confidence but also limits the industry's ability to scale up rapidly.

Technical challenges—especially in retrofitting old, poorly insulated buildings—complicate the heat decarbonisation process. While new buildings can integrate heat pumps more easily, older homes often require significant fabric upgrades to ensure efficient operation. Installing a heat pump without improving insulation can increase energy use. Although rapid heating decarbonisation is essential, fabric improvements remain crucial for reducing energy demand, enhancing comfort, and supporting heat pump performance. The "fabric first" approach should therefore continue to play an important role—particularly where it is technically and economically feasible.³⁰

Finally, inconsistent or insufficient policy support weakens the investment climate.

A recent study found that policies are not yet strong or consistent enough to encourage a wide-scale uptake of clean heating

²⁹ European Heat Pump Association. 2023. *Wanted: half a million heat pump workers*, News piece 26 Jan 2023

³⁰ <https://journal-buildingscities.org/articles/10.5334/bc.388>

and cooling systems.³¹ The study finds that Hungary, Poland, and Czechia lag in implementing clean heating with limited plans to phase out fossil fuels and a significant administrative burden on implementing clean heat solutions. Hungary also lacks information and awareness raising on clean heat, and offers few incentives for installing clean heat solutions. While national strategies may include references to electrification of heating, implementation is often slow, and long-term regulatory clarity is lacking. Frequent changes in support schemes and a general lack of coordination with grid development and energy efficiency programs hinder progress.

Addressing these challenges in a coordinated manner—through stable subsidies to clean heating, training programs, electricity pricing and taxation reforms, and awareness campaigns—will be key to enabling a meaningful shift towards low-carbon heating in the V4 region.

Heat pumps are increasingly gaining relevance not only at the individual household level, but also in collective heating systems such as large apartment blocks and district heating systems. In multi-dwelling residential buildings with centralized heating systems, large-scale air-to-water or ground-source heat pumps can serve as efficient low-emission heat sources, especially when combined with thermal storage. These systems are particularly effective when the building has undergone energy efficiency upgrades (e.g., insulation, window replacement), allowing heat pumps to operate at lower temperatures and higher efficiency. In some cases, hybrid solutions—where heat pumps are used alongside gas boilers—can ensure reliability while reducing fossil fuel use. For retrofitting older buildings, centralized heat pump systems are a viable solution to decarbonize heating without requiring significant changes at the apartment level.

In district heating networks, large-scale heat pumps are emerging as key technologies in the transition away from fossil fuels. They can extract heat from a variety of low-temperature renewable sources such as ambient air, groundwater, surface water, or even wastewater. When powered by renewable electricity, these systems can supply green heat to entire neighbourhoods, making them an important pillar of low-carbon urban heating strategies. Several district heating providers across Europe are already integrating heat pumps into their supply mix, often in combination with other technologies such as geothermal energy, biomass, and waste heat recovery. As district heating networks lower their supply temperatures to align with fourth-generation (4GDH) standards, the compatibility with large-scale heat pumps improves, making them a cornerstone of decarbonized heating systems.

4.3 Biomass-Based Heating systems

Biomass-based heating continues to play a significant role in residential heat supply, particularly in rural areas across Central and Eastern Europe. When sourced and used sustainably, biomass can contribute to the decarbonisation of the heating sector as a renewable and locally available energy source.

Biomass in heating typically refers to solid biofuels such as firewood, wood chips, and wood pellets, which can be burned in individual stoves, boilers, or larger centralised systems. In some regions, agricultural residues or purpose-grown energy crops may also be used. While traditional biomass use (e.g. open wood stoves) is often inefficient and associated with significant air pollution, modern biomass heating technologies—such as pellet boilers equipped with emission controls—can offer much higher efficiency and substantially lower particulate emissions.

One of the key advantages of biomass is its potential to replace fossil fuels in existing heating systems, particularly in off-grid or low-density areas where alternatives such as district heating or heat pumps are less feasible. In addition, biomass is often locally produced, supporting rural economies and enhancing energy security.

In the context of district heating, biomass remains one of the most widely used renewable sources, especially in regions with abundant forest-based resources or agricultural residues. In many Central and Eastern European countries, biomass-fired boilers have emerged as a primary alternative to coal and gas in existing heating plants. Technologies range from small-scale wood chip units to large combined heat and power (CHP) plants that use pellets or other solid biofuels. Biomass is particularly attractive for district heating providers because it delivers dispatchable, high-temperature heat that is compatible with legacy infrastructure and does not require major modifications to existing networks.

However, biomass heating also raises important concerns. From an environmental perspective, the carbon neutrality of biomass depends on sustainable sourcing, forest management practices, and the carbon payback period. Unsustainable harvesting can lead to deforestation, loss of biodiversity, and negative climate impacts. Moreover, even modern biomass combustion can contribute to local air pollution if not properly regulated and maintained.

In policy terms, support for biomass heating should be carefully targeted. Priority should be given to replacing outdated, polluting systems with modern, clean biomass technologies, especially in areas where other renewable heating options are limited. At the same time, it is crucial to ensure robust sustainability criteria and emissions standards, and to integrate biomass within a broader strategy that prioritises energy efficiency and low-emission technologies.

