



# ComActivate

Enabling community action for energy sufficiency

## REPORT OF EXISTING APPROACHES FOR INDIVIDUAL REFURBISHMENT ROADMAPS (IRRS) FOR RESIDENTIAL BUILDINGS ACROSS EUROPE

Overview of different approaches to long-term planning in  
the building sector

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## Content

<b>EXECUTIVE SUMMARY .....</b>	<b>3</b>
<b>OBJECTIVES .....</b>	<b>4</b>
<b>BOUNDARY CONDITIONS FOR RENOVATION PASSPORTS.....</b>	<b>5</b>
HISTORY OF BUILDING RENOVATION PASSPORTS WITHIN THE EUROPEAN DIRECTIVE ON THE ENERGY EFFICIENCY OF BUILDINGS (EPBD) .....	5
CONTENT OF A RENOVATION PASSPORT .....	5
MANDATORY CONTENT OF A RENOVATION PASSPORT IN LINE WITH ANNEX VIII EPBD .....	6
OPTIONAL CONTENT OF A RENOVATION PASSPORT IN LINE WITH ANNEX VIII EPBD.....	7
<b>BEST PRACTICES OF RENOVATIONS PASSPORTS.....</b>	<b>8</b>
IMPLEMENTED RENOVATION PASSPORTS .....	9
WONINGPAS (BELGIUM/FLANDERS).....	9
CASA+ (PORTUGAL) .....	15
URBANZEB   URBAN3R (SPAIN) .....	23
SFP (GERMANY/BADEN-WÜRTTEMBERG) .....	34
ISFP (GERMANY).....	41
IBROAD (EU) .....	48
TESTED RENOVATION PASSPORTS .....	56
IBROAD2EPC .....	56
GREEN HOME - GERMAN ROUNDTABLES ON ENERGY EFFICIENCY IN HOMEOWNER ASSOCIATIONS .....	63
<b>CONCLUSION .....</b>	<b>70</b>
<b>REFERENCES.....</b>	<b>70</b>

## Executive Summary

The report provides an overview of long-term planning approaches in the building sector, with a particular focus on Renovation Passports. It is part of the EU project *ComActivate*, which aims to enhance energy efficiency and address energy poverty in communities across Central and Eastern Europe. The project seeks to achieve energy savings, reduce greenhouse gas emissions, and create jobs through strategic building renovations.

Renovation Passports are highlighted as essential tools for guiding energy-efficient building renovations. They offer tailored roadmaps, allowing homeowners to implement improvements step-by-step while considering their specific circumstances. The document reviews successful models from various countries, including Belgium's Woningpas, Portugal's casA+, Spain's urbanZEB and urban3R platforms, Germany's SFP and iSFP programs, and the EU-wide iBRoad initiatives. These examples demonstrate how effective Renovation Passports can streamline access to information, encourage targeted investments, and reduce inefficiencies in the renovation process.

The report also identifies challenges in implementing these tools, such as issues with data availability and quality, high costs, unclear financing mechanisms, and the difficulty of engaging all relevant stakeholders. Recommendations for overcoming these obstacles include adapting Renovation Passports to local contexts, enhancing digitalization, and ensuring the tools are user-friendly and accessible.

Overall, the report provides valuable insights for developing national Renovation Passport programs and supporting energy-saving initiatives in European communities.

## Objectives

The ComActivate project provides an approach for tackling energy poverty in Communities in Central and Eastern Europe by enhancing the energy efficiency of buildings. Four typical municipalities i.e. Burgas in Bulgaria, Józsefváros (Budapest) in Hungary, and Elektrėnai and Kaišiadorys in Lithuania will implement the approach with the aim of reducing energy poverty, enhancing energy security, and aligning emissions with climate targets. Several markers e.g. final energy savings, GHG emission reduction, implemented new ideas, realised sites and created employment are used to track the impact of ComActivate.

In an initial stakeholder workshop on renovation passports and neighbourhood concepts the valuable opinions and ideas will be gathered. The results from the workshop will influence the development of the roadmaps, which will later be iteratively adapted based on the feedback. The neighbourhood energy sufficiency roadmaps (NESRs) will be tailored to national and regional aspects (language, energy classes, climate zones, building type specifications, renovation recommendations, national minimum energy performance standards, milestones and others) for each municipality. The whole process will be based on a sufficiency guideline.

