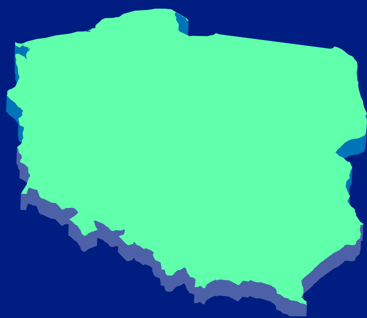
EPBD.wise

Bringing European Building Policy to Life

Development of NBRP: Policy guidelines for Poland



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ABOUT EPBD.WISE

EPBD.wise aims to kickstart action to bring Europe's buildings directive to life and make our climate goals a reality. Over the course of three years, project partners work with public authorities (such as municipalities, energy agencies, etc.) in six European countries (Bulgaria, Greece, Hungary, Poland, Romania, and Ukraine) for the design, implementation, and evaluation of key provisions to ensure our buildings are in line with our climate goals. Starting with the six focus countries, EPBD.wise builds a replicable model to support the widespread implementation of these measures across Europe.

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Publication date
March 2026

Project number	101120194
Start date of project	October 2023
Duration of the project	33 months
Deliverable number	D2.2
Deliverable leader	TU Wien

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CONTENTS

LIST OF ABBREVIATIONS

BSO	Building Stock Observatory
DH	District heating
EC	European Commission
EED	Energy Efficiency Directive
EPBD	Energy Performance of Buildings Directive
ETS2	Emissions Trading System 2
EPC	Energy performance certificates
FCCP	Focus country contact point
FED	Final energy demand
GHG	Greenhouse gas
JRC	Joint Research Centre
LTRS	Long-term renovation strategy
MEPS	Minimum energy performance standards
MFH	Multi-family house
MR&E	Monitoring, reporting, and evaluation
NBRP	National building renovation plan
NECP	National energy and climate plan
NZEB	Nearly zero-energy buildings
PED	Primary energy demand
PEF	Primary energy factor
RED III	Renewable Energy Directive
RES-H	Renewable energy sources for heating
RP	Renovation passport
SFH	Single-family house
SME	Small and medium-sized enterprises
V/A	Volume/surface
WPB	Worst-performing buildings
ZEB	Zero-emission building

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EXECUTIVE SUMMARY

This document provides policy guidelines for implementing the national building renovation plan (NBRP) in Poland, in accordance with Article 3 and Annex II of the Energy Performance of Buildings Directive (EPBD) 2024/1275. It offers support and recommendations to Polish stakeholders and policymakers for developing a comprehensive NBRP that aligns with EU decarbonisation objectives and the goal of transforming the national building stock into zero-emission buildings by 2050.

BUILDING STOCK ASSESSMENT

Poland's building stock is dominated by residential buildings, with single-family houses (SFH) and multi-family houses (MFH) accounting for the largest share of the total floor area. Older, unrenovated buildings, particularly those constructed before 1990, demonstrate the highest energy demands, often exceeding 250 kWh/(m².year), due to inadequate insulation and outdated heating systems. The document presents the distribution of specific energy needs across building categories, which forms the basis for identifying the worst-performing buildings (WPB) and setting renovation priorities. Building stock data was derived from multiple sources, including the EU Building Stock Observatory (BSO), national statistics, and the Invert/EE-Lab database.

SCENARIO ANALYSIS AND MODELLING

The document presents five policy scenarios analysed using the Invert/EE-Lab building stock model, examining different combinations of policy instruments including minimum energy performance standards (MEPS), CO_2 pricing, and investment subsidies. Key findings include:

- **Regulatory+ scenario** (comprehensive MEPS combined with fossil boiler bans) achieves the fastest phase-out of fossil fuels and the most significant reductions in energy demand.
- **Pure economic scenario** (high CO_2 prices without MEPS) results in slower progress and continued reliance on gaseous fuels.
- Without stringent regulatory measures, fossil fuels and gases remain prevalent in the energy mix, potentially leading to higher costs for renewable alternatives in the long term.

The scenario results demonstrate that stringent regulatory measures, such as MEPS for non-residential buildings and progressive renovation requirements for residential buildings, are essential to achieve Poland's decarbonisation targets.

POLICY RECOMMENDATIONS

The document provides targeted policy recommendations for Poland across several key areas:

- **Data infrastructure:** Strengthened building stock data systems, achieved by improving the completeness and reliability of EPC databases, developing a comprehensive building register, and establishing robust data collection mechanisms for renovation monitoring.
- **Regulatory framework:** Implementation of MEPS for non-residential buildings and progressive renovation trajectories for residential buildings, aligned with Article 9 of the EPBD.
- **Financial mechanisms:** Development of targeted subsidy programmes and financial instruments to support building renovation, particularly for the worst-performing buildings and vulnerable households.
- **Stakeholder engagement:** Establishment of structured consultation processes involving ministries, local authorities, building owners, the construction industry, and civil society.

MONITORING AND EVALUATION

Continuous monitoring of renovation activities is essential for tracking progress toward NBRP targets. Poland should focus on improving the completeness and reliability of EPC and logbook data, while gradually integrating market indicators and cross-referencing them with building registers. Surveys among building professionals can complement this system by providing sectoral insights, especially for private, unsubsidised renovations.

ALIGNMENT WITH EU FRAMEWORK

The NBRP guidelines presented in this document are closely linked to other EPBD provisions, particularly Article 9 (MEPS and renovation trajectories). The document identifies specific inputs to the NBRP template provided by the European Commission in Annex II, covering building stock overview, roadmap development, policies and measures, and monitoring frameworks.

INTRODUCTION

1.1 SCOPE AND OBJECTIVES OF THE DELIVERABLE

This document provides guidelines for policymakers on setting up national building renovation plans (NBRPs) according to EPBD Article 3 and Annex II in Poland. It builds on the existing long-term renovation strategies (LTRS) introduced by the amending Directive (EU) 2018/844 (see Chapters 1.4 and 1.5) and the policy needs and good practice examples identified in a previous phase of the project [1]. A relevant part of the report focuses on developing scenarios for renovating building stocks and establishing the necessary database.

This document provides support and recommendations to stakeholders and policymakers for the development of NBRPs. In particular, it identifies the specific parts in the NBRP template provided in EPBD Annex II to which the policy guidelines provide targeted inputs. The drafting of the NBRP is closely connected to the development of other policy elements specified in the EPBD. In particular, there is a strong link between NBRPs and the provisions in Article 9 of the EPBD, since the trajectories of progressive building renovation for residential buildings and minimum energy performance standards (MEPS) for non-residential buildings form an integral part of the projections to be presented in the NBRP, namely in terms of targets to be achieved and the policy measures required to reach them.

Thus, both documents – the policy guidelines for Article 9 and the one for NBRP – refer to each other in specific points [2]. Additionally, certain elements, such as the description of scenario assumptions and the modelling approach outlined in this document, are also relevant to Article 9. Table 1 provides an overview of how the content is organised across the two reports. Reading both policy guideline documents together is considered helpful for a complete understanding.

TABLE 1: DISTINCTION OF CONTENT REGARDING POLICY GUIDELINE DOCUMENTS FOR NBRP AND ARTICLE 9

	Policy guideline NBRP (D2.2)	Policy guideline Article 9 (D3.2)
Building stock data	Data collection and description of building stock data, including its distribution regarding energy consumption levels	How to derive the worst-performing buildings and 16th/26th quantile thresholds for minimum energy performance standards
Modelling assumptions and scenario design	Overall modelling approach, scenario design, and scenario framework data (e.g. energy prices)	Specific elements affecting the effectiveness of the Article 9 instrument, such as the evolution of primary energy factors
Scenario results	Overall pathway results, e.g. in terms of final energy demand by energy carrier	Specific results showing the target achievement of Article 9, split by residential and non-residential buildings
Checking target achievement	Overall evaluation of target achievement, including ZEB consistency, RED III consistency, and fossil fuel phase-out	Article 9 targets, in particular, focus on the compliance of the trajectories for residential buildings
Stakeholder engagement	Included	Not included
Monitoring, evaluation	Monitoring of renovation activities and establishing a continuous feedback and evaluation mechanism	Focus on the compliance with MEPS (non-residential buildings)

1.2 STRUCTURE OF THE DELIVERABLE

This deliverable is structured to provide a comprehensive framework for implementing NBRP according to the Energy Performance of Buildings Directive (EPBD) (2024/1275) [3]. Chapter 2 summarises the policy needs identified through consultations with stakeholders and good practices relevant to Poland. Chapter 3 provides an overview of the building stock data for the three countries and explains how to use this data to evaluate the target achievements outlined in the EPBD. Chapter 4 conducts scenario analyses to examine the potential effects of varying policies. Chapter 5 presents the modelling and scenario results. Chapter 6 includes templates and guidance on setting up the NBRP documents, including structure, content, figures, and tables. Chapter 7 outlines procedures and recommendations for stakeholder involvement. Chapter 8 addresses the monitoring and evaluation of renovation activities. Chapter 9 discusses the interaction with other policy elements. Chapter 10 is the main section of the document, where country-specific policy guidelines and recommendations are presented for Poland. The final chapter summarises the key findings and provides practical advice to policymakers.

1.3 METHODOLOGY AND APPROACH

This chapter outlines the general approach and main steps required for setting up the NBRP. Figure 1 illustrates a three-step methodology, starting with assessing the data on the current building stock, which is also used for identifying the worst-performing buildings (WPB). This provides the input for modelling projections of building renovation, based on the assumption of policy measures. Policy measure assumptions and modelling results must be considered iteratively in the stakeholder discussion process. Integrating this with the complete set of policy instruments and components of the EPBD needs to be collected in the NBRP report.

STEP 1: BUILDING STOCK DATA COLLECTION AND IDENTIFYING THE WPB

The first step of the process consists of collecting data on the current building stock and ongoing building activities. Reliable and comprehensive data collection is essential for evaluating a building's energy performance and overall condition. The key objective is to identify the WPBs: buildings with high energy consumption, low energy class, or a certain construction period and renovation status.

This is facilitated by a cyclical interaction between data and WPB classification, ensuring the most critical cases are prioritised for renovation. Accurate data sources may include energy performance certificates (EPCs), renovation rates, and historical consumption patterns.[1][2]

STEP 2: MODELLING, POLICIES AND MEASURES, AND STAKEHOLDER ENGAGEMENT

Once the data on the building stock is set up and WPBs have been identified, the process moves toward designing policies, measures, and related decision-making. This step involves three key elements:

1. **Modelling:** Using data-driven models to assess renovation scenarios, predict energy savings, and optimise investment strategies. In this study, we use the building stock model Invert, described in more detail in Chapter 4.5.
2. **Policies and measures:** Developing regulatory frameworks, financial incentives, and renovation guidelines to support energy efficiency improvements. In particular, measures in line with Article 9 of the EPBD must be considered. Within this study, we focus on the role of minimum energy performance standards (MEPS), CO_2 prices, investment subsidies, and different development pathways of primary energy factors (see Chapter 4). These policy instruments were selected because they represent the core mechanisms available to Member States for driving building renovation: MEPS provide regulatory requirements that mandate action on the worst-performing buildings; CO_2 pricing creates economic incentives for fuel switching and efficiency improvements; and subsidies address financial barriers that often prevent building owners from undertaking renovations. The interaction between these instruments determines the pace and depth of building stock transformation.

1 For the building stock data analysis in this project, we rely on existing data sources and proven approaches, as described in Chapter 3.

2 For Poland, additional details on building stock data and worst-performing building identification are provided in Deliverable D3.2.

3. **Stakeholders:** Collaboration among policymakers; local, regional, and national authorities; researchers; building owners; civil society; financial institutions; and other partners listed in Article 3 of the EPBD is essential to ensure the feasibility and effectiveness of renovation strategies.

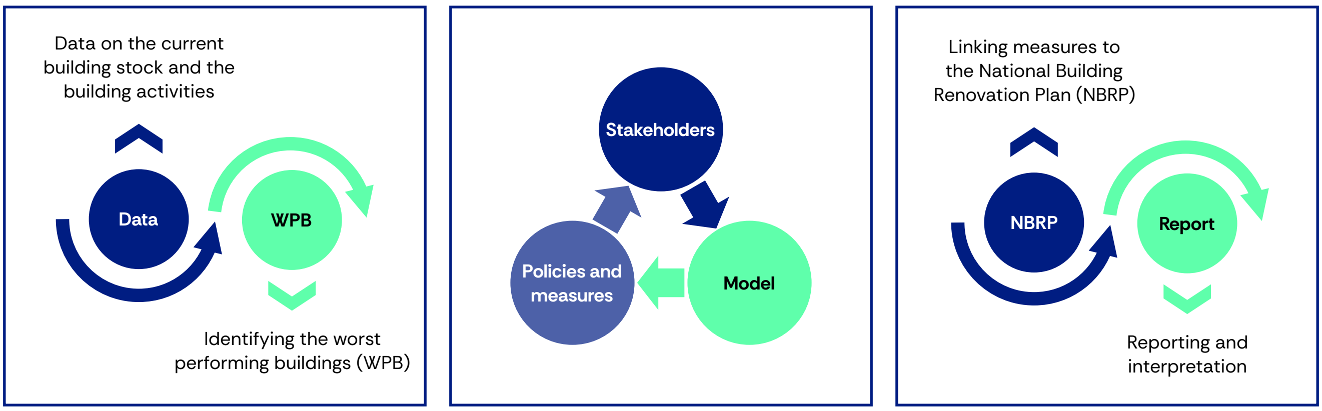
The results of this report were discussed with stakeholders in the framework of dedicated policy forums. More detailed guidelines for framing this stakeholder engagement process are discussed in Chapter 7. For comprehensive guidance on monitoring, reporting, and evaluation of NBRP implementation, see Deliverable D6.3 An integrated monitoring, reporting and evaluation framework for effective EPBD implementation.

The interplay between these three components ensures that renovation efforts are achievable and aligned with national and European climate goals.

STEP 3: LINKING MEASURES TO THE NBRP AND RELATED TARGETS

The final step is to integrate the identified measures into the NBRP. A feedback loop links the proposed renovation measures to the specific targets and milestones defined in the EPBD, including the 2030 and 2035 trajectories for residential buildings and MEPS compliance for non-residential buildings. A feedback loop should be established in the drafting phase of the NBRP to ensure continuous monitoring and policy evaluation, and to maintain this link with long-term goals. This will help policymakers evaluate the effectiveness of implemented measures and make necessary adjustments to improve outcomes.

FIGURE 1: STEPWISE APPROACH TO DERIVE TRAJECTORIES FOR A PROGRESSIVE DECREASE IN THE AVERAGE PRIMARY ENERGY USE



1.3.1 INTERFACE WITH ARTICLE 9

The development of NBRPs is closely linked to the implementation of Article 9 of the EPBD, which establishes minimum energy performance standards (MEPS) for non-residential buildings and progressive renovation trajectories for residential buildings. Both instruments share common data requirements, particularly regarding the characterisation of building stock and the identification of worst-performing buildings. The scenario analyses and modelling approaches presented in this document are directly relevant to the implementation of Article 9, as they inform the feasibility and impact of different MEPS trajectories. For detailed guidance on implementing Article 9, refer to the companion policy guideline in Deliverable D3.2.