³¹ Fill the Clean heat gap. Clean heat readiness in Europe: A survey of Member States. The Trinomics study analysed clean heat readiness in 12 countries: Croatia, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Lithuania, Poland, Spain, and Sweden.

4.4 Solar thermal systems

Solar thermal technology is a mature and environmentally friendly method of harnessing solar energy, used primarily for the production of domestic hot water (DHW). Solar collectors absorb sunlight and convert it into thermal energy, significantly reducing the need for conventional gas or electric water heating. In well-designed systems, especially in sunnier regions, solar collectors can cover the majority of a building's hot water demand—cutting carbon emissions and lowering energy costs. In the Visegrád countries, solar thermal systems typically cover 50—70% of annual DHW demand, depending on local solar irradiation and system design. Hungary, benefiting from higher solar exposure, often achieves coverage rates at the upper end of this range. In contrast, Poland, especially in its northern regions, tends to experience significantly lower coverage rates, due to reduced solar availability.

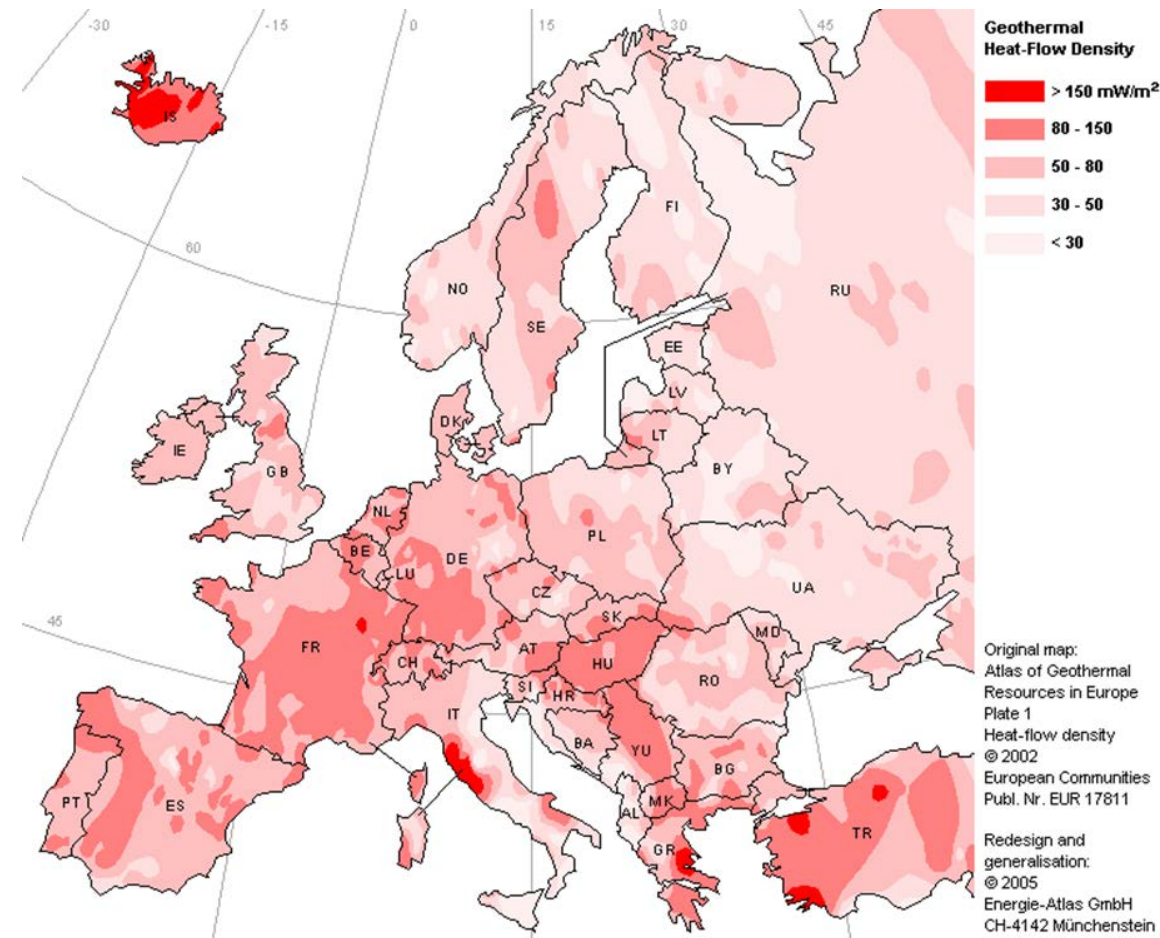
Although the primary application of solar thermal systems is DHW production, they can also provide limited support for space heating. By integrating with thermal storage tanks, underfloor heating systems, or auxiliary heat pumps, solar-heated water can contribute to indoor climate control. However, this is typically supplementary and not suitable as a standalone heating solution, especially in colder climates, where solar availability is lowest during peak heating demand.

In large apartment buildings, their use is less common but technically feasible, typically for shared hot water systems. In district heating, solar thermal is increasingly seen as a promising renewable source—particularly in low-temperature networks—with several large-scale installations already operating in countries like Denmark and Austria, though such applications are still rare in Central and Eastern Europe.