This report briefly introduces the framework for Renovation Passports in the European Union and provides an overview for best practice Renovation Passports that have already been implemented. The best practices are shown as examples at national and EU level, containing general information but also country or project specific obstacles and their solutions. The examples are organized sequentially, starting with national cases and progressing to EU-level implementations. The conclusion to this report consolidates the learnings from the shown examples and suggest which could be used for ComActivate.

### Objectives of this report

- Overview of boundary conditions for Renovation Passports
- Best practice Renovation Passports across the EU
- Conclusion

# Boundary conditions for Renovation Passports

## History of building renovation passports within the European directive on the energy efficiency of buildings (EPBD)

The concept of Building Renovation Passports (BRPs) in the European Union (EU) emerged as part of broader efforts to improve energy efficiency and decarbonize the building sector, which is a significant contributor to the EU's greenhouse gas emissions. The idea gained momentum in the context of the EU's Energy Performance of Buildings Directive (EPBD), first introduced in 2002 and revised several times.<sup>1</sup>

The 2018 revision of the EPBD was a key moment in the development of BRPs. This revision introduced the idea of a Building Renovation Passport as a potential tool to support long-term, step-by-step renovation strategies for individual buildings. The BRP is designed to provide a tailored roadmap for the renovation of a building, considering its specific characteristics and potential for energy efficiency improvements. The passport includes recommendations for renovations, timelines, estimated costs, and potential energy savings, helping owners to plan and finance energy-efficient upgrades over time. BRPs have been designed, tested and evaluated since in several countries, e.g. in the iBRoad project.<sup>2</sup>

The ongoing revisions to the EPBD and other related policies continue to shape the development and potential future mandatory adoption of BRPs across the EU. Many stakeholders asked for planning security during the recast process of the EPBD (EuroACE, 2023), which was finally taken into account in the recent update of the EPBD. Relevant changes were also made regarding BRPs.

First, building renovations plans are now called renovation passports (RPs). Article 12 mainly refers to the renovation passport as a “tailored roadmap for the deep renovation of a specific building in a maximum number of steps that will significantly improve its energy performance” as defined in Article 2 §19. Taking the definition of a deep renovation<sup>34</sup> from Article 2 §§19 and 20 into account it can be said that a renovation passport shall outline a long-term renovation strategy for individual buildings into a (n)ZEB. For the first time member states are provided with a timeline for the introduction of a national renovation passport scheme, which has to be introduced within 24 months after the 2024 EPBD recast was entered into force (i.e. 28<sup>th</sup> of May 2026). However, using the national schemes is voluntary for building owners unless member states decide to make it mandatory (Sibileau and Vladyka, 2024).

The link between Energy Performance Certificates (EPCs) and RPs was strengthened in the 2024 EPBD recast. RPs shall now indicate the estimated energy class per renovation step. It is now also possible to issue the RP and EPC jointly. A deep analysis of this approach was conducted, leading to the development of an online solution, which has been field tested and evaluated within the H2020 project [iBRoad2EPC](#). The digital output from iBRoad2EPC addresses Article 12 §8, which requires the storage of or access to any renovation passport in/via a digital building logbook where available.

## Content of a renovation passport

As per Article 12 EPBD the content of a renovation passport is defined within Annex VIII of the 2024 EPBD recast. Annex VIII differentiates between the content of an RP into mandatory and optional

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<sup>1</sup> All versions of the EPBD are available at the [EC online portal](#).

<sup>2</sup> See the [iBRoad project website](#) for all publications and information on the implementation of individual building renovation roadmaps in several EU member states.

<sup>3</sup> Art. 2 § 19 defines deep renovation as a “renovation which is in line with the ‘energy efficiency first’ principle, which focuses on essential building elements and which transforms a building or building unit:

(a) before 1 January 2030, into a nearly zero-energy building;

(b) from 1 January 2030, into a zero-emission building”

<sup>4</sup> Art. 2 § 20 defines staged deep renovation as “a deep renovation carried out in a maximum number of steps, as set out in a renovation passport”

content. Any RP shall make use of the information already available in the EPC of the building, if available, and extent this information. It shall further use standardised metrics.