1.4 DESCRIPTION OF THE NBRP FRAMEWORK UNDER EPBD (2024/1275)

NBRPs are introduced with the Directive (2024/1275) in Article 3, under which each Member State (MS) shall establish a plan to ensure the renovation of the national stock of residential and non-residential buildings, both public and private, into a highly energy-efficient and decarbonised building stock by 2050, and transform it into zero-emission buildings (ZEBs) by 2050 [3]. The NBRPs are not just a reporting obligation under the EPBD; they are a strategic policy tool essential in steering the long-term evolution of the national building inventory. Buildings account for a large share of the EU's total energy use and greenhouse gas emissions. Consequently, NBRPs present an essential tool for Member States to synchronise their national initiatives with the EU's goal of achieving climate neutrality by 2050. Through establishing specific objectives, recognising investment requirements, and aligning policy efforts across various sectors and governance tiers, NBRPs act as a detailed guide for achieving a highly energy-efficient and emission-free building stock. Additionally, they assist in incorporating broader societal objectives, such as reducing energy poverty, fostering job creation, and enhancing indoor environmental quality, making them essential tools for achieving a fair and inclusive energy transition. Article 3 outlines that each NBRP must include:

- An overview of the national building stock for different building types, including their share in the national building stock, construction periods, and climatic zones; an overview of market barriers and market failures; an overview of the capacities in the construction, energy efficiency, and renewable energy sectors; and the share of vulnerable households.
- A roadmap with nationally established targets and measurable progress indicators, including the reduction of the number of people affected by energy poverty, with a view to achieving the 2050 climate neutrality goal, in order to ensure a highly energy-efficient and decarbonised national building stock and the transformation of existing buildings into ZEBs by 2050.
- An overview of implemented and planned policies and measures.
- An outline of the investment needs for the implementation of the NBRP, the financing sources and measures, and the administrative resources for building renovation.

- The thresholds for the operational greenhouse gas emissions and annual primary energy demand of a new or renovated ZEB.
- Minimum energy performance standards (MEPS) for non-residential buildings.
- National trajectory for the renovation of the residential building stock, including the 2030 and 2035 milestones for average primary energy use in kWh/(m^2.y).
- An evidence-based estimate of expected energy savings and wider benefits, including those related to indoor environmental quality.

Annex II of the Directive (2024/1275) provides additional information on the mandatory and optional indicators to be included in the NBRP. For example, it specifies that Member States must report on primary and final energy consumption, annual operational greenhouse gas (GHG) emissions, and the annual renovation rate of the national building stock. Optional indicators include aspects such as the number of EPCs per construction period, the reduction in energy costs per household, and the number of jobs created in the renovation sector.

Member States must submit the first draft of NBRPs to the Commission by 31 December 2025. To support Member States in this process, the European Commission has published guidance and provided an NBRP template, which consists of an Excel sheet for targets, indicators, and measures, as well as a Word template for the NBRP narrative. The final guidelines were published in June 2024.

1.5 STATUS OF PREVIOUS LTRS AND SCENARIO WORK

This chapter provides an overview of the LTRS, including its status and main elements, for Poland. The chapter summarises the available data, including information on the building stock, energy performance characteristics, and renovation needs, as well as the scenarios and modelling assumptions used to project renovation pathways up to 2050.

Although the level of detail and structure varies across countries, all three strategies aim to identify cost-effective renovation trajectories that align with national climate and energy goals while addressing technical, financial, and institutional challenges.

Poland's LTRS provides a detailed analytical basis for assessing the current state of the national building stock and its future renovation potential. The document includes extensive data covering both the residential and non-residential sectors:

- Number of buildings per building type (SFH, MFH, collective accommodation buildings, public buildings, production, utility and warehouse buildings, other non-residential).
- Median of annual PEF values for residential buildings by building purpose and age [kWh/(m^2.year)].
- Median of annual non-renewable PEF values for public buildings by building purpose and age [kWh/(m^2.year)].
- Age structure of Polish pre-2002 housing stock and its baseline unitary annual energy factors.

- Requirements concerning maximum values of the heat penetration coefficient for envelope elements of heated building spaces.
- Inhabited residential buildings and dwellings in inhabited residential buildings in the years 2002 and 2011.
- Space heating by heating techniques in 2018 (in %).
- Water heating by heating techniques in 2018.
- Households by light sources used in 2015 and 2018.
- Thermal renovation needs of the multi-family buildings included in the survey.
- Heat source in the buildings surveyed before and after energy renovation.
- Average PEFs before and after energy renovation and savings gained.
- Average PEFs before and after energy renovation and savings gained by type of owner or manager.
- Average values of annual energy consumption for central heating before and after energy renovation and savings gained, by types of owners or managers.
- Estimated costs of deep energy renovation with no replacement of the heat source in 2035 for single-family, multi-family, and commercial and industrial buildings, depending on the pre-renovation condition.
- Estimated costs of deep energy renovation with the installation of a heat pump in 2035 for single-family, multi-family, and commercial and industrial buildings, depending on the pre-renovation condition.
- Estimated price of district heat and electricity in 2035–2050 under conditions of climate neutrality (PLN/kWh).
- Expected percentages of residential buildings to undergo energy renovation.
- Area of residential buildings to undergo potential energy renovation.
- Estimated annual final energy demand of residential buildings by year built.
- Potential for final energy savings in residential buildings.
- GHG emission reduction volume for residential buildings.
- Particulate matter emission reduction volume for residential buildings.
- Savings produced by support for investments under the Thermomodernisation and Renovation Fund (cumulative savings in PLN million).
- Total number of renovations to be completed in a certain period (2021–2030, 2031–2040, 2041–2050) and number of deep renovations to be completed in a certain period (2021–2030, 2031–2040, 2041–2050) under the recommended scenario.
- Estimated average building renovation capex in the recommended scenario, 2021–2050.
- Estimated energy and cost savings as a result of renovations.

The Polish LTRS also provides long-term energy renovation scenarios up to 2050, reflecting different renovation depths, rates, and policy assumptions. Three main scenarios are analysed:

SCENARIO 1: QUICK AND DEEP ENERGY RENOVATION

The first scenario assumes a broad-ranging, deep energy renovation of the building stock, starting with buildings that have the lowest energy efficiency. It is the most ambitious and most economically viable plan.

This scenario assumes that by 2027, all buildings with a PEF greater than 330 kWh/(m².year), and by 2035, all buildings with a PEF higher than 230 kWh/(m².year), will have undergone energy renovation. By 2045, all buildings will have a PEF of no more than 150 kWh/(m².year). According to this scenario, by 2050, 65% of the building stock will have a PEF of less than 50 kWh/(m².year), and 24% will have a PEF between 50 and 90 kWh/(m².year). The remaining 11% of the buildings, which cannot undergo a deep renovation due to technical reasons, will have achieved a PEF between 90 and 150 kWh/(m²). Under this scenario, the average annual renovation rate is around 3%.

SCENARIO 2: STAGED ENERGY RENOVATION

The second scenario involves the extensive renovation of building stocks, where buildings in the poorest condition will be renovated in stages until the highest energy efficiency levels are achieved. The individual stages of renovation comprise only portions of the full scope of energy renovation work, allowing the target energy performance to be attained in steps, and avoiding the accumulation of spending and aggregate demand for the necessary goods and services. Importantly, this approach ensures consistency between the various renovation stages and prevents duplication or conflicting activities in subsequent stages.

This scenario assumes that by 2027, all buildings with a PEF greater than 330 kWh/(m².year), and by 2035, all buildings with a PEF higher than 230 kWh/(m².year), will have undergone energy renovation. By 2045, all buildings will have a PEF of no more than 150 kWh/(m².year). Thus, the pace at which the poorest performance brackets are eliminated remains the same as in the first scenario; however, buildings start to be renovated to a PEF below 90 kWh/(m².year) only after 2035.

In the staged energy renovation scenario, by 2050, 63% of the building stock will have achieved a PEF of less than 50 kWh/(m².year), and 19% will have a PEF between 50 and 90 kWh/(m².year). The remaining 18% of the building stock, which cannot undergo deep thermal renovation due to technical or economic reasons, will have attained the PEF bracket of 90–150 kWh/(m².year). Therefore, the outcome of this scenario is less effective than that of quick and deep energy renovation, due to the lower cost and technical efficiency of staged activities.

SCENARIO 3: RECOMMENDED SCENARIO

The recommended scenario combines the advantages of the two scenarios mentioned above. It involves the rapid execution of the first stage of energy renovation for buildings in the poorest energy efficiency brackets, followed by the popularisation of deep energy retrofits in the near future, and subsequently, the market-wide adoption of high-standard renovations.

This scenario assumes that by 2027, all buildings with a PEF greater than 330 kWh/(m^2.year), and by 2035, all buildings with a PEF higher than 230 kWh/(m^2.year), will have undergone energy renovation. By 2045, all buildings will have a PEF of no more than 150 kWh/(m^2.year).

In the recommended scenario, by 2050, 65% of buildings will have achieved a PEF of less than 50 kWh/(m^2.year), and 22% will have a PEF between 50 and 90 kWh/(m^2.year). The remaining 13% of the building stock, which cannot undergo deep thermal renovation due to technical or economic reasons, will have attained the 90–150 kWh/(m^2.year) bracket. Therefore, the result of this scenario is comparable to that obtained in the quick and deep energy renovation scenario. This results from the early launch of scaling up deep energy renovation investments and a reduction in the number of subsequent renovation stages, which improves the economic and technical efficiency of activities compared to the multi-stage retrofitting scenario.

SUMMARY OF THE POLICY NEEDS AND BEST PRACTICE EXAMPLES

The key policy needs related to developing and implementing NBRPs were identified in the scope of Deliverable D2.1. Our approach consisted of comprehensive desk research, analysing existing projects and related reports to establish a baseline understanding of policy needs in focus countries. We conducted a detailed questionnaire in Poland and other focus countries within the EPBD.wise project. Subsequently, we organised workshops with focus country contact points (FCCPs) and policy forums in Poland to better understand national needs and the specific situation.

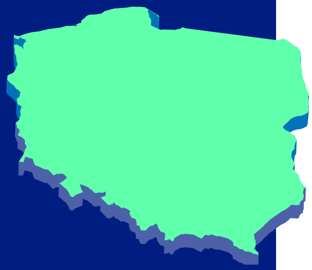
This multi-faceted research approach enabled us to identify specific policy needs for each focus country. From this analysis, countries prioritised different policy elements based on their unique needs; for Poland, NBRPs were identified as a priority. Moreover, our findings must not only cater to the immediate needs of these focus countries but also remain applicable and replicable for other EU countries. This broader vision ensures that the strategies and policy recommendations developed can serve as a model for harmonised building renovation policies across the entire European Union (EU).

The identification of policy needs was complemented by the identification of good practice examples. This process included quantitative and qualitative analysis, stakeholder engagement, legal and administrative screening, and evaluation techniques. Based on the Joint Research Centre's (JRC) report, good practice examples were compiled for Deliverable D2.1. The report assessed each LTRS, evaluated the strategies' compliance with the Directive, and checked if all the requirements were adequately addressed in each national strategy [4]. Table 2 provides an overview of the policy needs identified across the focus countries, along with corresponding good practice examples from other Member States.

TABLE 2: OVERVIEW OF POLICY NEEDS

General challenge addressed	Specific challenge addressed	Policy needs (1–7)	Good practice example
Data availability, accessibility, and quality for effective policymaking	Building stock overview (residential and non-residential)	1	Italy
Good governance	Public consultation	–	Slovakia
	Policies and actions on public buildings	2	Wallonia, Belgium
	Implementation details on the latest LTRS	2	Spain
	Policies and actions on deep renovations of buildings, including staged deep renovation and RPs	2, 6	Wallonia, Belgium
	Policies and actions on WPB and energy poverty	2, 4, 6	Spain
Construction industry and labour and skill shortages	An overview of national initiatives to promote smart technologies, as well as skills and education in the construction and energy efficiency sector	–	Wallonia, Belgium
Clear presentation of co-benefits	Expected energy savings and wider benefits	6, 7	Lithuania
Estimation of the impacts, in particular, of the broader benefits of energy efficiency	Roadmap with indicative milestones (decarbonisation, renovation rate, renovation of building stock, energy savings)	7	Finland
	Cost-effective approach to renovation (identification of trigger points)	2, 7	Lithuania
Financing	The mechanisms for mobilising investments (the aggregation of projects under single or multiple ownership to make them more attractive to investors, the reduction of the perceived risk of energy efficiency financing for investors and the private sector, the use of public funds to leverage private investment, the guidance of investments into an energy-efficient public building stock, the provision of better advice in the market, such as one-stop shops)	3	Wallonia, Belgium

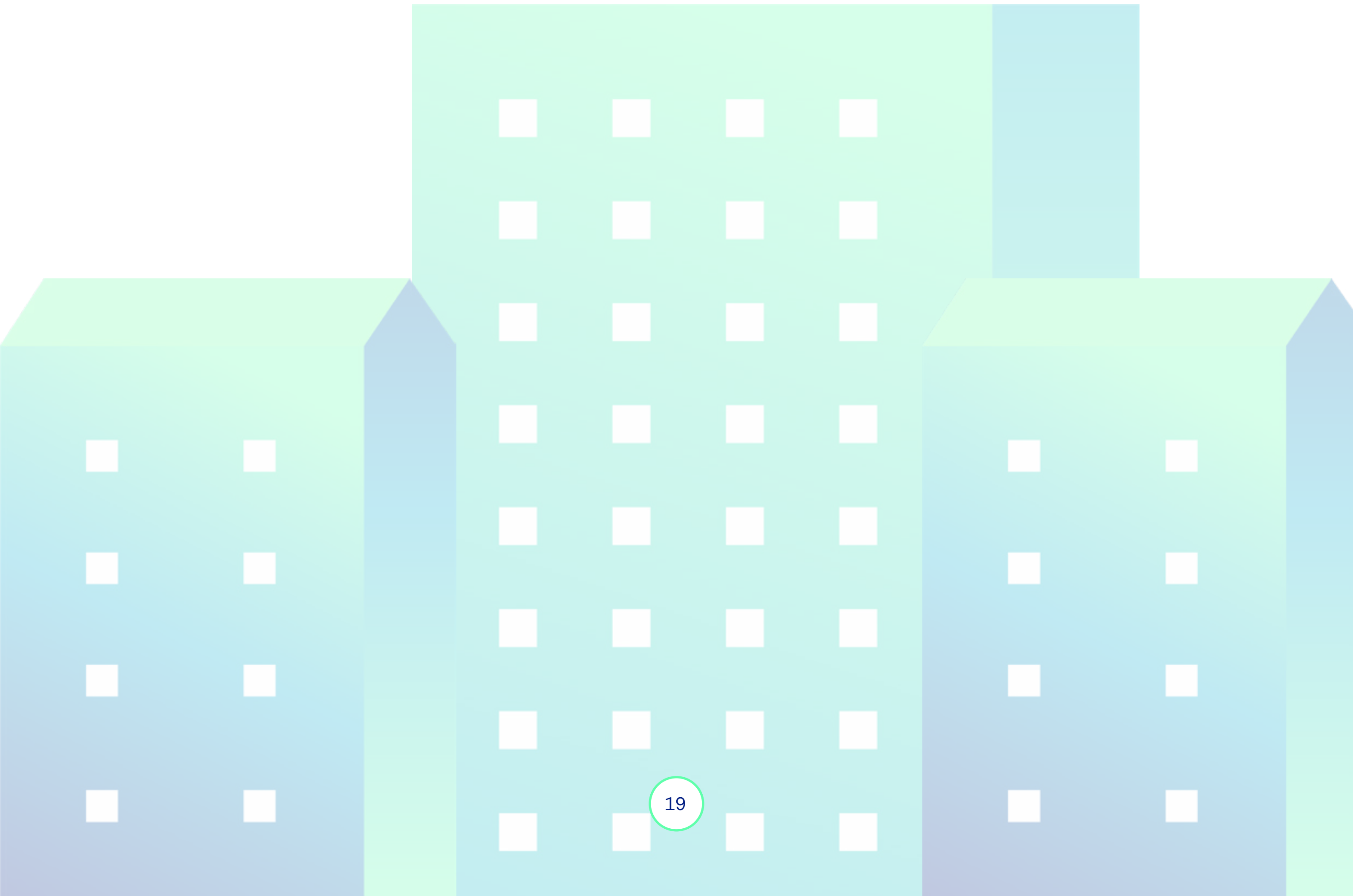
In Poland, the primary obstacle to a comprehensive understanding and implementation of the NBRP is the significant gap in building stock data, particularly for single-family homes. This sector represents a substantial and crucial part of Poland's building stock, yet lacks comprehensive strategies, coherent policy support, and data. Poland requires tailored support in drafting and operationalising these plans, as well as fostering sector-specific integration, developing methods for building stock data collection, exploring funding and financing mechanisms, and establishing a methodology for cost calculations. This should primarily focus on decarbonising the building sector, where targeted initiatives could include incentivising energy-efficient technologies and practices. Enhancing expertise and resources dedicated to these areas would improve Poland's alignment with EPBD mandates and its overall energy efficiency targets.