4.5 Geothermal energy systems

Deep geothermal energy represents a reliable and renewable source of low-carbon heat, making it a valuable asset in the decarbonisation of heating systems. Unlike solar or wind energy, geothermal heat is available continuously, independent of weather or seasonal variation.

The map below illustrates geothermal heat-flow density across Europe, measured in milliwatts per square meter (mW/m^2), indicating the natural geothermal gradient and potential for geothermal energy use. Within the Visegrád countries, Hungary stands out with some of the highest heat-flow densities, particularly in the southeastern and central regions, often exceeding $100 \text{ mW}/\text{m}^2$. Slovakia and Poland show moderate



Source: Energie-Atlas GmbH (2005), based on European Commission (2002), Atlas of Geothermal Resources in Europe

geothermal potential, with large areas in the 50—80 mW/m² range, while Czechia has lower values, mostly between 30—50 mW/m². These differences suggest that Hungary is particularly well-suited for direct-use geothermal heating, while the other V4 countries may require deeper drilling or hybrid systems to economically exploit geothermal resources.

Deep geothermal energy is used in district heating (DH) systems in the region. This is largely due to the high upfront investment costs associated with drilling deep wells and developing infrastructure, which make geothermal heating economically viable only at scale. When used in DH networks, geothermal systems can supply large volumes of thermal energy efficiently to buildings.

Several cities in the V4 region already use geothermal-based district heating, such as Szeged, Miskolc and Győr in Hungary or Galanta in Slovakia. These projects demonstrate how geothermal energy can contribute meaningfully to regional heating decarbonisation when integrated into existing or newly developed district heating networks.

4.6 Waste heat for District Heating in CEE

In 2022, waste heat accounted for 3.6% of total district heat delivered in Europe. Heat from non-biodegradable municipal waste in waste-to-energy plants made up 6.4% of the fuel mix.³² The highest shares of waste heat use are seen in countries with strong district heating networks and supportive policies.

In the EU, an estimated 2,860 TWh/year of waste heat—mainly from industry, power generation, and waste-to-energy plants—remains untapped. This is nearly equal to the region's space and water heating demand in buildings.

District heating systems enable the use of industrial waste heat, such as in Brescia (Italy), where steel mill heat recovery covers 14% of annual demand. Sectors like steel, cement, glass, chemicals, and newer sources like data centres and hydrogen production offer major potential.³³

Data centre heat recovery is gaining momentum, with notable projects in Denmark. However, similar initiatives are still rare in CEE, where regulatory barriers, limited financing tools, and fragmented policies hinder broader adoption. Unlocking waste heat potential in CEE requires stronger policies, investment incentives, and better heat planning frameworks.

A good example of waste heat recovery has recently been piloted in Warsaw, Poland. The Municipality of Warsaw signed a Memorandum of Understanding with industry partners, which underscores the city's commitment to integrating metro-generated heat into Warsaw's district heating infrastructure. Warsaw is heated with Europe's largest district heating system, dating back to the Soviet era. The project aimed at redirecting waste heat to warm homes and buildings around the city. A pilot study assessed how much waste heat the metro system generates and whether it's cost effective to feed it into Warsaw's district heating network.³⁴ The study found that Warsaw's metro stations waste roughly 62 GWh of heat annually—enough to keep 14,000 households warm each year. If this low-grade heat is pumped up to the right temperature with heat pumps and fed into the larger system, it could significantly cut the city's reliance on fossil-fuelled plants. That could reduce around 42,000 tons of CO₂ emissions per year—with the right renewable electricity backing it up.³⁵ Now, a pilot at the Bemowo (M2) station has already started: heat pumps are being installed to test the concept before expanding across other stations. If it proves viable, Warsaw could position itself as a European leader in waste heat utilization.



³² DHC Market Outlook 2024. EuroHeat&Power. Link

³³ DHC Market Outlook 2024. EuroHeat&Power. Link

³⁴ Danfoss. <https://assets.danfoss.com/documents/latest/461187/BE512836747061en-000101.pdf>

³⁵ balkangreenenergynews.com

5. GOOD PRACTICES ACROSS THE REGION

A variety of promising policy measures and practical solutions have been implemented across Central and Eastern Europe to support the decarbonisation of heating systems. These good practices range from targeted electricity tariffs that incentivise renewable-based heating at the household level, to large-scale investments in modernised and low-emission district heating networks. The following section highlights several examples from Hungary, Poland, Czechia, and Slovakia, showcasing both national initiatives and innovative local actions that contribute to cleaner, more sustainable heat supply.

5.1 Hungary — Discounted electricity tariff to support renewable-based individual heating systems

In Hungary, natural gas dominates the heating system (57% of residential space heating), followed by renewables and biofuels (31%), which mainly covers firewood. Heating with solid fossil fuels is uncommon (1%).

In Hungary, the expansion of heat pump deployment faces a number of structural and economic challenges that hinder the technology's uptake. One of the key barriers is the artificially low, state-regulated price of natural gas, which reduces the financial attractiveness of switching to heat pumps. With gas prices remaining well below market levels due to government subsidies, heat pumps struggle to compete on a purely economic basis—particularly in heating-dominated households where return on investment is a crucial factor.