The mandatory content shall be included if a member state decides to implement a RP in its national framework. Optional content, while not required, can provide valuable information about the building. Hence, it is in many cases worth to consider the optional content for any national implementation of renovation passports.

## Mandatory content of a renovation passport in line with Annex VIII EPBD

Nine key pieces of information must be included mandatorily in an RP according to the EPBD. This data is crucial to anyone interested in the status and possible future development of the building in question.

### Current energy performance

The energy performance of a building can be expressed as final energy demand in kilowatt hours, which is the most common unit for EPCs in the EU, primary energy demand is also widely used. The energy performance could also include on-site produced electrical energy, measured energy for space heating and cooling, domestic hot water and many more indicators as proposed in the X-tendo project<sup>5</sup>.

### Graphical representation of the renovation passport

A staged deep renovation includes several steps which build upon each other and need to be conducted in certain succession to ensure the best possible outcome – a (nearly) zero-emission building – and even avoid lock-in situations which may be expensive and work-intensive to resolve. One way to graphically represent a renovation process was developed within the iBRoad2EPC project<sup>6</sup>. Their features single steps, and was rated very useful by energy experts and building owners taking part in a field test of the iBRoad2EPC tool and can hence serve as a best practice (see Mellwig et al., 2024).

### Information on relevant national requirements

Many member states will implement renovation passports regarding minimum national requirements on energy performance of buildings and/or the phase-out of fossil fuels for heating and cooling or have already done so. According to Annex VIII, a renovation passport shall contain this information, including application dates and if relevant building type-specific schedules to inform building owners in the best possible way about future obligations.

### Explanation of the optimal renovation step sequencing

A staged deep renovation consists of several steps. The optimal sequence of these steps depends on various factors, like the current state of each building component, i.e. the energetic quality, age and general condition of the component, national requirements in place now and at a later stage, available funding, technical interference between the components, e.g. roof and outer walls, and many more. This leads to an individual sequence of renovation steps for each building. The sequence of the renovation passport shall be explained in detail to the reader according to Annex VIII EPBD.

### Information on each renovation step

All single renovation steps of the renovation plan shall be explained in detail to the reader. In particular, the EPBD requires the explanation to include:

- The name and description of the renovation measures conducted within the step.
  - This includes technology, technique and material options
- The estimated energy consumption savings (final and primary; in kWh) that are to be achieved with the conduction of the renovation step. However, this estimation cannot be precise, as user

<sup>5</sup> <https://x-tendo.eu/toolboxes/real-energy-consumption/>

<sup>6</sup> <https://ibroad2epc.eu/portfolio-items/conceptualising-ibroad2epc/>

behaviour has a big influence on energy consumption. Also, the phenomenon of the “rebound effect”<sup>7</sup> cannot be quantified sufficiently.

- Estimation of operational greenhouse gas emission reduction
- Estimation of savings on the energy bill
  - Indicating the assumptions on prices
- Estimated energy class before and after the renovation step.

## Information about a potential connection to district heating or cooling

Changing the heat supply is one of the bigger steps within a renovation process. The shift from a fossil-fuel boiler to a renewably sourced heating system, e.g. a heat pump, can reduce the carbon footprint of the building by a large amount. However, if the local municipality plans to supply the whole district with a district heating or cooling system, it would be neither efficient nor sustainable for the building owner and the environment to install a heat pump, which is to be replaced by the district heating soon. To avoid such or comparable lock-in effects, a renovation passport shall provide information about a potential connection to district heating or cooling. Heating networks are not necessarily climate-friendly today, but in the future, they will have to become climate-neutral, just like all individual heating systems. Once buildings are connected to a heating network, they no longer need to be converted to renewable heating systems.

## Share of generation and consumption of renewable energy after the renovation

Renewable energy sources are the key to a sustainable heating/cooling supply. Photovoltaics can deliver electricity for heat pumps or home appliances or charge an electric vehicle directly or via a battery. Solar energy can also be used to directly provide heat via solar thermal systems. With a heat pump it is also possible to convert solar energy into cooling energy. Other renewable energy sources like wind, water and soil may also be used to extract energy for heating, domestic hot water, cooling or electric devices directly in the building. The raising importance of renewable energy sources induces the metering of produced and used renewable energy in buildings. A renovation passport shall provide information on the share of renewable energy in the total energy consumption of the building.