For Poland, the policy support areas focus on:

1. Improving building stock data collection and quality.
2. Assessing policies and measures required to set and achieve specific targets.
3. Understanding investment needs and required financing programmes.
4. Identifying and collecting data on worst-performing buildings.
5. Developing measures to enhance energy performance in public buildings.
6. Policies and actions on deep renovations.
7. Analysing broader impacts and measures to address energy poverty.

Table 2 provides an overview of these policy needs alongside good practice examples from other Member States.



BUILDING STOCK DATA AS A STARTING POINT[3]

This chapter addresses Section (a) of the NBRP template in Annex II of the EPBD, which requires Member States to provide an overview of the national building stock. The data and methods presented here directly support policymakers to complete sections of the template related to building stock characteristics, energy performance distribution, and identification of worst-performing buildings.

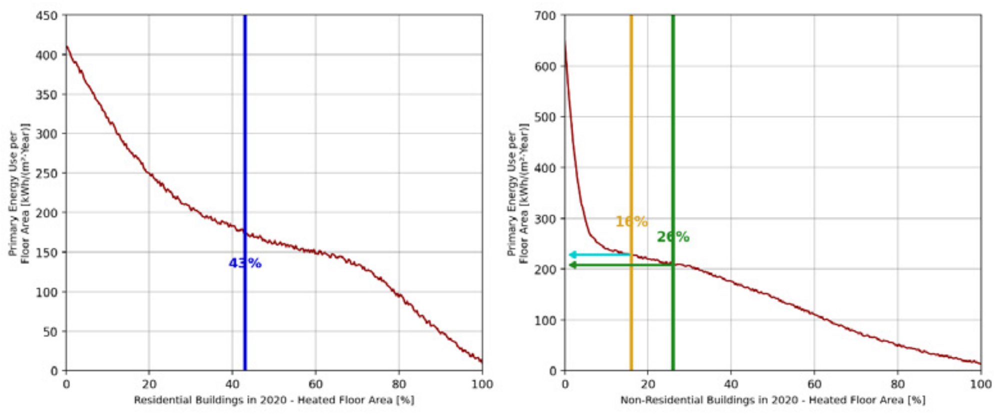
THE NBRP CONTAINS THE FOLLOWING THREE MAIN PARTS:

1. **Overview of the national building stock.**
2. **Roadmap for 2030, 2040, 2050.**
3. **Overview of implemented and planned policies and measures.**

In this regard, building stock data is a key starting point for developing the NBRP, particularly for assessing the target achievements laid out in the EPBD. The development of NBRPs requires a description of the building stock, among others, along two dimensions: ① conditioned floor area and ② primary (or final) energy use per floor area, each for both residential and non-residential buildings. The resulting distribution curve is needed to derive the 43% share of WPB on the one hand and the 16^{th} and 26^{th} quantiles for non-residential buildings on the other hand.

3 As described in Chapter 1.1, there are links between the policy guideline documents of NBRP and Article 9. In particular, regarding building stock data, the analyses regarding Article 9 build on the concepts and data described here.

FIGURE 2: DISTRIBUTION CURVE OF THE BUILDING STOCK (PRIMARY ENERGY USE OVER CONDITIONED FLOOR AREA OF THE BUILDING STOCK) AS A KEY REQUIREMENT



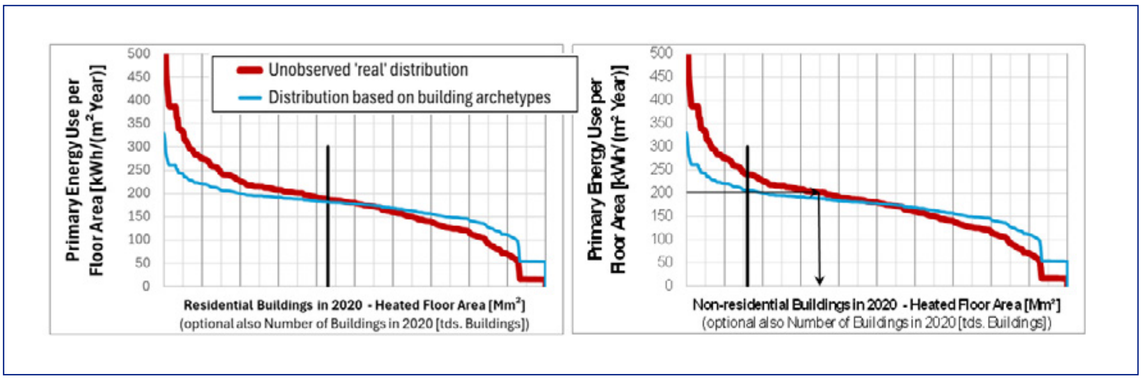
3.1 METHODS FOR COMPILING BUILDING STOCK DATA AND RELATED ENERGY USE

There are four main approaches to derive the primary energy use data needed:

1. Archetype-based (reference buildings) bottom-up modelled results based on geometries and U-values, installed technology (e.g. EU Building Stock Observatory (BSO)).
2. Measured energy consumption data for a representative sample of buildings.
3. EPCs (from a representative sample for the whole building stock).
4. Statistical approach (applying distribution functions).

The archetype-based approach can build on reliable data sources such as the BSO [5], national building stock statistics, or other sources such as Tabula/Episcope [6]. However, essential data elements are often missing, such as the share of previously performed building renovation activities for the split of heating systems on different building segments or vintage classes (construction periods). Here, expert opinions or additional data may be necessary. By comparing data from measured energy consumption of buildings (red line), which is typically unobserved, with the distribution based on the archetype approach (blue line), Figure 3 shows that the actual distribution might be steeper, i.e., the archetype-based approach might underestimate the variance of the distribution. If the actual implementation and measurement of achievements for non-residential buildings were based on actual energy consumption (i.e., the red curve), while the setting of the 16th and 26th percentile thresholds is based on the archetype approach, this could lead to a significant deviation in the case of non-residential buildings. In the case shown on the right-hand side of the figure, it would mean that not 16% but rather 35% would need to be renovated. Such a distortion obviously should be avoided.

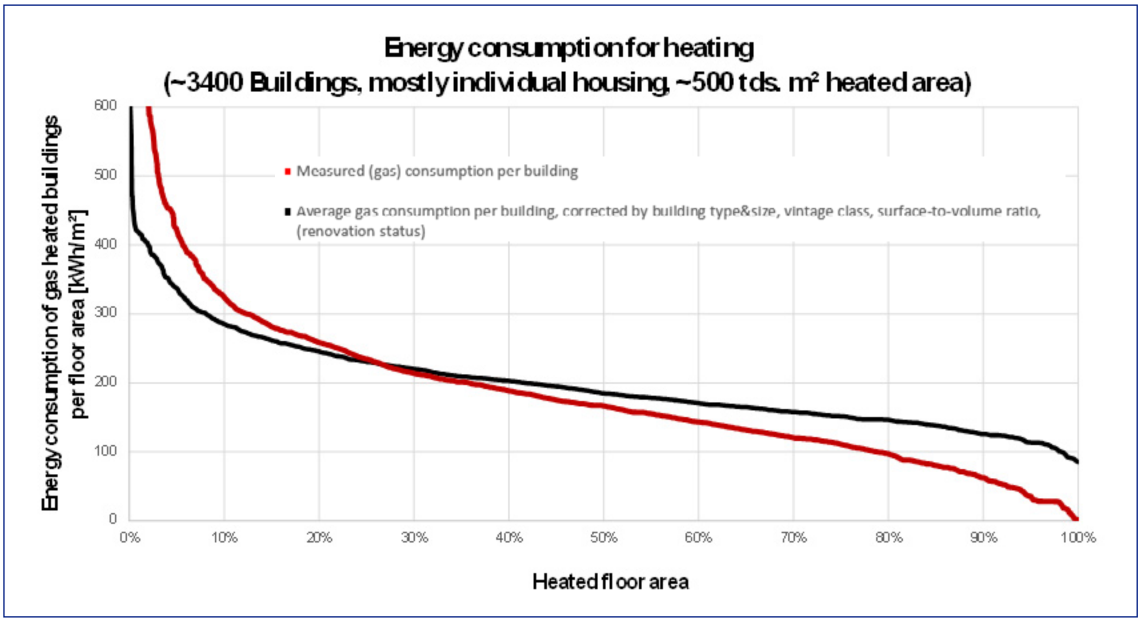
FIGURE 3: POSSIBLE BIAS IN THE USE OF THE ARCHETYPE-BASED BOTTOM-UP APPROACH FOR RESIDENTIAL BUILDINGS (LEFT) AND NON-RESIDENTIAL BUILDINGS (RIGHT)



The approach based on measured energy consumption for a representative sample of buildings benefits from the fact that the measured energy consumption data explicitly consider the actual building usage, refurbishment status, climatic conditions, and other relevant factors. Also, if the building stock is heated by a high share of gas or district heating, a few grid operators or companies typically own the consumption data. However, in the case of electricity, the consumption counted in the EPBD is usually not directly measured. Secondary heating systems are also often difficult to consider. In particular, if larger shares of electricity, heating oil, and biomass are used for heating or if there is a high cooling demand, the approach typically has its limitations. Additionally, it is crucial to note that the use of consumption data must comply with data protection regulations.

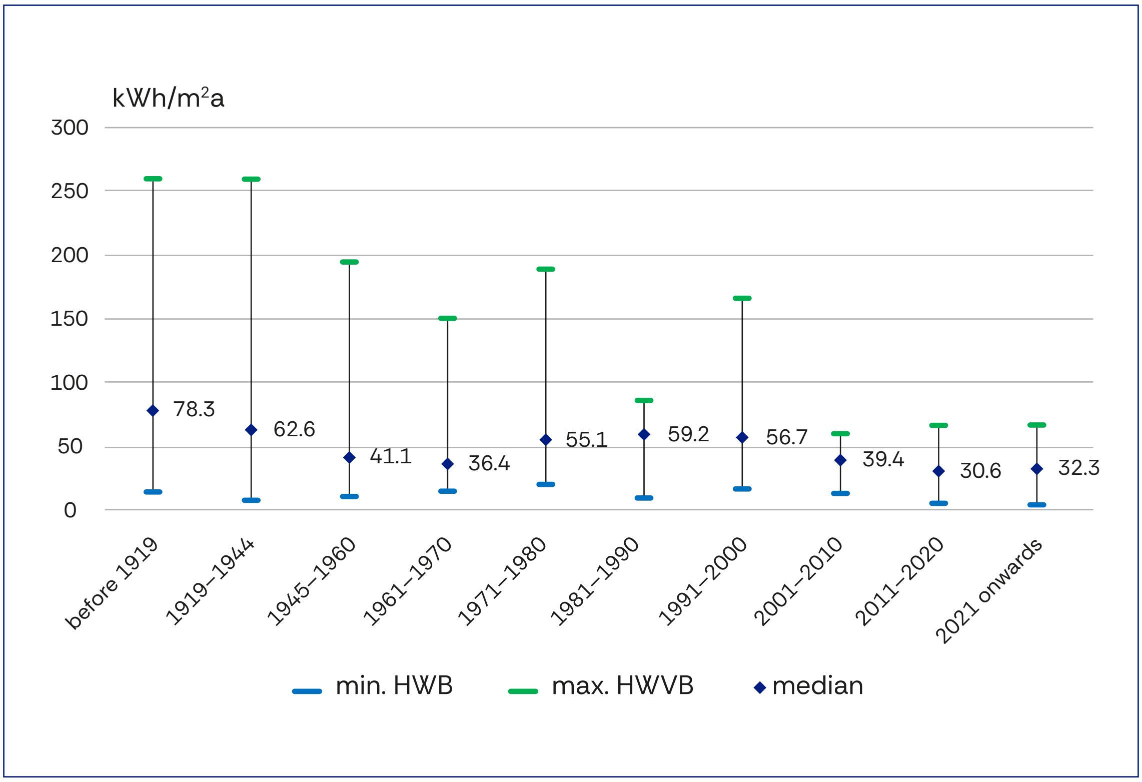
The figure illustrates the potential error associated with this approach, where measured energy consumption (in this case, gas consumption) is used to derive the distribution curve of energy consumption.

FIGURE 4: MEASURED ENERGY CONSUMPTION AND THE BIAS TO GAS CONSUMPTION CORRECTED BY CERTAIN BUILDING-RELATED DATA



The approach based on EPC databases benefits from the fact that EPCs typically include the required information based on an established, clearly defined, and agreed-upon methodology. In many countries, the data is stored in one or a few databases. However, as a downside, it is worth noting that the total sum of primary energy use reported by EPCs is generally inconsistent with the energy use data in energy balances. Also, in many countries, there is a bias in the buildings represented in EPC databases. The distribution of energy needs for space heating in residential buildings in an exemplary city, as shown in Figure 5, illustrates that there is likely an overrepresentation of refurbished buildings, which can be observed, for example, from the low mean value in the 1961–1970 period. Also, in this city, EPCs are only available for 12–15% of all buildings.

FIGURE 5: DISTRIBUTION OF ENERGY NEEDS FOR SPACE HEATING IN RESIDENTIAL BUILDINGS, FOR EXAMPLE, IN AN AUSTRIAN CITY WITH A POPULATION OF ABOUT 130,000



Source: Behmann: Statistische Quartalsblätter, Stadtmagistrat Innsbruck, Referat Statistik und Berichtswesen, Heft 2/2023.

The approach is based on a standard distribution chosen in the Austrian NBRP. Here, energy consumption data from the energy balances and the useful energy analysis for different building categories have been considered from 1990–2020. The total energy consumption is climate-corrected and divided by the gross floor area. This represents the average building. By describing this building with the V/A (volume/surface) ratio and considering this ratio, the value is adjusted by the mean V/A value. In addition to this mean value, a normal distribution is assumed, so that the lower range of the 99% quantile aligns with the building code for the most efficient buildings in 2021 (NZEB standard). Since the building codes and EPCs in Austria refer to the V/A (volume/surface ratio, also known as characteristic length), these values can be directly linked to the results in EPCs and building codes.