The last change in the regulated prices was announced in 2022, when Hungary introduced thresholds for electricity and gas consumption, above which usage is no longer eligible for subsidized rates and is instead billed at significantly higher market rates.

For households consuming below the average annual gas threshold (63,645 MJ or $\sim 1,729 \text{ m}^3$), the subsidized price of natural gas is approximately 2,5 eurocent/kWh. For consumption above this threshold, the price rises steeply to around 19 eurocent/kWh.

In comparison, the standard electricity price is around 9 eurocent/kWh for yearly annual consumption of 2523 kWh, and 17 eurocent/kWh for higher usage, making electricity generally more expensive per unit of energy than gas under the regulated regime.³⁶ This pricing structure creates a disincentive for consumers to switch from gas to electric heating systems, including heat pumps.

The share of households above average consumption for gas is today less than 10 percent, down from 23 percent, and the share of energy billed at above average consumption for gas is now 13 percent, down from 3.6 percent. Hungarian policy makers aim to keep average consumption prices low, which they are trying to compensate for with a significantly higher gas price for above-average consumers.

However, Hungary offers a seasonal "H tariff" aimed at supporting renewable-based heating technologies by lowering their operating costs. This special electricity rate is available to household users who heat with heat pumps, including split air conditioners.

The pricing of the H tariff is the most favourable among the available electricity tariffs (~ 6 eurocent/kWh), even lower than the controlled (night) electricity rate. This tariff has been available since 2010 nationwide during the heating season, from October 15 to April 15, continuously.

The equipment must meet a minimum SCOP value of 3.4 to be eligible for the H tariff. The SCOP (Seasonal Coefficient of Performance) is the seasonal performance factor used for heat pumps. It indicates the energy efficiency of the device during heating, showing how much heat energy can be extracted from the invested electrical energy. In case of a heat pump that operates at a SCOP of 3.4, this translates to a final heating energy cost of just $\sim 1,7$ eurocent/kWh, making it cheaper than even subsidized natural gas.

Outside the heating period, the heat pump can be operated under the normal A1 tariff. It is important to highlight that the electricity price change effective from August 1, 2022, did not affect the H tariff; its price did not increase and remains unrestricted.

Despite the H tariff's competitive pricing, several barriers limit its widespread adoption. Heat pumps typically involve a greater initial investment than conventional heating options such as gas boilers. This higher upfront cost covers not only the heat pump unit and installation, but also potential modifications to a home's electrical infrastructure or radiator system, especially in older properties.

³⁶ <https://www.mvmnext.hu/aram/pages/aloldal.jsp?id=791>

One of the main obstacles is the additional investment required to install a separate metering system dedicated to this tariff, which can be a significant upfront cost for households. Moreover, the application process is often perceived as administratively burdensome. These financial and procedural barriers, combined with the fact that the tariff is only available seasonally—from October to April—reduce its overall attractiveness.

As a result, even though the H tariff could significantly lower heating costs for electricity-based systems like heat pumps, its potential remains underutilized. Additionally, the public perception of cheap gas due to subsidies continues to reduce the economic appeal of switching to heat pumps — especially for households with existing gas infrastructure and access to the regulated price.

Another notable measure is that mandatory heat pump stock data collection was introduced in Hungary from 2024. It is a significant policy step, as accurate data on heat pump stock is essential for policymakers to understand the current state of the market, identify trends, and tailor support schemes, subsidies, and regulations to actual market conditions.³⁷

5.2 Hungary — Residential Solar and Heating Modernisation Scheme

The Residential Solar and Heating Modernisation Scheme was a flagship programme launched by the Hungarian government in 2021 under the EU's Recovery and Resilience Facility (RRF). Its primary objective was to improve the energy efficiency and decarbonisation of Hungary's residential sector, especially among low-income households. The scheme targeted single-family homes and offered non-repayable grants covering up to 100% of eligible costs.

To qualify, applicants had to meet strict income criteria: the combined taxable income of the household (as declared in 2019) could not exceed HUF 4.85 million (approx. €12,000). Only homeowners of detached or semi-detached houses used as primary residences were eligible.

Within the framework of the application, support can only be requested for one of the following two distinct technical scopes:

- Installation of a rooftop solar photovoltaic system intended to cover own consumption, or
- Installation of a rooftop solar photovoltaic system combined with the electrification of the heating system using a heat pump, installation of an electricity storage system, and replacement of windows and doors.³⁸

The Residential Solar and Heating Modernization Scheme was intended to be an ambitious and well-targeted programme aiming to support lower-income households and reduce energy poverty through access to clean energy and home renovation. Despite its generous funding structure, the programme quickly ran into serious implementation issues. It received an unexpectedly high volume of applications, which overwhelmed the administrative system—particularly the central implementing agency (ÉMI Nonprofit Ltd.) and the IT infrastructure responsible for handling submissions and evaluations.

An additional structural problem was the delay in EU fund transfer, which meant that contractors were not paid on time, and project pipelines stalled. As a result, the realisation rate remained very low — as of 2024, only a fraction of approved projects have been completed, and many applicants have received no clear feedback. While the programme has not been officially terminated, its practical implementation is largely frozen, leaving many homeowners in uncertainty and diminishing public trust in large-scale state-led clean energy schemes.

5.3 Good examples of district heating decarbonization

5.3.1 The Szeged Geothermal Project — A Flagship Urban Energy Transition in Hungary

In 2023, the EU's largest geothermal heating system was inaugurated in Szeged. Recognizing the environmental and economic challenges posed by its fossil-fuel-based heating system, the municipality set out in the mid-2010s to fundamentally transform its heat supply. The region's geological characteristics, particularly the presence of thermal water-rich formations and a favourable geothermal gradient, provided a natural opportunity to tap into deep geothermal energy as a sustainable alternative.

Initiated in 2015 and implemented in several phases, the Szeged Geothermal Project aims to decarbonize the city's entire district heating system by replacing natural gas with geothermal energy. The system supplies renewable heat to approximately 28,000 homes and 400 public institutions, making it one of the largest geothermal district heating systems in Europe. The project is a joint initiative of Szeged's municipal district heating company (Szegedi Távfűtő Ltd., SZETÁV), Geo Hőterm Ltd., and Hungary's National Development Program Office.

- The technical design is based on a hybrid heating model that integrates new geothermal infrastructure with the existing natural gas network, the latter now serving primarily as backup.³⁹ With support from the EU's Cohesion Fund, the €70 million investment received €23 million in non-repayable funding. In addition to grant funding, the project relies on long-term heat purchase agreements between the city and the geothermal developer, which provided revenue certainty and encouraged

³⁷ Hungarian Heat Pump Association. <https://www.hoszisz.hu/images/pdf/MAHOSZ-adatszolgaltatast-tamogato-level-2025-MEKH.pdf>

³⁸ <https://napelem.palyazat.gov.hu/lakossag/felhivas>

³⁹ https://ec.europa.eu/regional_policy/whats-new/newsroom/25-05-2023-eu-cohesion-policy-inauguration-of-the-largest-geothermal-heating-system-in-the-eu-in-szeged-hungary_en

private investment.⁴⁰ The system is expected to halve gas use and cut CO₂ emissions by 30,000 tons annually. In addition to mitigating greenhouse gas emissions, the project contributes to improved urban air quality by reducing local particulate and nitrogen oxide emissions—an especially important co-benefit in winter months.

The success of the Szeged Geothermal Project was made possible by a combination of technical, financial, and policy enablers. While favourable geological conditions were essential, they would not have sufficed without targeted policy support. Hungary's National Energy and Climate Plan (NECP) explicitly identifies geothermal energy as a strategic priority, and KEHOP made it a dedicated investment target. Moreover, recent regulatory reforms in Hungary have significantly streamlined permitting for geothermal projects, particularly by simplifying the approval process for reinjection wells and exempting geothermal developments from hydrocarbon concession rules. These legal adjustments have reduced risk and administrative burden, making geothermal projects more attractive for municipalities and private investors alike. In addition, Szeged's long-term political and institutional commitment was critical.

The Szeged project offers important lessons for other municipalities seeking to decarbonize urban heating systems. It demonstrates that geothermal district heating can be both technically and economically viable at scale, provided that the right policy, regulatory, and financial frameworks are in place. The combination of EU structural funds, local commitment, and a stable investment environment created the conditions for success. As a result, other Hungarian cities—including Győr, Békéscsaba, and Hódmezővásárhely—are now pursuing similar geothermal initiatives, using Szeged as a model.

In sum, the Szeged Geothermal Project stands as a leading example of how deep geothermal energy can serve as a reliable and sustainable foundation for urban heat decarbonization. It showcases the effectiveness of integrated local action, public-private cooperation, and EU-funded investment in accelerating the green transition of cities in Central and Eastern Europe.

5.3.2 District heating decarbonization in Poland

District heating plays a significant role in Poland, especially compared to many other EU countries. More than 50% of Polish households are connected to district heating networks, while the residential heat demand met by district heating is 19%.⁴¹ The total heat production was around 425,000 TJ in 2021⁴², with about 63% of that generated through combined heat and power (CHP) systems. However, the sector is still heavily reliant on fossil fuels, particularly coal, which made up nearly 70% of the fuel mix in 2021. According to recent estimate⁴³ by the Polish district heating association, the decarbonization of district heating in Poland will cost up to more than 460 billion PLN by 2050.

While it is unclear at this point which technology will dominate the district heating sector in the future, the transition process itself will be long and expensive, and will require significant financial support for district heating companies.

Key to the decarbonization of the district heating sector is the development of an appropriate strategy at the national level, consistent with EU regulations (EU ETS, EED, RED III and EPBD). Currently, the Ministry of Climate and Environment is working on the publication of the Strategy for district heating until 2030 with an outlook to 2040. The main goals by

2030 are: 85% efficient district heating systems, increase the share of RES in the sector to 28.4%, decrease CO₂ emissions to 34%, increase the role of cogeneration (5.1 GWe of new capacity), connect 1.5 million households to the district heating network, develop new service delivery models and new tariff principles, implement new technologies — lowering carrier temperature, network cooling, thermal waste conversion; heat storage, decarbonized gases, heat pumps). The strategy in its final form has not been adopted to date.

The key influence on the decarbonization of district heating in Poland is in the hands of local governments, under whose jurisdiction local district heating companies are located. Activities related to decarbonization of district heating networks are the subject of municipal development strategies and plans and are progressively planned and implemented by Polish municipalities.