3.2 BUILDING STOCK DATA

The building stock data presented in this section is derived from multiple sources, including the EU Building Stock Observatory (BSO), Polish national statistical databases, and the Invert/EE-Lab database maintained by TU Wien. Data has been validated against national energy balances and updated to reflect the most recent available statistics (as of 2023).

Figure 6 shows the specific energy needs for space heating, measured in kWh/(m².year), across various building subsectors in Poland, with the data plotted against gross floor area (in thousands of square metres). The coloured areas of the graph correspond to different building categories, with single-family houses (SFHs) and multi-family houses (MFHs) occupying the majority of the floor area. The blue line represents the specific heating energy demand for the whole building stock at the start of the year for existing buildings. Figure 7 shows specific energy needs for space heating against the number of buildings where SFHs dominate. The large proportion of residential buildings plays a crucial role in shaping the distribution of energy consumption, as there are fewer buildings and a lower total floor area in non-residential sectors, such as offices and services, compared to residential ones. Older, unrenovated SFH and MFH buildings, primarily located on the left side of the graph, demonstrate the highest energy demands (exceeding 250 kWh/m².year) due to inadequate insulation standards and outdated heating systems. In contrast, newer or renovated buildings on the right exhibit significantly reduced heating requirements, reflecting advancements in energy efficiency regulations. The variations among building types emphasise the necessity for targeted renovation strategies to enhance energy performance, especially within the residential sector, which has the highest energy consumption per unit area.

The energy needs shown in the following figures are based on calculations. User behaviour might lead to slightly different shapes and deviations from this theoretical pattern.

FIGURE 6: SPECIFIC ENERGY NEEDS FOR SPACE HEATING OVER GROSS FLOOR AREA BY BUILDING CATEGORY. SOURCE: INVERT DATABASE

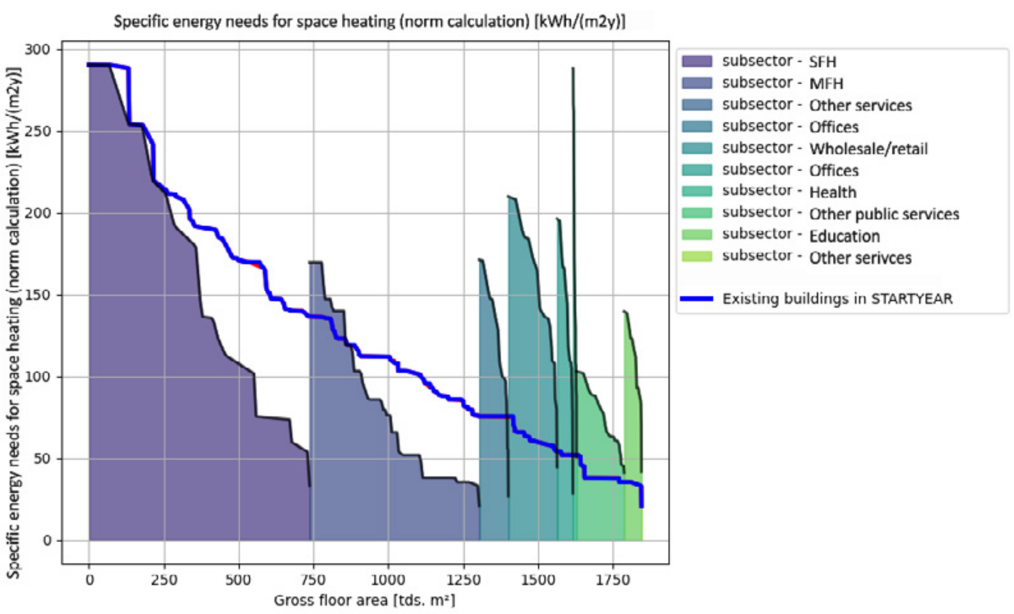
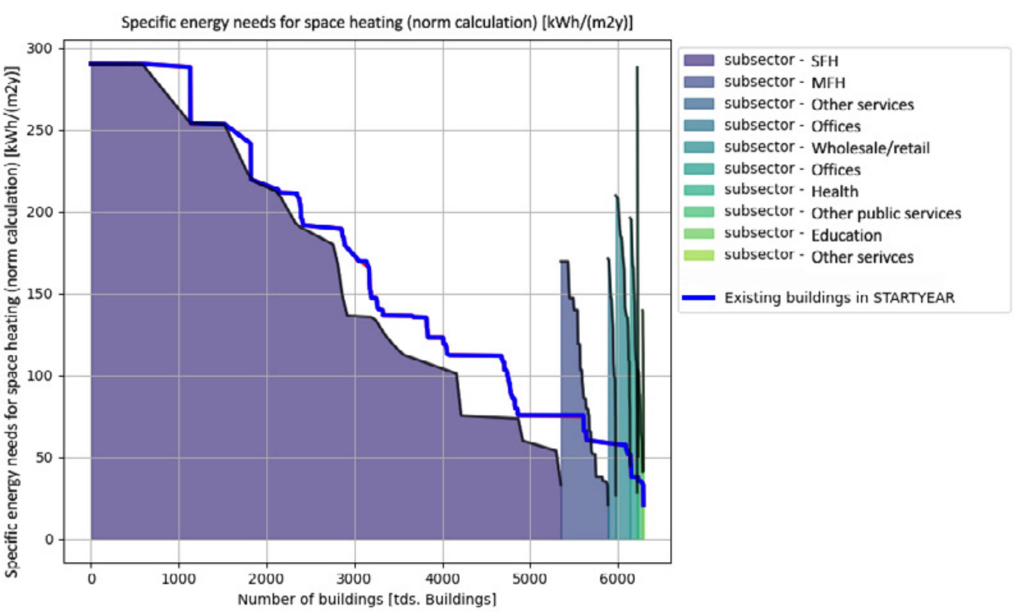


FIGURE 7: SPECIFIC ENERGY NEEDS FOR SPACE HEATING OVER THE NUMBER OF BUILDINGS PER BUILDING CATEGORY. SOURCE: INVERT DATABASE



DRAFT NBRP SCENARIO ANALYSES: METHOD AND SCENARIO DESIGN

This chapter examines how various policy packages can achieve national building renovation objectives in Poland. Using the Invert/EE-Lab building-stock model parameterised for each country, we assess final/primary energy, operational GHG emissions, renovation activity by depth, uptake of heating options, and outcomes for worst-performing buildings.

4.1 POLICY DIMENSION

The policy dimension describes the types of policy instruments considered in the scenario design. These instruments represent the main levers available to Member States for driving building renovation under the EPBD framework. Each scenario combines different settings of these instruments to explore alternative renovation pathways.

The scenario design developed for this analysis addresses several key policy elements outlined in Annex II (c) of the recast Energy Performance of Buildings Directive (EPBD 2024/1275), which specifies the required content for national building renovation plans (NBRPs). Two elements are fully incorporated into the modelling framework. Element (b), concerning national minimum energy performance standards (MEPS), is explicitly modelled through a dedicated policy axis that varies across three levels: ① No MEPS, ② Non-residential sector only, and ③ Both sectors, allowing for systematic comparison of regulatory stringency and its impact on building stock transformation. Element (f), regarding the decarbonisation of heating and cooling and the phasing out of fossil fuels, is directly addressed through the **Ban on fossil-based boilers** axis, which differentiates scenarios based on whether such a ban is implemented, aligning with the EPBD's objective of complete fossil fuel boiler phase-out by 2040. Several additional elements are partially addressed: element (d), concerning the protection of vulnerable customers and alleviation of energy poverty, is indirectly considered through the **Subsidy budget** dimension, where scenarios with higher subsidy levels linked to Emissions Trading System 2 (ETS2) revenues can provide greater financial support for households, though targeted measures for vulnerable groups are not explicitly modelled; element (h), on the promotion of renewable energy sources in buildings, is implicitly addressed, as both the fossil boiler ban and carbon pricing mechanisms create economic incentives for switching to renewable heating systems; and element (n), regarding market barriers and failures, is partially captured through CO_2 pricing, which addresses carbon externalities, and subsidies, which help overcome upfront investment barriers that often prevent building owners from undertaking energy renovations.

Instruments are grouped into regulatory, economic, and non-financial measures:

- **Regulatory:** Minimum energy performance standards (MEPS) by sector; an optional ban on installing new fossil-fuel boilers.
- **Economic:** Public grants (with higher rates for worst-performing buildings and low-income households), zero-interest/guaranteed loans, on-bill repayment where applicable, tax relief/green mortgages, and targeted top-ups (e.g. envelope depth, heat-pump/DH connection). Budgets vary between moderate and high; where relevant, "high" assumes recycling of ETS2-type revenues or equivalent national sources.
- **Non-financial:** One-stop shops for advice/applications, skills, and quality-assurance programmes, and facilitation tools for homeowner associations/multi-family decision making.

4.2 SCENARIO SPECIFICATION

The scenarios vary across four levers in a harmonised way across countries:

1. **Scope of minimum energy performance standards (MEPS):** In both sectors / in non-residential only / none.
2. **Fossil boiler ban:** Present/absent.
3. **Carbon-price level:** ~75€/t vs. ~300€/t.
4. **Public-support budget:** Moderate vs. high (the latter assuming, where relevant, recycling of ETS2-type revenues or equivalent national sources).

EPBD ALIGNMENT AND THRESHOLDS USED FOR EVALUATION:

- Residential trajectory: Average primary energy of the whole residential stock reduced by ≥16% by 2030 and ≥20–22% by 2035, with further decline toward 2050 along a progressive path.
- Worst-performing share (WPB): ≥55% of the total reduction to 2030/2035 achieved by renovating the bottom 43% of the stock (defined by national distribution of primary energy).
- Non-residential MEPS: percentile thresholds such that no more than 16% of floor area is above the national threshold by 2030, and no more than 26% by 2033.

THRESHOLD DERIVATION AND WPB IDENTIFICATION

- Percentiles and WPB cut-offs are read from country-specific distributions of specific primary energy vs. conditioned floor area by category.

- Distributions combine EPC samples, measured data (where available), model-based adjustments, and light statistical smoothing to avoid archetype bias, ensuring defensible thresholds.

The five scenarios are designed to explore how different combinations of policy instruments affect Poland's transformation of its building stock toward decarbonisation. Each scenario represents a coherent policy package that could be realistically implemented. The scenarios are not predictions but rather illustrative pathways that help policymakers understand:

- Which policy combinations are most effective for achieving EPBD targets.
- The trade-offs between regulatory and economic instruments.
- The expected pace of fossil fuel phase-out under different conditions.

The scenario results inform the development of Poland's NBRP by providing quantitative inputs for the roadmap (Annex II, Section (b)) and evidence for selecting policy measures (Annex II, Section (c)).

FIVE SCENARIOS:

1. **Regulatory+** – Moderate carbon price; MEPS in residential and non-residential; ban on new fossil boilers; moderate subsidy budget.
2. **Regulatory** – Moderate carbon price; MEPS in both sectors; no boiler ban; moderate subsidy budget.
3. **Moderate** – Moderate carbon price; MEPS in non-residential only; no boiler ban; moderate subsidy budget.
4. **Mix** – High carbon price; high subsidy budget; MEPS in non-residential only; no boiler ban.
5. **Pure economic** – High carbon price; high subsidy budget; no MEPS; no boiler ban.

Outputs assessed per scenario: final and primary energy (by carrier and segment), operational GHG, renovation activity by depth, outcomes for the worst-performing share, and heating-system uptake (e.g. heat pumps and low-carbon district heating). Scenarios are policy-sensitive (not forecasts) and are compared against the residential trajectory, WPB contribution, and non-residential percentile thresholds above (refer to Figure 8).

FIGURE 8: SCENARIO GROUPING

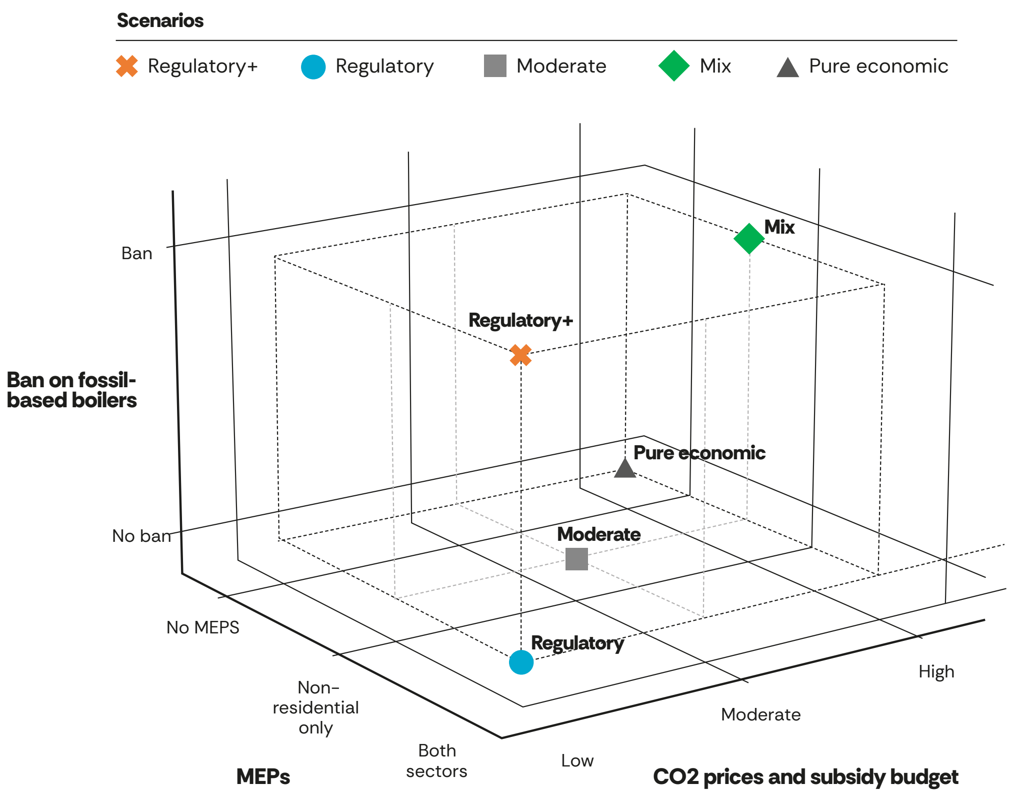


TABLE 3: SCENARIO DESIGN

	Regulatory+	Mix	Regulatory	Pure economic	Moderate
MEPS	Residential and non-residential	Non-residential	Residential and non-residential	No	Non-residential
Ban on fossil-based boilers	Yes	No	No	No	No
Subsidies for building envelope renovation	Moderate	High	Moderate	High	Moderate
Subsidies for RES-H systems	Moderate	High	Moderate	High	Moderate
CO_2 price	75€/t	300€/t	75€/t	300€/t	75€/t

4.3 SCENARIO FRAMEWORK DATA

The energy prices shown in Table 4 are input assumptions to the Invert model, derived from multiple sources, including IEA World Energy Outlook projections, Eurostat historical data, and national energy price statistics. They represent retail prices including taxes but excluding CO_2 costs, which are added separately according to the scenario specifications.

TABLE 4: ENERGY PRICES FOR POLAND FOR THE YEARS 2020, 2030, 2040, AND 2050 IN €/MWH

	2020	2030	2040	2050
Electricity	166	180	152	152
Gas	47	59	59	59
Oil	75	94	94	94
District heating	56	71	71	71
Coal	35	44	44	44
Biomass:				
Wood logs	29	36	36	36
Wood chips	25	32	32	32
Pellets	35	44	44	44

Sources: EU Building Stock Observatory (BSO), European Commission, https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/eu-building-stock-observatory_en; Statistics Poland (GUS), National Census of Population and Housing 2021 (published 2023), https://stat.gov.pl/en/topics/population/national-census-of-population-and-housing-2021/; Statistics Poland (GUS), Energy Statistics 2023, https://stat.gov.pl/en/topics/environment-energy/energy/.