The following are examples of actions at the local level, which are also good practices in the field of district heating decarbonization.

Municipality of Gliwice

Within the framework of the City Development Strategy “Gliwice 2040” adopted in 2022, decarbonization activities related to the production and distribution of heat within the city are included, aimed at safe and non-polluting energy production from waste, as well as the use of municipal wastewater energy. Various projects will be implemented as part of the strategy's implementation:

- The Green Energy Park in Gliwice (Park Zielonej Energii) is expanding its heating plant with a new multi-fuel steam boiler that uses waste-based fuels to produce heat and

⁴⁰ <https://hu.euronews.com/my-europe/2024/04/15/szegeden-mukodik-az-eu-legnagyobb-geotermikus-rendszere?>

⁴¹ Eurostat, 2021.

⁴² Energy Regulatory Office (URE)

⁴³ Impact of EU regulations on the transformation of the centralized district heating sector in Poland. Polish Association of Heat Energy, October 2024

electricity—supporting the city’s circular economy. Only non-recyclable waste will be used, with no harmful emissions released into the air. To boost energy efficiency, the system includes:

- Flue gas heat recovery, adding up to 6 MWt of extra heat,
 - A 12,000 m³ heat storage tank for flexibility,
 - And heat pumps to capture even more energy from exhaust gases, contributing an additional 5 MWt.
- Industrial construction of a multi-format solar field with a capacity of up to 13.5 MWt, producing heat for the needs of Gliwice residents;
 - Construction of an installation for the recovery of heat contained in municipal wastewater, together with accompanying infrastructure, is planned at the wastewater treatment plant in Gliwice. The project involves the installation of heat pumps that will be powered by the heat generated during the treatment of municipal wastewater. All recovered heat will be directed to the city's district heating network. The installation will allow the production of 12 to 14 MWt of green heat;

Construction of a photovoltaic farm with a capacity of up to 4 MWe (37,000 m²) with the installation of a battery for electricity.

The investment plan has been structured to achieve the status of an Efficient District Heating System, and the total CO₂ reduction is expected to result in a 70% reduction in CO₂ emissions compared to 2022. The first heat and electricity from the new heat source will flow to Gliwice residents in 2028.

The 2040 strategy of Gliwice in the area of heat supply received the Energy Transformation Leader Award at the 2024 Climate Congress in Warsaw. It is also nominated in the competition for the Green Product Award 2025, which will be announced during the international congress LET'S TALK ABOUT IT on November 6, 2025.

Municipality of Gniezno

District Heating Company in Gniezno (PEC) is actively involved in the process of decarbonization of the district heating system, taking a number of measures to reduce CO₂ emissions and increase the share of renewable energy sources.

One of the key steps was to replace traditional coal fines with biomass such as wood pellets and shredded oil palm nut shells. This change allowed a significant reduction in sulfur compound emissions and operating costs. The estimated savings are around PLN 200 per ton of fuel compared to the previously used coal dust, which translates into around PLN 4 million in savings per heating season. In connection with the use of biomass, PEC also conducts research and development activities on the analysis and conditions of biomass combustion, including the expected conversion of boilers, thanks to which it receives a tax credit that allows additional cost deductions and allocates funds for further development.

As a result of the large-scale deployment of biomass, PEC has achieved the status of an Efficient District Heating System. This means that at least 50% of the energy used in the system comes from renewable sources, which stabilizes heat prices and contributes to environmental protection.

Gniezno is also exploring the possibility of using geothermal waters for heat generation — exploration and appraisal wells were drilled in 2024 and yielded the first positive results, opening up opportunities for further work on implementing geothermal solutions.

Municipality of Bytom

Bytom's District Heating Company (PEC) is implementing a project entitled Green Energy Mine, which consists of eliminating local heat sources powered by coal fuel (eventually also by gas) in multi-family buildings and replacing them with heat generated from RES — photovoltaic panels combined with the installation of ground source heat pumps, whose bottom source is heat from inside the earth (deep boreholes reaching up to 100 meters deep).

The “Green Energy Mine” project sets the path for further pro-environmental investments, involving the development of renewable energy sources where it is not technically possible to connect to the system heat, replacing high-emission coal and gas boilers. Through these measures, PEC is contributing to the goals of 5th generation heating, in line with European plans for the development of the sector. The project has been named a “Green Energy Mine” because of its use of heat extracted from underground, making reference to the mining history of the city of Bytom.

Initiatives at the local level are key to decarbonizing the district heating sector. The activities outlined above are just some examples of good decarbonization practices implemented by local governments in Poland. An innovative, customized approach to decarbonization of the sector by Polish district heating companies, tailored to their capabilities and conditions, is the key to success on the road to decarbonization.

5.3.3 Heating Decarbonization in Czechia: Policies, Incentives, and Local Innovations

Regulatory Framework and Financial Incentives

Czechia is actively pursuing the decarbonization of its heating sector through a combination of regulatory measures and financial incentives, mostly subsidies. The regulatory framework is based on EU directives, namely EED, EPBD4, RES3 and EU ETS system.

The Czech government aims to phase out coal by 2033 and oil and gas by 2050. Efforts are underway to replace coal and natural gas with cleaner energy sources, including biomass, heat pumps, and waste heat recovery. Significant investments are being made to modernize heating infrastructure and support the transition to sustainable heating solutions.

The following examples are among the most significant incentives in the field of clean heating in the Czech Republic:

- **EU Support for Green District Heating** — In April 2023, the European Commission approved a €401 million Czech scheme to promote green district heating based on renewable energy and waste heat.
- **EIB Financing for Sustainable Heating** — The European Investment Bank has granted a €75 million loan to support the upgrade of the heat generation and distribution system in Brno, including the construction of a new biomass-fired combined heat and power unit.

Boiler replacement

Boiler replacement schemes are already underway, backed by government initiatives aimed at phasing out fossil fuels such as coal and natural gas. Several ministries have launched financial incentive programs to support this transition.

One of the most prominent is the New Green Savings Program, which offers subsidies covering up to 50% of costs for residential buildings that switch to renewable heating systems—including biomass boilers and various types of heat pumps. The program also supports additional energy-saving technologies like ventilation with heat recovery, wastewater heat recovery, and the use of solar thermal or photovoltaic systems to harness renewable energy.

Another program, the Operational Program Environment focuses on public buildings and supports similar solutions including cogeneration systems for combined production of electricity and heat or cooling using renewable energy sources, renovation of heat transfer stations and renovation of hot water distribution systems in areas of more buildings connected to one central boiler room (e.g. schools, hospitals).

Czechia supports a range of renewable heating technologies:

- **The country promotes various types of heat pumps**, including air-to-air, air-to-water, and ground-source systems. These are supported through financial incentives under the New Green Savings program.
- **Biomass Heating** — Biomass boilers, particularly those using wood chips, are encouraged. The Brno district heating project exemplifies this, with plans to construct a biomass-fired combined heat and power unit.
- **Geothermal Energy** — Prague is exploring geothermal heating solutions, including the utilization of geothermal energy from underground metro stations and river sources.
- **Waste Heat Recovery** — The country recognizes the potential of waste heat recovery, with projects aiming to harness heat from wastewater treatment plants and data centers.

Decarbonization of District Heating

The Czech Republic is actively pursuing the decarbonization of its district heating sector, with significant progress reported by the Teplárenské sdružení České republiky (Czech District Heating Association).

Over the past five years, more than ten district heating plants have transitioned away from coal, supplying heat and hot water to over 110,000 households and numerous other consumers. These plants have replaced more than 500,000 tons of coal annually with alternative energy sources such as biomass, natural gas, waste heat, and other renewable sources. This shift has resulted in a reduction of carbon dioxide emissions by approximately 600,000 tons per year. The transition also leads to significant savings on emission allowance payments, contributing to maintaining favorable heat prices for consumers.

Studies indicate that by 2040, up to one-third of district heating could be supplied by large heat pumps utilizing low-temperature renewable sources such as geothermal energy, riv-

ers, and wastewater treatment plants. Achieving this goal requires the removal of various barriers and the acceleration of building renovations, particularly those with high energy consumption.⁴⁴

The total investment required to replace coal in district heating plants is estimated to exceed 200 billion CZK. Specifically, investments in large heat pumps and the utilization of low-temperature heat sources are projected at approximately 52 billion CZK by 2040, with around 14 billion CZK anticipated by 2030.

The initial phase of phasing out coal in smaller heating plants is nearly complete. Larger plants in regional capitals are actively working on replacing coal, with projects expected to be operational between 2027 and 2030. The district heating sector aims to complete the transition away from coal by 2030.

Significant efforts are underway to decarbonize district heating systems on the local level, for example:

- **Mělník Power Plant Transformation** — ČEZ is transitioning the Mělník site, the largest source of district heating in Czechia, from coal to low-emission sources such as gas, biomass, and modern technologies. The goal is to achieve low-emission heat production by 2030.
- **Dětmarovice Modernization** — ČEZ plans to build a new low-emission heating and power plant in Dětmarovice, replacing coal with a combination of biomass and natural gas. This project aims to ensure reliable heat supplies for Bohumín and Orlová for the coming decades.
- **Brno's Sustainable Heating Upgrade** — The city of Brno is upgrading its heat generation and distribution system, including the construction of a biomass-fired combined heat and power unit, to reduce emissions and dependence on gas imports.

⁴⁴ Association for District Heating of the Czech Republic, tscr.cz

Other local innovations and good practices in the heating sector

Several municipalities and projects exemplify good practices in heating decarbonization:

- Prague's Heat Detox Initiatives — Prague is implementing innovative projects such as utilizing waste heat from wastewater treatment plants and exploring geothermal energy from metro stations. The city aims to reduce its reliance on coal-based heating through these initiatives. Prague is working towards a healthy future, pledging to reduce 45% of its CO₂ emissions by 2030, when compared to 2010 — a goal surpassing that of the European Commission. However, due to its use of coal in the heating system, the Czech capital has big challenges ahead on its journey to detox heat.
- Neighbourhood Project in Hradec Králové — The NOHO construction development company is developing a carbon-neutral residential project that functions as an energy community, utilizing photovoltaics, heat pumps, and smart controls for energy supply.