4.4 USED MODELS: INVERT/ EE-LAB AND INVERT/OPT

The scenario analyses in this report are based on two complementary building stock models developed by TU Wien: Invert/EE-Lab and Invert/Opt.

Invert/EE-Lab is a techno-socio-economic simulation model that projects energy-related investment decisions in buildings, covering space heating, hot water, and cooling. The model uses a highly disaggregated building stock description (by type, age, renovation state, heating system, and regional infrastructure availability) and simulates investment decisions through discrete choice and technology diffusion approaches. It has been applied in over 40 EU projects and is parameterised for EU-27+ countries [7], [8].

Invert/Opt is a cost-optimisation variant that calculates cost-optimal renovation pathways by combining available technology options for building envelope and heating systems, subject to constraints such as biomass availability, infrastructure access, and suitable roof areas for solar technologies.

Both models enable assessment of policy scenarios against EPBD requirements, including residential energy reduction trajectories, worst-performing building thresholds, and non-residential MEPS compliance. Detailed model descriptions and structure diagrams are provided in Annex A.

4.5 ALTERNATIVE RENOVATION PATHWAYS

Figure 9 presents the final energy demand (FED) projections for Poland's building sector across five policy scenarios from 2020 to 2050. The Regulatory+ and Regulatory scenarios, both implementing comprehensive MEPS in residential and non-residential sectors, achieve the most substantial energy demand reductions, with coal and oil virtually eliminated by 2035–2040. These scenarios show significant growth in district heating, electricity (reflecting heat pump deployment), and biomass, while substantially reducing overall demand. The fossil boiler ban present in Regulatory+ accelerates the phase-out of coal and oil compared to the Regulatory scenario. The Mix scenario (high carbon price of 300€/t, high subsidies, MEPS only in non-residential) achieves meaningful reductions with balanced growth across renewable heating technologies. The Moderate scenario (75€/t, moderate subsidies, MEPS only in non-residential) shows that the absence of residential MEPS results in a more gradual transformation, with gas maintaining a greater presence through 2050. The Pure economic scenario (300€/t, high subsidies, no MEPS) shows that high carbon pricing alone can stimulate technology transitions, with pronounced electricity growth reflecting heat pump deployment, though coal and gas persist longer than in regulatory scenarios.

Cross-scenario analysis reveals that MEPS implementation across both sectors (Regulatory+, Regulatory) drives comprehensive fuel switching and renewable technology deployment, resulting in the most complete fossil fuel phase-out. High carbon pricing (300€/t) in the Pure economic and Mix scenarios stimulates efficiency improvements and technology transitions through economic incentives, but without residential MEPS, gas maintains a substantial presence through 2050. The fossil boiler ban in Regulatory+ accelerates but does not fundamentally alter the decarbonisation trajectory compared to the Regulatory scenario, suggesting well-designed MEPS can achieve a deep fossil fuel phase-out without explicit technology bans. All scenarios demonstrate coal phase-out by 2035–2045, while natural gas shows greater persistence in scenarios without comprehensive MEPS coverage in both sectors. The tertiary sector adapts faster across all scenarios than the residential sector, underscoring the importance of extending regulatory mandates to residential buildings for comprehensive building-stock decarbonisation.

FIGURE 9: FINAL ENERGY DEMAND (FED) RESULTS FOR POLAND FOR THE YEARS 2021–2050

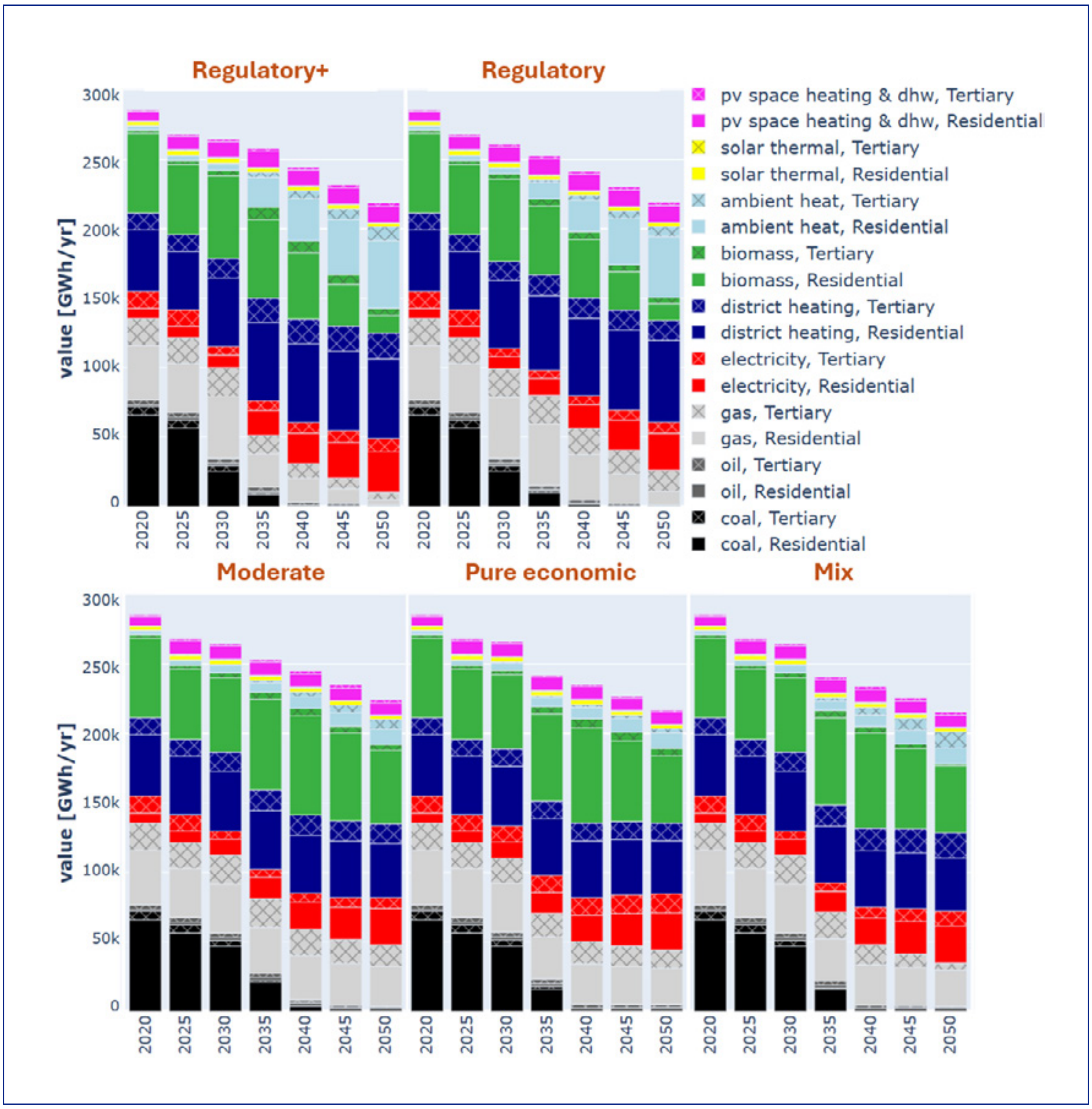


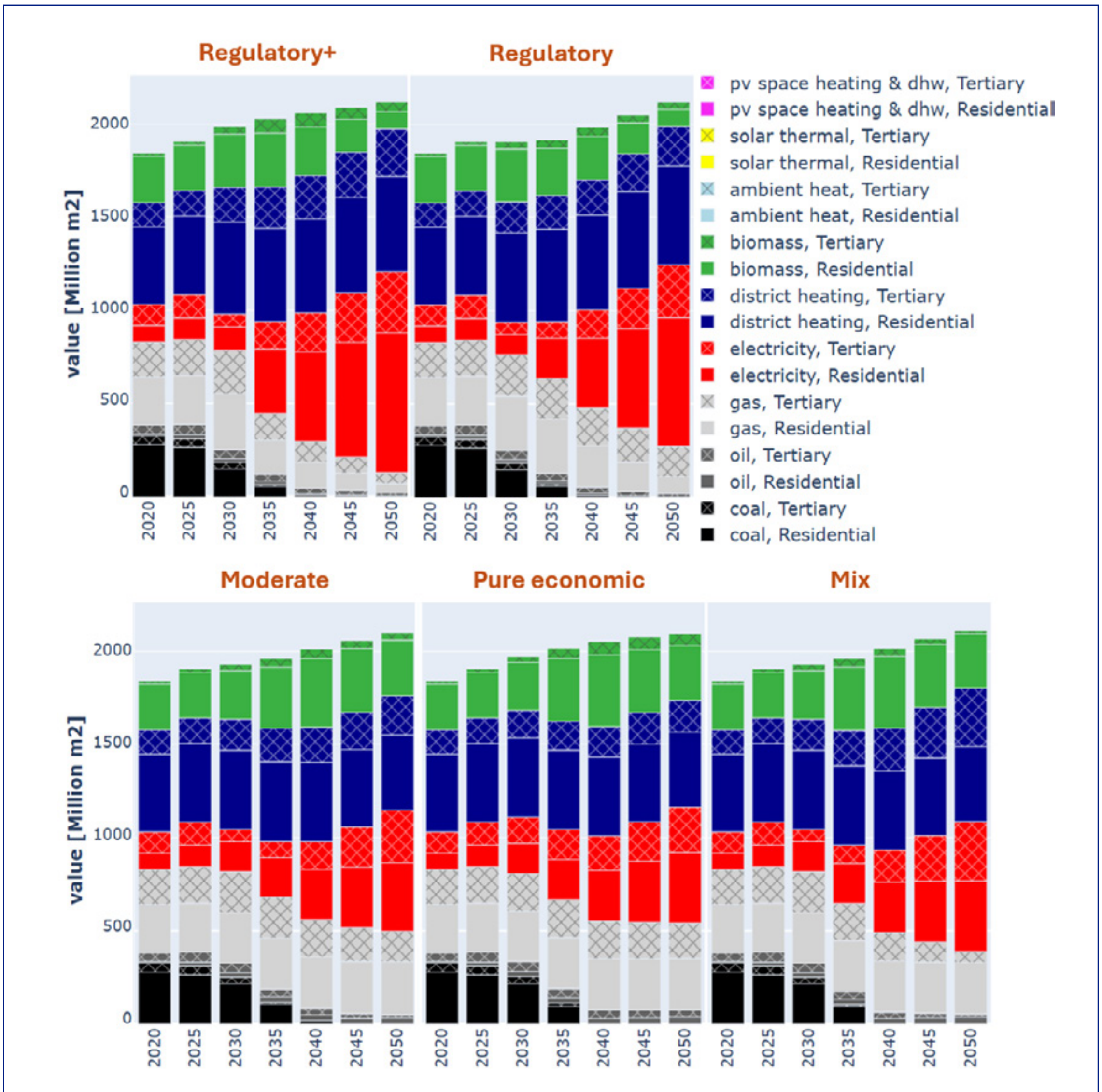
Figure 10 presents projections for the heated gross floor area for Poland by heating system type across the five policy scenarios from 2020–2050. Total heated floor area grows modestly across all scenarios, from approximately 1,800 million m² in 2020 to around 2,000–2,100 million m² by 2050, reflecting continued building stock expansion.

The Regulatory+ scenario exhibits the most rapid transformation in heating system composition. Coal-heated floor area is virtually eliminated by 2030, oil disappears early, and gas-heated floor area declines sharply, becoming negligible by 2045. The Regulatory scenario follows a similar trajectory, though coal and gas persist somewhat longer, with residual gas-heated floor area still visible through 2040. In both scenarios, the fossil fuel phase-out is accompanied by substantial expansion of district heating, growth in biomass-heated floor area, and, notably by 2045–2050, a significant increase in ambient heat, reflecting accelerated heat pump deployment. Electrically heated floor area grows in the near-term but declines later as heat pump systems (captured from ambient heat) increasingly replace direct electric heating.

The Moderate, Pure economic, and Mix scenarios demonstrate more gradual heating system transitions. Gas-heated floor area maintains a more substantial presence through 2040–2045 across all three, declining more slowly than in the regulatory scenarios. Coal-heated floor area also persists longer, though it diminishes significantly by 2040 in all cases. Among these three, the Pure economic scenario retains the largest gas-heated share through the projection period, indicating that economic instruments alone, without comprehensive MEPS, are less effective at driving a complete fossil fuel phase-out. The Mix scenario shows notably strong district heating expansion, comparable to the regulatory scenarios, suggesting that combining economic instruments with partial regulatory measures can effectively support centralised heating infrastructure.

Across all scenarios, biomass and district heating emerge as the dominant heating sources by 2050, with ambient heat becoming an increasingly important component. Solar thermal and photovoltaic-based space heating and domestic hot water systems also appear by 2050, though their floor area shares remain modest relative to other sources.

FIGURE 10: HEATED GROSS FLOOR AREA RESULTS FOR POLAND FOR THE YEARS 2021–2050



4.6 ALIGNMENT WITH EU DIRECTIVES AND LONG-TERM POLICY GOALS

Figure 11 presents the share of renewable energy in Poland's residential sector from 2020–2050 across the five policy scenarios, calculated using RED III-compliant methodologies. The residential sector exhibits substantial growth in renewable energy across all pathways, increasing from approximately 28% in 2020 to 95% by 2050, with all scenarios converging by the end of the projection period.

The Regulatory+ scenario achieves the fastest renewable energy penetration, pulling ahead of other scenarios by 2030 and maintaining a consistent lead through 2040. By 2035, Regulatory+ reaches approximately 61%, while the Pure economic and Mix scenarios cluster around 57%, and the Regulatory and Moderate scenarios follow at approximately 54–55%. This indicates that the combination of stringent MEPS and high carbon pricing in the Regulatory+ scenario accelerates the transition most effectively in the near- to medium-term.

By 2030, initial differentiation emerges, with Regulatory+ reaching approximately 39% while the Pure economic and Mix scenarios cluster around 35–36%. The steepest growth occurs between 2030 and 2045, with annual increases of approximately 2–3 percentage points as carbon pricing intensifies, MEPS requirements phase in, and cumulative effects of building stock turnover accelerate the transition. Notably, the Pure economic and Mix scenarios outperform the Regulatory scenario in the 2035–2040 period, suggesting that economic instruments, particularly higher carbon pricing, can drive renewable uptake as effectively as regulatory measures alone during this critical transition phase.

By 2045, all scenarios converge to 84–86%, and by 2050, they reach near-complete convergence at approximately 95%. This convergence demonstrates that achieving Poland's residential sector contribution to the NBRP's zero-emission building stock target by 2050 is technically feasible across multiple policy configurations, though the Regulatory+ scenario offers the advantage of earlier action and a faster transition pathway.