Conclusion

The Czech Republic's approach to heating decarbonization—through regulatory frameworks, financial incentives, and forward-thinking local initiatives—shows a strong commitment to shifting toward sustainable and renewable heating solutions.

Ongoing support and cooperation between national and local levels are crucial to achieving the country's environmental and energy targets. In particular, subsidy programs are playing a key role in enabling widespread transformation of heating systems across society. The drive to decarbonize is also fuelled by the pressing need to strengthen energy security and independence.

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5.3.4 Good Practices for the Decarbonization of Heating Systems in Slovakia

The decarbonization of Slovakia's heating systems—particularly district heating (DH)—is a critical component of the country's climate and energy transition. With nearly 70% of residential heat demand met by fossil fuels, and district heating still heavily reliant on natural gas, a transformation is both urgent and necessary. Slovakia's roadmap to 2050 requires

a mix of policy reform, infrastructure investment, renewable energy integration, and consumer-focused strategies.

One of the central pillars of heating decarbonization in Slovakia is the expansion of heat pump technology. Current uptake remains low, but government and independent roadmaps envision that by 2030, heat pumps could provide up to 9% of building heat demand—nearly doubling from current levels. Key to scaling this technology are electricity tariff reform, targeted incentives in the form of stable, long-term subsidies to overcome upfront investment barriers, Regulatory Bans on Fossil Boilers. Electrification efforts must also be paired with a cleaner power grid, emphasizing renewable electricity expansion.

Slovakia's district heating systems are highly centralized. Current DH networks rely heavily on natural gas and some coal. To meet EU decarbonization benchmarks and Renewable Energy Directive targets, Slovakia must reach 50% renewable share in DH, using biomass, geothermal, solar thermal, and industrial waste heat, which can be integrated into existing systems.

A central element of Slovakia's heating transition is the integration of renewable energy sources into district heating networks. Several cities, such as Kežmarok, have begun using geothermal energy, while other systems increasingly rely on large-scale heat pumps, solar thermal collectors, and sustainably sourced biomass. Municipalities like Galanta and Partizánske are already demonstrating success with geothermal heating.

The scale of Slovakia's heating transition demands both domestic and EU-level financing. Between 2021 and 2027, more than €60 million from EU Cohesion Funds are earmarked for DH modernization. However, long-term planning requires sustained investment channels. In addition, municipalities and utilities need support in technical capacity, data management, and public engagement.

Slovakia's path to heating decarbonization lies in a multi-pronged strategy: electrification, fuel switching, efficiency, infrastructure upgrades, and regulatory reform. These must be underpinned by strong governance, inclusive financing, and stakeholder collaboration. Good practices emerging from local geothermal pilots, building renovation programs, and smart DH network upgrades show that progress is possible.

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6. CONCLUSION AND POLICY RECOMMENDATIONS

Heat pumps are widely considered as one of the most promising clean heating solutions for individual buildings. In many European countries, heat pumps can offer competitive operating costs compared to gas boilers. However, their affordability relative to fossil fuel heating depends largely on the electricity-to-gas price ratio. Policymakers in the CEE countries should align energy prices with climate goals by gradually phasing out fossil fuel subsidies and reforming energy tariff structures that currently disincentivise clean heating technologies. Ensuring that electricity prices reflect environmental costs is essential to improving the competitiveness of heat pumps. A rebalancing of tariffs should go in parallel with protecting vulnerable households through targeted support.

While lower operating costs can make heat pumps a cost-effective choice in the long run, the high upfront investment remains a significant barrier, often preventing households from making the switch. To address this challenge, support schemes should target both the upfront investment costs and the ongoing operational costs. Many successful European subsidy programs focus on reducing the initial financial burden through grants, low-interest loans, or tax incentives, making the transition to heat pumps more accessible.

In off-grid areas, modern biomass heating may remain an option, provided that strict sustainability and air quality criteria are met. Solar thermal systems, though typically limited to domestic hot water, can help reduce energy demand—especially in sunnier regions.

Emphasising a fabric-first approach, reducing heat demand should be the starting point for decarbonising residential

heating. Improving the building envelope through insulation, window replacement, and better airtightness—is essential to minimise energy losses and enable the efficient use of low-carbon technologies.

To modernize and decarbonize district heating in the region, policy changes should focus on regulatory reform, investment in renewable energy sources, and increased energy efficiency. Governments in CEE countries should enhance regulatory incentives to encourage market competitiveness and transparency in heat pricing. In addition, policy should prioritize long-term heat planning within integrated energy strategies.

A transition to low-carbon energy sources is essential. Policymakers should incentivize the integration of renewable energy technologies—such as biomass, geothermal, and solar thermal—into district heating networks. Financial mechanisms like subsidies, feed-in tariffs, or low-interest loans can support this shift and reduce dependence on imported fossil fuels.

Finally, improving energy efficiency across the supply chain is critical. This includes modernizing distribution networks, deploying smart metering systems, and encouraging demand-side measures such as building insulation and energy-efficient appliances. Technical training and public awareness campaigns can support these efforts, ensuring a just and inclusive energy transition.





PRIORITIZING ENERGY RENOVATION
IN THE CEE COUNTRIES