FIGURE 11: SHARE OF RENEWABLES IN POLAND'S RESIDENTIAL SECTOR FROM 2020–2050

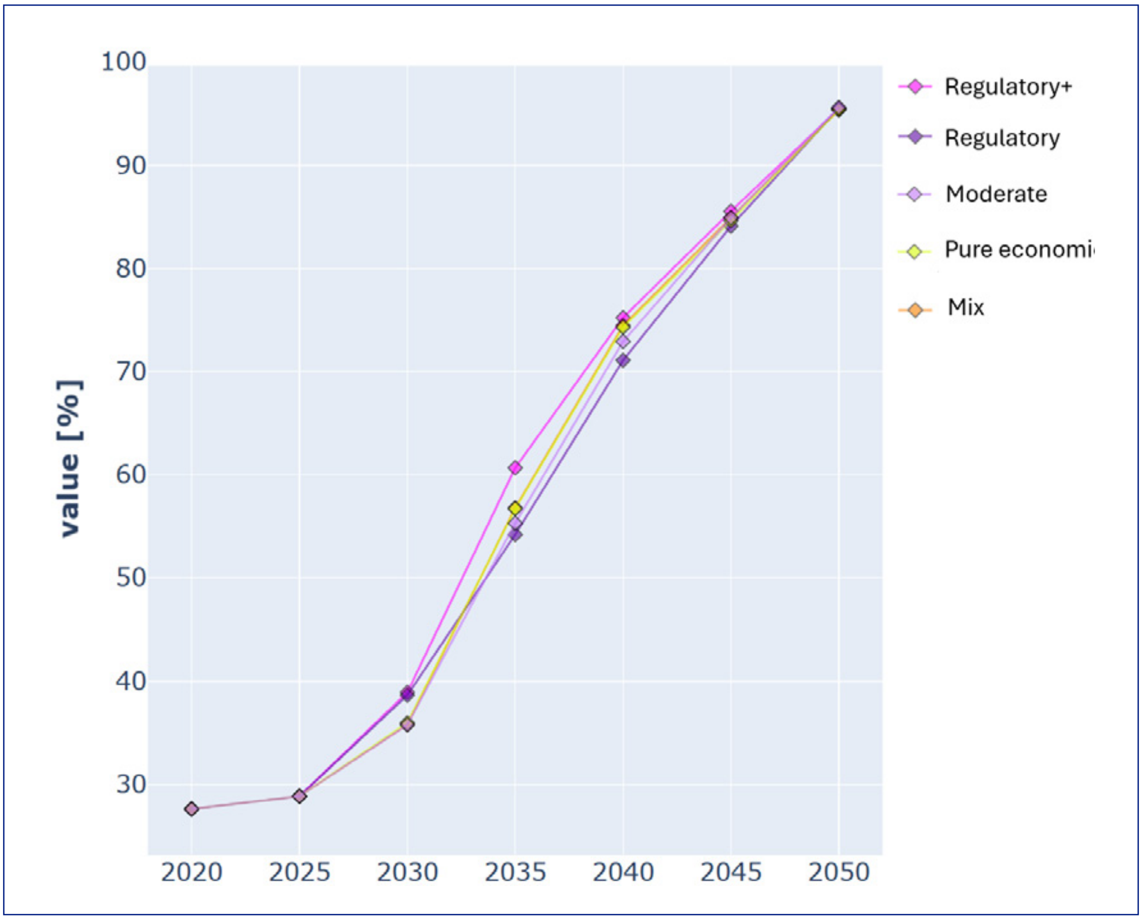


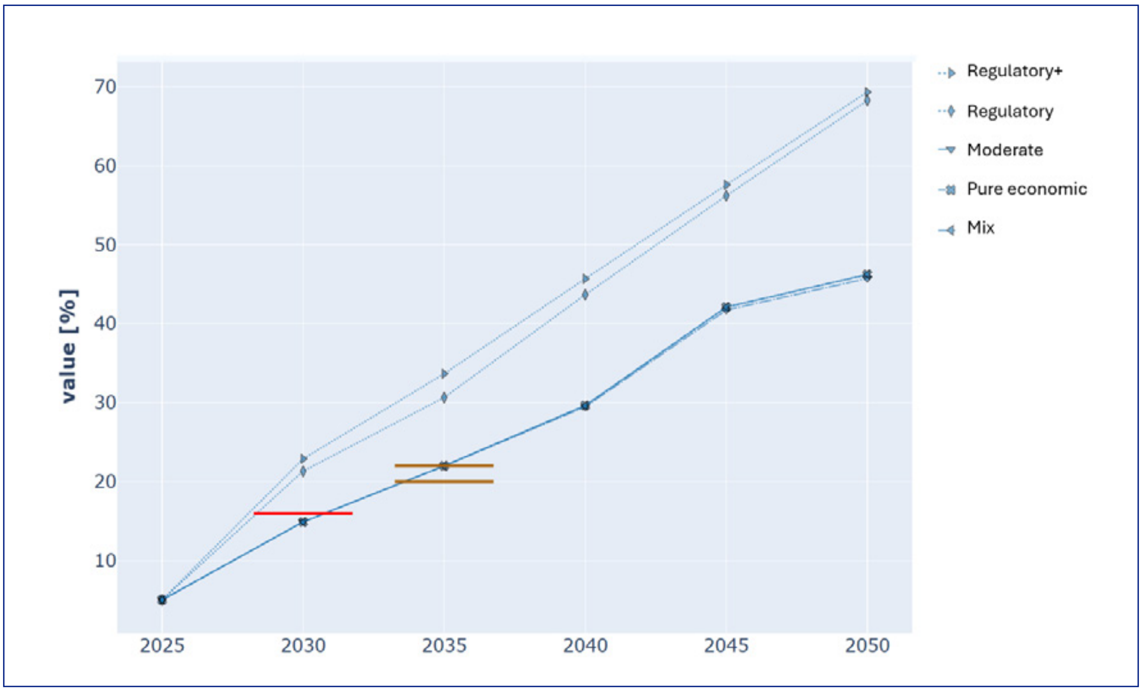
Figure 12 presents specific primary energy demand reductions in Poland's residential sector from 2025–2050, expressed as percentage reductions relative to a baseline trajectory. The horizontal lines indicate the EPBD trajectory targets for 2030 (red) and 2033–2040 (orange).

The residential sector shows two distinct groups of trajectories, with savings ranging from approximately 46–69% by 2050 depending on policy design. The Regulatory+ and Regulatory scenarios achieve the highest savings at approximately 69% by 2050, driven by the comprehensive implementation of MEPS in the residential sector that mandates building efficiency improvements. The Mix scenario follows a similar trajectory, also reaching approximately 69% by 2050, indicating that high carbon pricing (300€/t) combined with non-residential MEPS can deliver equivalent energy efficiency outcomes to full regulatory approaches. The Moderate and Pure economic scenarios cluster together at lower levels, achieving approximately 46% savings by 2050, reflecting the more limited impact of scenarios without residential MEPS.

All scenarios start at similar levels around 5% in 2025. By 2030, a clear divergence emerges: the regulatory scenarios (Regulatory+ and Regulatory) reach approximately 21–23% savings, exceeding the EPBD 2030 trajectory target, while Moderate and Pure economic reach only approximately 14–15%, falling short of the target. This early divergence highlights the importance of residential MEPS for meeting near-term policy milestones. By 2035, the regulatory scenarios and Mix exceed the subsequent EPBD targets at approximately 31–34%, while Moderate and Pure economic remain around 21–22%, just meeting the minimum threshold.

These results demonstrate that in Poland, regulatory instruments targeting the residential sector are essential for achieving ambitious energy efficiency targets. The similar performance of Moderate and Pure economic scenarios, despite the latter having significantly higher carbon prices (300€/t versus 75€/t), suggests that economic incentives alone are insufficient to drive deep residential renovation without regulatory mandates.

FIGURE 12: SPECIFIC PRIMARY ENERGY DEMAND SAVINGS IN POLAND'S RESIDENTIAL SECTOR FROM 2020–2050



STRATEGIES FOR MONITORING, EVALUATION, AND CONTINUOUS IMPROVEMENT

National building renovation plans serve a dual function: they are both strategic planning instruments and frameworks for monitoring, reporting, and evaluation (MR&E) of renovation policies. Article 3 of the EPBD 2024/1275 establishes that NBRPs shall include measurable progress indicators and be subject to regular updates based on implementation experience. The European Commission will assess Member State progress through the NBRP reporting cycle, with updates required every five years. This chapter outlines strategies for establishing effective MR&E systems, drawing on the detailed guidance provided in EPBD.wise Deliverable D6.3 An integrated monitoring, reporting and evaluation framework for effective EPBD implementation.

Various approaches exist for tracking renovation activity, differing in terms of data quality, effort, and coverage. Table 5 evaluates key data sources for monitoring renovation activity across three criteria:

1. **Effort:** The administrative and financial resources required to collect and analyse data from each source. This assessment focuses on ongoing operational costs for data analysis, rather than initial infrastructure setup costs (e.g. for EPC databases, these reflect analysis costs rather than database establishment costs).
2. **Reliability:** The quality and trustworthiness of the data for policy evaluation purposes, considering factors such as data verification, standardisation, and consistency.
3. **Completeness:** The extent to which the data source captures the full range of renovation activities in the building stock. For example, financial support databases provide highly reliable information but only cover subsidised renovations, leaving non-subsidised activities untracked – hence the medium (🟠) completeness rating.

Overall, the table highlights that no single method provides full coverage, but that multiple complementary sources can provide a solid foundation:

TABLE 5: EVALUATION OF DATA SOURCES FOR BUILDING RENOVATION MONITORING BY EFFORT, RELIABILITY, AND KEY CHARACTERISTICS

	Reliability low	Reliability medium	Reliability high
Effort low	EPC databases 🔴 – 🟢 Machine learning-based assessments 🔴 – 🟢	EPC databases 🔴 – 🟢 Market data 🟠 – 🟢 Building permits 🔴 – 🟠 Machine learning-based assessments 🔴 – 🟢	Financial support databases 🟠 EPC databases 🔴 – 🟢 Market data 🟠 – 🟢 Building permits 🔴 – 🟠 Survey among professionals 🟠 Model-based assessments 🔴 – 🟢
Effort medium	Machine learning-based assessments 🔴 – 🟢	Machine learning-based assessments 🔴 – 🟢	Survey among professionals 🟠 Machine learning-based assessments 🔴 – 🟢
Effort high		Survey among building owners 🟠 – 🟢	Surveys among building owners 🟠 – 🟢

🔴 – Completeness low; 🟠 – Completeness medium; 🟢 – Completeness high

A. CONTINUOUS TRACKING OF EPC DATABASE AND BUILDING LOGBOOK

- This approach provides real-time, standardised data on renovation activities and energy efficiency improvements. It offers up-to-date insights but requires strong infrastructure and raises privacy concerns.

B. DOCUMENTATION OF FINANCIAL SUPPORT INSTRUMENTS AND PROGRAMMES

- These are databases from funding programmes and financial support schemes, such as the French Observatoire National de la Rénovation Énergétique (ONRE), established in 2019 by the Ministry of Ecological Transition to monitor all components of public policy on energy renovation (Ministère de la Transition Écologique, 2019). This approach provides comprehensive economic and regional data, making it highly valuable for evaluating policies and tracking public investment in renovations. By only capturing renovations that receive financial support, this approach may miss some activities in the private sector.
- Another approach is using data from programmes offering financial or technical support for renovations to a specific sector, such as the SHAERE database (Sociale Huursector Audit en Evaluatie van Resultaten Energiebesparing) for the Dutch non-profit housing sector, which contains energy performance data for approximately 60% of all social housing dwellings [9]. However, this approach fails to provide insights into renovations in other sectors, such as the private sector.

C. BUILDING PERMITS

- Building permit data can track major renovation works that require formal approval, such as structural modifications, extensions, or changes to building use. This data source provides direct, verified records of formal renovation activities and enables geographically specific analysis at the municipal level. However, coverage is limited because many energy efficiency measures, including insulation upgrades, window replacements, and heating system changes, typically do not require building permits in most Member States. Building permits are, therefore, most useful as a complementary source for tracking deep renovations involving structural changes, rather than as a primary indicator of overall renovation activity.

D. SURVEY AMONG BUILDING OWNERS AND PROFESSIONALS

- These surveys gather industry professionals' data on renovation practices and market trends. They offer technical accuracy but may not capture small-scale renovations, as their results depend on the sample size.

E. MACHINE LEARNING-BASED ASSESSMENTS

- This approach uses large datasets (e.g. satellite images, energy use data) to identify renovation activities and trends through predictive models. It enables scalable, automated monitoring and can flag likely renovations or compliance gaps. However, it requires high-quality, standardised data and raises concerns about transparency, accuracy, and potential bias if used without human oversight.

Given the diversity of national contexts and capacities, countries must tailor their monitoring systems to suit their specific needs. The following section provides country-specific guidance for Poland, building on the policy needs identified in Deliverable D2.1. It outlines priority data sources, innovative methods, and institutional measures for reliable, actionable, cost-effective renovation monitoring and continuous policy improvement.

For Poland, the existing EPC infrastructure and permitting systems can be a strong foundation for monitoring renovation activities. The country should focus on improving the completeness and reliability of EPC and logbook data, while gradually integrating market indicators and cross-referencing them with building registers. Surveys among building professionals can complement this system by providing sectoral insights, especially for private, unsubsidised renovations. Given the deliverables' finding of inconsistent baseline data and fragmented sources, Poland should prioritise the development of an integrated monitoring platform that links EPCs, financial support data, and permits. The use of machine learning for spatial trend detection could be piloted in metropolitan regions where data quality is higher. These actions address Policy Needs 1 (data availability), 4 (identification of WPB), and 7 (renovation pathways).

Monitoring must be closely linked to regular evaluation and revision cycles of the NBRPs. Progress indicators should go beyond energy performance alone, including social impact, public investment leverage, and renovation depth metrics. Transparent reporting, data sharing across governance levels, and continuous stakeholder engagement are key to transforming monitoring into a tool for policy learning, not just compliance. Monitoring frameworks could also consider mechanisms for voluntary or incentivised data reporting from market actors, such as installers, contractors, or energy advisors.

CONSISTENCY AND INTERACTION WITH OTHER POLICY INSTRUMENTS

The NBRPs are not developed in isolation but are closely linked to other policy instruments established under the EPBD and related EU legislation. Ensuring consistency and synergies between these instruments is crucial for achieving a highly energy-efficient and decarbonised building stock by 2050.

In addition to their role under the EPBD, NBRPs must also remain consistent with the Fit for 55 framework, including the Energy Efficiency Directive (EED) and the Renewable Energy Directive (RED III). NBRPs should also align with national energy and climate plans (NECPs), which, although not part of the Fit for 55 package, provide the overarching national framework for coordinating energy and climate policy. This alignment ensures that the renovation targets, scenario assumptions, and policy measures within NBRPs contribute coherently to EU-wide energy efficiency and GHG reduction objectives.

6.1 ZERO-EMISSION BUILDINGS (ZEBS)

NBRPs are designed to guide the progressive transformation of the building stock into ZEBs by 2050. This includes defining thresholds for operational greenhouse gas emissions and annual primary energy demand for new and renovated buildings.

The scenario development and target-compliance assessments within NBRPs explicitly verify whether the renovation pathways align with the ZEB definition and long-term decarbonisation objectives. In this context, NBRPs should:

- Ensure that the national targets for renovated floor area and energy-use reduction are consistent with the performance levels required to reach the ZEB standard by 2050.
- Integrate intermediate milestones (2030, 2040) to demonstrate steady progress towards achieving ZEB compliance.

- Reflect the gradual replacement of fossil-fuel-based heating and cooling systems with renewable and low-emission alternatives.
- Incorporate the deployment of renewable energy solutions, electrification trends, and improved energy-system integration into the scenario assumptions.

Thus, the ZEB requirements act both as a benchmark and an endpoint for evaluating NBRP trajectories, ensuring that long-term objectives are embedded in the planning, modelling, and implementation framework.

6.2 MINIMUM ENERGY PERFORMANCE STANDARDS (MEPS)

MEPS serve as a regulatory backbone for building stock decarbonisation. For non-residential buildings, the EPBD establishes mandatory MEPS requiring the 16% worst-performing buildings to be renovated by 2030 and 26% by 2033. For residential buildings, Member States must define national trajectories to progressively reduce average primary energy use, targeting a reduction of 16% by 2030 and 20–22% by 2035 compared to 2020 levels.

The NBRPs integrate both MEPS (for non-residential buildings) and national trajectories (for residential buildings), directly linking them to the Article 9 provisions of the EPBD. Poland's scenario analysis indicates that achieving these targets requires comprehensive regulatory measures in both sectors; the Regulatory+ and Regulatory scenarios demonstrate that MEPS applied to residential buildings significantly accelerate energy savings compared to scenarios relying solely on economic instruments.

Scenario development supports these regulatory requirements by quantifying their potential contribution to energy savings, renovation uptake, and emissions reduction under different pathways. To ensure consistency, NBRPs should:

- Define a clear phase-in timeline for non-residential MEPS implementation with milestones for 2030 and 2033.
- Establish the national trajectory for residential buildings, specifying the 2030 and 2035 primary energy reduction targets.
- Include enabling measures such as financial support schemes, advisory services, and technical assistance to facilitate compliance and ensure a socially fair transition.
- Use scenario modelling to estimate the expected impact of MEPS and trajectories on renovation rates, energy demand, and emissions.
- Align implementation with the overall decarbonisation pathway and energy-efficiency targets set under national planning frameworks.

This integration ensures that regulatory requirements are part of an evidence-based, scenario-driven renovation pathway, not isolated mandates.

6.3 ENERGY PERFORMANCE CERTIFICATES (EPCS)

EPCs form the essential data backbone for NBRPs, identifying the least energy-efficient buildings and tracking the progress of renovations over time. While EPC data may vary in completeness and quality across countries, they provide a harmonised methodology and an established national database for assessing building performance.

Scenario modelling within NBRPs relies on EPC data to define baseline conditions, classify buildings by energy performance, and evaluate the outcomes of implemented measures. Therefore, strengthening EPC systems is crucial for enhancing the accuracy and reliability of policy evaluation and model-based projections. To ensure consistency, NBRPs should:

- Promote full digitalisation and interoperability of national EPC databases, enabling data exchange with building cadastres, renovation funding programme records, and building permit systems.
- Update EPC calculation methodologies to incorporate the new ZEB and MEPS definitions from the EPBD recast, ensuring that energy performance ratings accurately reflect compliance requirements and enable meaningful comparisons across building types.
- Integrate EPC data into the monitoring and reporting cycles of the NBRP to continuously assess progress toward national and EU objectives.

A more holistic and flexible EPC framework, one that accommodates different building types, usage patterns, and regional climate conditions, allows scenario analyses and compliance checks to be grounded in reliable, verifiable data, supporting transparent tracking of renovation outcomes.

6.4 RENOVATION PASSPORTS (RPS)

Renovation passports are complementary instruments that provide building-level renovation roadmaps. They aim to help building owners plan staged renovations that align with national long-term targets and the overall decarbonisation pathway.

Within the NBRPs, RPs are a practical link between scenario-based national projections and individual renovation actions. To strengthen their contribution, NBRPs should:

- Promote the gradual roll-out of RPs, beginning with the worst-performing and public buildings, where data availability and support mechanisms are strongest.
- Incorporate information from RPs into national monitoring systems and use these data to validate model projections on renovation uptake and performance improvements.
- Integrate RPs into one-stop shops and advisory services, making them accessible to households and SMEs as tools for stepwise deep renovation.

- Link RPs with available financing instruments to support the implementation of identified renovation measures.

By connecting national-level modelling with building-specific action, RPs ensure that scenario outcomes translate into real, measurable progress on the ground.

6.5 POLICY COHERENCE AND ALIGNMENT

Consistency checks across all instruments are embedded into the scenario modelling and policy-assessment processes within NBRPs. These checks ensure that the strategic, regulatory, and financial components of building decarbonisation work harmoniously.

Key principles of alignment include:

- Ensuring that renovation pathways are compatible with ZEB thresholds and the long-term fossil-fuel phase-out.
- Embedding MEPS implementation into NBRP scenarios, allowing their impact to be monitored and evaluated against national targets.
- Using EPC data as the common reference for performance tracking, model validation, and policy evaluation.
- Integrating RPs as supporting instruments for building-level implementation, ensuring that long-term renovation planning aligns with NBRP objectives.
- Maintaining coherence with national energy and climate frameworks, ensuring that energy-efficiency and renewable-energy contributions are mutually reinforcing and not overlapping.

By systematically embedding these consistency principles into the NBRP scenario development and monitoring processes, Member States can ensure coherence, avoid duplication, and enhance the credibility and effectiveness of their long-term renovation strategies.

DEVELOPMENT OF POLICY RECOMMENDATIONS

The NBRP in Poland presents a strategic opportunity to accelerate building decarbonisation by building on existing national instruments, including the Clean Air Programme (Program Czyste Powietrze) and the Thermo-modernisation and Renovation Fund, already outlined in the long-term renovation strategies. The scenario analysis in Chapter 5 demonstrates that Poland can achieve up to 30% energy savings by 2050 through comprehensive policy packages combining regulatory measures (MEPS, fossil boiler phase-out) with financial support. The Regulatory+ scenario consistently outperforms purely economic approaches, highlighting the essential role of regulatory backstops.

7.1 KEY RECOMMENDATIONS BY ACTION AREA

LEGISLATIVE AND REGULATORY FRAMEWORK:

- Embed MEPS as a central regulatory lever, initially focusing on non-residential buildings with gradual extension to the residential sector.
- Define and operationalise ZEB thresholds.
- Establish consistency checks across MEPS, ZEB, and renewable energy trajectories to support fossil fuel phase-out.

INSTITUTIONAL ARRANGEMENTS AND GOVERNANCE:

- Establish an integrated monitoring platform connecting the EPC registry, building logbooks, permits, and funding mechanisms.
- Institutionalise stakeholder working groups and open consultations throughout NBRP cycles.
- Implement biennial evaluation reports for data-driven policy adjustments.

TECHNICAL AND ANALYTICAL INFRASTRUCTURE:

- Improve EPC and building logbook data quality; cross-reference with building registers to identify worst-performing buildings (43%).
- Employ mixed analytical methods (EPC data, measured consumption, archetype modelling) aligned with energy balance statistics.
- Maintain scenario development as a central NBRP element for policy evaluation and investment planning.

FISCAL AND FINANCIAL MEASURES:

- Link MEPS enforcement with targeted subsidies and preferential financing, prioritising energy-poor households.
- Develop a national financing roadmap integrating EU funds, national instruments, and private capital.
- Design financial incentives to reward deep renovations over shallow measures.

INFORMATION, AWARENESS, AND CAPACITY BUILDING:

- Implement one-stop shops providing integrated information on funding, standards, and renovation steps.
- Conduct regular surveys to capture non-subsidised renovation activity and market dynamics.
- Maintain transparent reporting and public consultation throughout NBRP cycles.

7.2 SUGGESTED IMPLEMENTATION ROADMAP

To support coordinated implementation, Table 6 maps key actions to responsible institutions and timelines. In Poland, building energy efficiency responsibilities are distributed across the Ministry of Economic Development and Technology (MRiT, building regulations, EPCs), the Ministry of Climate and Environment (MKiŚ, climate policy), and the National Fund for Environmental Protection and Water Management (NFOŚiGW, funding programmes). Effective NBRP delivery requires these institutions to work as a coordinated team.

TABLE 6: IMPLEMENTATION ROADMAP FOR POLAND'S NBRP

Action area	Key actions	Lead institution	Supporting institutions	Timeline
Regulatory	Define MEPS thresholds (non-residential)	MRiT	MKiŚ, ITB	2025–2026
	Establish residential trajectory (Article 9)	MRiT	MKiŚ, GUS	2025–2026
	Define ZEB thresholds	MRiT	ITB	2025–2027
	Fossil boiler phase-out timeline	MKiŚ	URE, MRiT	2025–2027
Data & monitoring	Integrate the EPC registry with permits	MRiT	GUS	2025–2027
	Develop a monitoring dashboard	MKiŚ	NFOŚiGW	2025–2026
Financing	Align Clean Air Programme with MEPS	NFOŚiGW	MKiŚ	2025–2026
	Develop blended finance mechanisms	MF	NFOŚiGW, BGK	2026–2028
	Target support for energy-poor households	MRPiPS	NFOŚiGW	2025–2027
Capacity building	Establish one-stop shop network	Voivodeships	MRiT	2025–2028
	Public awareness campaigns	MKiŚ	NFOŚiGW, KAPE	2025–2026

MRiT = Ministry of Economic Development and Technology; MKiŚ = Ministry of Climate and Environment; MF = Ministry of Finance; MRPiPS = Ministry of Family, Labour and Social Policy; NFOŚiGW = National Fund for Environmental Protection and Water Management; GUS = Central Statistical Office; ITB = Building Research Institute; URE = Energy Regulatory Office; BGK = Bank Gospodarstwa Krajowego; KAPE = National Energy Conservation Agency

7.2.1 COORDINATION MECHANISMS

Effective implementation requires the following coordination structures:

- **Inter-ministerial working group:** Chaired by MRiT, meeting quarterly to ensure policy coherence. Members: MKiŚ, MF, MRPiPS, NFOŚiGW.
- **Data governance platform:** Technical body ensuring interoperability between EPC databases, permits, and funding records.
- **Funding coordination committee:** Chaired by NFOŚiGW, aligning eligibility criteria across all renovation funding programmes.
- **Stakeholder advisory council:** Biannual consultations with industry, housing associations, local governments, and civil society.

7.2.2 IMPLEMENTATION PHASES

PHASE 1 (2025–2026) – FOUNDATION:

Establish coordination mechanisms; define MEPS and ZEB thresholds; align funding programmes; launch awareness campaign.

PHASE 2 (2027–2028) – ACCELERATION:

Implement MEPS for non-residential; roll out one-stop shops; deploy building logbooks; introduce blended finance; conduct first biennial evaluation.

PHASE 3 (2029–2030) – CONSOLIDATION:

Achieve 2030 MEPS milestone; verify residential trajectory progress (16% reduction); refine policies based on evaluation; prepare for 2033/2035 targets.

By implementing this coordinated roadmap, Poland can transform its NBRP into a dynamic, evidence-based instrument that links regulatory standards, financial mechanisms, and technical data systems, ensuring the building stock contributes fully to EU 2030 and 2050 climate objectives.

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ANNEX A: MODEL DOCUMENTATION

A.1 INVERT EE-LAB

Invert/EE-Lab is a comprehensive techno-socio-economic bottom-up building stock model that simulates energy-related investment decisions in buildings, specifically focusing on space heating, hot water generation, and space cooling end-uses [10]. The model is based on a highly disaggregated description of building stocks across EU-27+ countries (including Iceland, Norway, Switzerland, and the UK), incorporating:

- Building characteristics: Type, construction period, renovation state, existing heating systems.
- User structure: Ownership patterns, occupancy types, decision-making behaviour.
- Regional elements: Availability of energy infrastructure (district heating, natural gas) at the sub-country level.
- Climate zones: Heating and cooling degree days by region.

The model simulates investment decisions in building envelope improvements and heat supply/distribution systems through a combination of discrete choice approaches and technology diffusion theory. As a myopic simulation tool, it evaluates the effects of different policy interventions – including economic incentives, regulatory measures, and technology development programmes – on total energy demand, energy carrier mix, emission reductions, and costs.

Key model capabilities include:

- Simulation of renovation decisions under different policy frameworks.
- Assessment of heating system replacement choices.
- Projection of energy demand by carrier and end-use.
- Evaluation of policy cost-effectiveness.

Analysis of technology diffusion patterns

Invert/EE-Lab has been applied in over 40 projects across EU-27+ countries over more than ten years, supporting policymakers, researchers, and industry professionals in energy efficiency and building technology assessment [11].

FIGURE 13: OVERVIEW OF THE STRUCTURE OF INVERT/EE-LAB

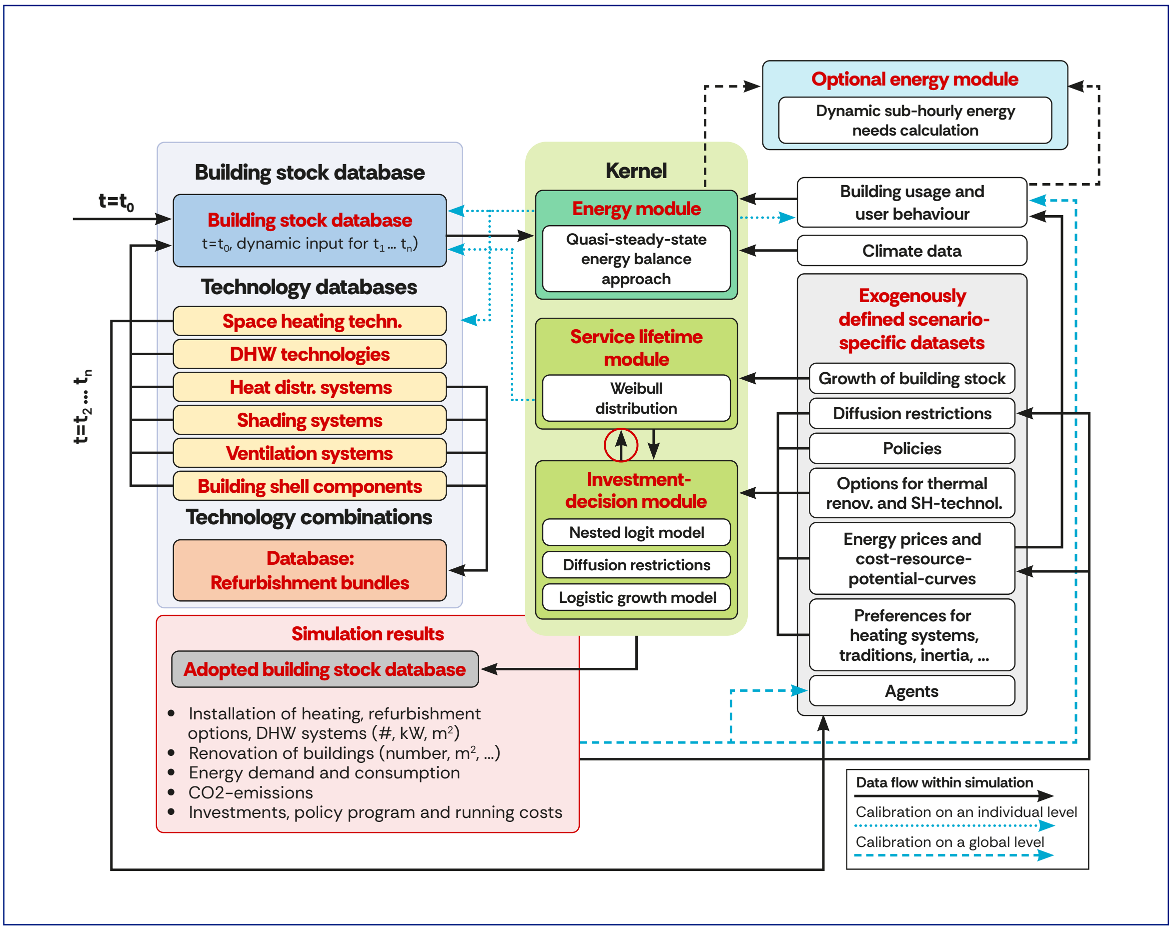


Figure 13 illustrates the model's structure, showing the interaction between building stock characterisation, policy inputs, investment decision modules, and output indicators. The discrete choice module determines renovation and heating system decisions based on economic factors, policy incentives, and behavioural parameters. Technology diffusion constraints ensure realistic deployment rates for new technologies.

A.2 INVERT/OPT MODEL

Invert/Opt is a derived model version specifically designed to calculate cost-optimal renovation scenarios. Unlike the simulation-based Invert/EE-Lab, Invert/Opt uses optimisation algorithms to identify the most cost-effective combination of technology options for both heat savings (envelope measures) and heat supply (heating systems) across different time periods.

Key features of Invert/Opt include:

- Cost-optimality calculation: Identifies renovation measures that minimise total costs (investment and operating) while meeting energy or emission targets.
- High disaggregation: Varies by country from several hundred to several thousand building segments, split across multiple climate regions.

- Diffusion constraints: Accounts for the limited availability of tradeable biomass, energy infrastructure constraints, and suitable roof areas for solar technologies.
- Technology mix outputs: Produces diverse technology portfolios even in optimisation mode, reflecting real-world constraints.

The model calculates cost-optimality for:

- Building envelope retrofitting (insulation of walls, roofs, floors; window replacement).
- Heating and hot water supply system replacement.
- Integration of renewable energy technologies (solar thermal, heat pumps, biomass).

FIGURE 14: OVERVIEW OF THE STRUCTURE OF THE INVERT/OPT

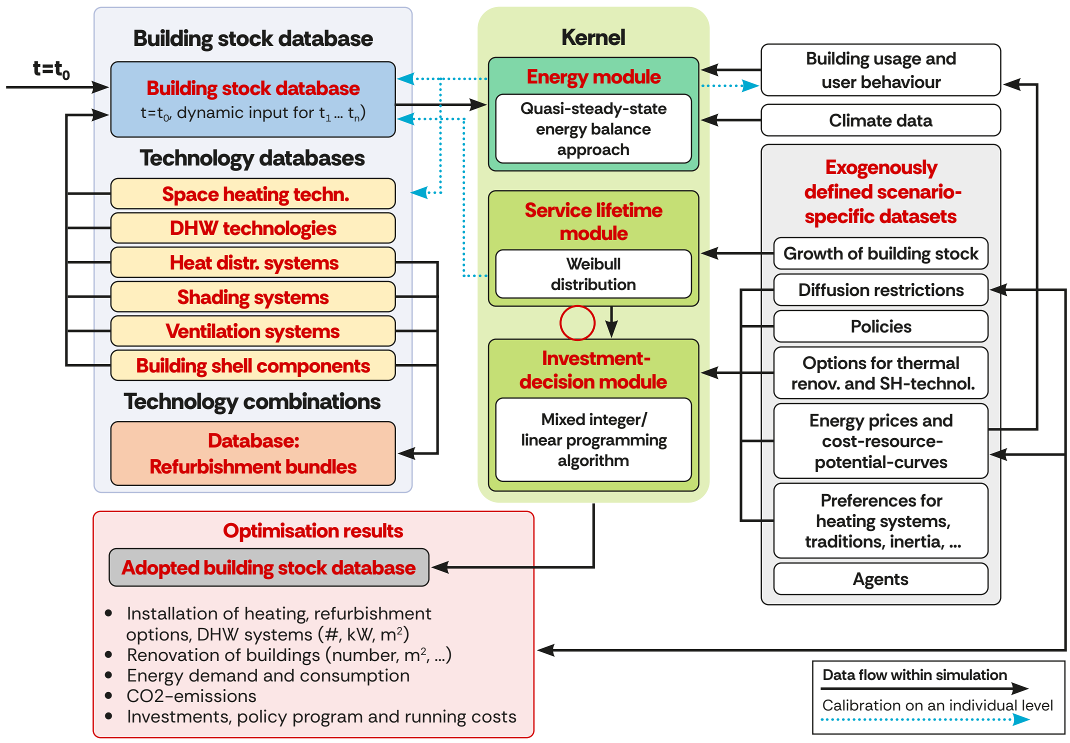


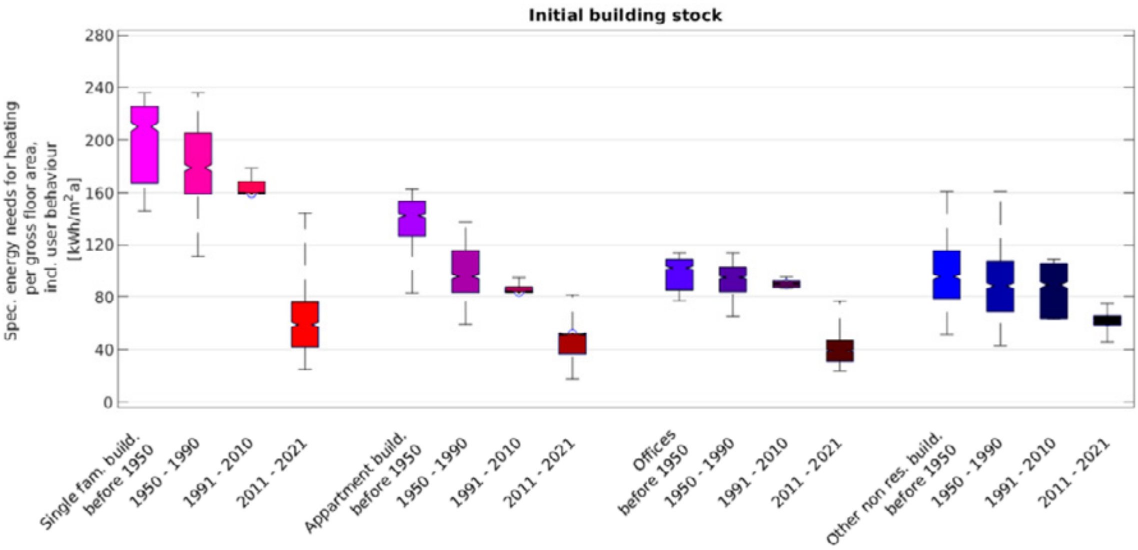
Figure 14 shows the optimisation framework, illustrating how building stock segments, technology options, cost parameters, and constraints feed into the optimisation algorithm to produce cost-optimal renovation pathways.

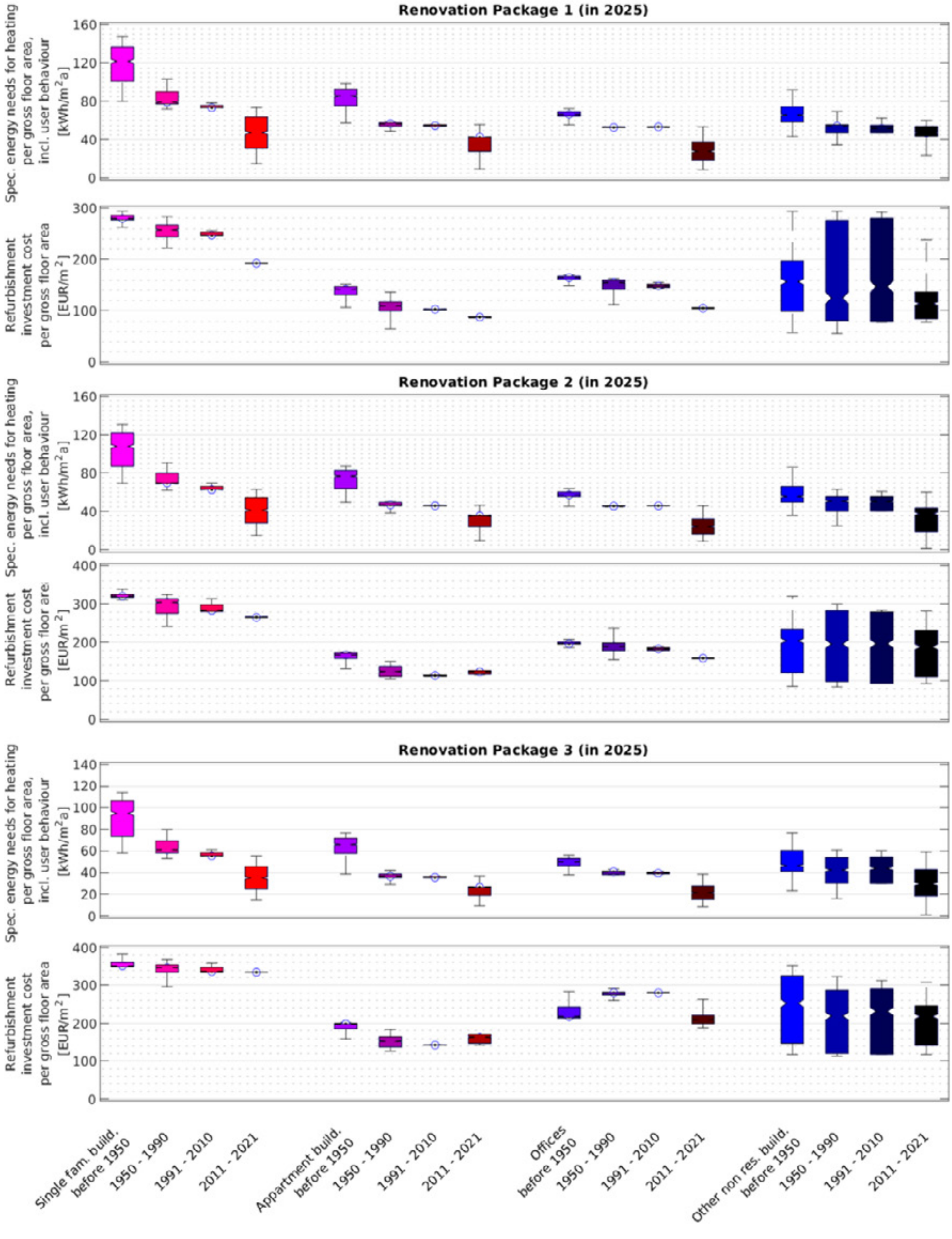
ANNEX B: ASSUMPTIONS REGARDING BUILDING RENOVATION MEASURES

The following figure provides an overview of the specific energy needs and renovation investment costs for residential building stocks in Poland. Poland is assessed across three renovation packages reflecting varying depths and scopes of energy renovation.

Figure 15 illustrates the results for Poland. It presents the distribution of specific energy needs and renovation investment costs for different segments of the Polish building stock, before and after renovation. The three renovation packages represent increasing levels of ambition in terms of energy performance. The upper part of the figure illustrates the distribution of specific energy needs, incorporating assumptions about changes in user behaviour and the rebound effect – i.e., the tendency of building occupants to increase indoor temperature levels after refurbishment, partially offsetting the net energy savings. The lower part of the figure displays the corresponding investment costs required for implementing each renovation package. Together, the visualisation provides a comparative overview of the energy performance improvements and financial implications associated with different renovation strategies and building typologies.

FIGURE 15: DISTRIBUTION OF SPECIFIC ENERGY NEEDS AND INVESTMENT COST FOR REFURBISHMENT BEFORE AND AFTER RENOVATING BUILDINGS WITH THREE DIFFERENT TYPES OF RENOVATION PACKAGES OF THE BUILDING ENVELOPE IN DIFFERENT BUILDING CLASSES FOR POLAND





Renovation Package 1 (in 2025)
Spec. energy needs for heating per gross floor area, incl. user behaviour [kWh/m²a]
Refurbishment investment cost per gross floor area [EUR/m²]
Renovation Package 2 (in 2025)
Renovation Package 3 (in 2025)
Single fam. build. before 1950
1950 - 1990
1991 - 2010
2011 - 2021
Appartment build. before 1950
Offices before 1950
Other non res. build. before 1950

ANNEX C: CONTRIBUTION TO THE NBRP DOCUMENT

This section aims to show that the list of indicators can be supported by the EPBD.wise modelling approach. The NBRP is a strategic planning tool mandated under Article 3 of the EPBD (2024/1275) [3]. Its purpose is to guide Member States in establishing a clear roadmap toward achieving a highly energy-efficient and decarbonised building stock by 2050. The NBRP outlines national targets for 2030, 2040, and 2050 and sets measurable progress indicators to monitor compliance with EPBD provisions.

The European Commission developed an annotated template document and an Excel sheet to facilitate the development of harmonised NBRP documents. In line with the EPBD, the document covers a broad spectrum of quantitative and qualitative indicators that reflect the national building stock's status, evolution, and renovation needs. These include:

1. Overview of the national stock.
2. Roadmap for 2030, 2040, and 2050.
3. Overview of planned and implemented policies and measures.
4. Outline of the investment needs, the budgetary sources, and the administrative resources.
5. Thresholds of new and renovated ZEBs.
6. Minimum energy performance standards for non-residential buildings.
7. National trajectory for the progressive renovation of the residential building stock.

The Commission has prepared an Excel-based indicator mapping tool to support the development and operationalisation of these indicators. This tool provides a structured overview of all mandatory and optional indicators, their grouping, and their relevance to different parts of the NBRP template. It is intended to assist focus countries and stakeholders in identifying data gaps and aligning their national reporting with EPBD requirements. Table 7 shows that the list of Annex II indicators can be supported by the EPBD.wise modelling approach.

TABLE 7: ANNEX II INDICATORS THAT CAN BE SUPPORTED BY EPBD.WISE

Annex II	Mandatory indicators	Optional indicators
(a) Overview of the national building stock	Number of buildings and total floor area (m^2): • per building type • per energy performance class • nearly zero-energy buildings • worst-performing buildings • The 43% worst-performing residential buildings	Number of buildings and total floor area (m^2): • per building age • per building size • per climatic zone
	Annual renovation rates: number and total floor area (m^2) • per building type • per renovation depth (weighted average renovation) • public buildings	
	Primary and final annual energy consumption (ktoe): • per building type • per end use Energy savings (ktoe): • residential buildings • non-residential buildings • public buildings Average primary energy use in kWh/(m^2.y) for residential buildings Share of renewable energy in the building sector (MW installed or GWh generated): • for different uses	Primary energy use of a building corresponding to the top 15 % (substantial contribution threshold) and the top 30 % (do no significant harm threshold) of the national building stock, as per Delegated Regulation (EU) 2021/2139 Share of heating systems in the building sector per boiler/heating system type Share of renewable energy in the building sector (MW installed or GWh generated): • on-site • off-site
	Annual operational greenhouse gas emissions ($kgCO_2eq/(m^2.y)$): • per building type Annual operational greenhouse gas emission reduction ($kgCO_2eq/(m^2.y)$: • per building type	
	Primary energy factors: • per energy carrier • non-renewable primary energy factor • renewable primary energy factor • total primary energy factor	
(b) Roadmap for 2030, 2040, 2050	Targets for annual renovation rates: number and total floor area (m^2): • per building type • worst-performing buildings • The 43 % worst-performing residential buildings	Targets for expected share (%) of renovated buildings: • per building type • per renovation depth
	Targets for expected primary and final annual energy consumption (ktoe): • per building type • per end use Expected energy savings: • per building type	Share of energy from renewable sources in the building sector (MW installed or GWh generated)
(d) Outline of the investment needs, the budgetary sources, and the administrative resources	• total investment needs for 2030, 2040, 2050 (million EUR) • budgetary resources	

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This project has received funding from the European Union's LIFE programme under grant agreement No.101120194. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.