## General information on improvement options for various other aspects of a green building

Annex VIII also proposes additional information to include in renovation passports. This features aspects regarding the embodied emissions<sup>8</sup>, circularity (e.g. separability, possibility of deconstruction, re-usability, re-cyclability), health and comfort (e.g. *indoor environmental quality* (IEQ)) (see BPIE, 2024) and adaptability to climate change. Information on funding for and contacts to reach out to about the latter aspects shall be provided in the renovation passports alongside information on technical advice such as one-stop-shops (OSS).

## Optional content of a renovation passport in line with Annex VIII EPBD

Next to the nine mandatory aspects, Annex VIII proposes even more optional topics to cover within the renovation passport. This additional information can enhance the RP hence the person issuing the RP should consider including at least some of them.

The EPBD mentions the following as optional content of a RP:

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<sup>7</sup> The rebound effect describes the phenomenon that measures which aim to enhance energy efficiency of buildings do often not lead to the calculated reduction in energy demand. This is amongst other reasons due to the user of the building feeling more confident about non-efficient behaviour (like leaving the windows open all day in a passive house) because their building has gained efficiency through the conducted measure. The rebound effect was initially observed by Jevons (1865) and further investigated e.g. by Saunders (2009).

<sup>8</sup> According to the Level(s) framework (Dodd et al., 2021) these emissions are often referred to as *whole life carbon* (WLC). They include the GREENhouse gas emissions emitted throughout the whole lifecycle of a product, starting with the production of the base materials and ending with an end-of-life scenario (e.g. combustion or preferably re-use)



- An indicative timing of steps
  - This provides the owner with a distinct long-term strategy
- For each renovation step:
  - a detailed description of the technologies, techniques and materials to be used, their advantages, disadvantages and costs.
  - how the energy performance of the building would compare to minimum energy performance requirements for buildings undergoing major renovation, nearly zero-energy building and zero-emission building requirements after completion of the step, and how the energy performance of the building elements replaced would compare to minimum energy performance requirements for single building elements, where these exist.
  - the estimated costs for carrying out the step.
  - the estimated payback period for the step, with and without any available financial support.
  - the estimated time needed to carry out the step.
  - where available, the reference values on the life-cycle greenhouse gas emissions for the materials and equipment and links to the relevant web pages where they can be found.
  - the estimated lifetime of measures and the estimated maintenance costs.
- Independent modules on:
  - the typical trades necessary or recommended for carrying out energy renovations (architects, advisors, contractors, suppliers and installer, etc.) or links to the relevant web pages.
  - a list of relevant architects, advisors, contractors, suppliers or installers in the area, that may include only those fulfilling certain conditions such as matching higher qualification or certification labels or conditions, or links to the relevant web pages.
  - the technical conditions needed for an optimal roll-out of low temperature heating.
  - how the renovation steps and additional measures could improve the smart readiness of a building.
  - technical and safety requirements for materials and works.
  - the underlying assumptions behind the calculations provided or links to the relevant web page where they can be found.
- Information on how to access a digital version of the renovation passport
- Any major renovations made to the building or building unit, as referred to in Article 8(1), and any retrofitting or replacement of a building element that forms part of the building envelope and which has a significant impact on the energy performance of the building envelope, as referred to in Article 8(2), where such information is made available to the expert carrying out the renovation passport
- Information related to seismic safety, where such information relevant to the building is made available to the expert
- Upon request and on the basis of information made available by the current building owner, an attachment containing additional information, such as the adaptability of spaces to evolving needs and any planned renovations.

## Best practices of Renovations Passports



## Implemented Renovation Passports

### Woningpas (Belgium/Flanders)

#### General information

The objective of the Woningpas was to provide a digital building passport where the building owner can get insight into all aspects of their building and the environment (energy, dwelling quality, water, soil, environment) and the evolution towards the long-term energy target. Furthermore, the Woningpas should integrate all attestations when building or renovating a house. To this end, the Woningpas was created as a central portal where all attestations are united. The region of Flanders (Belgium) implemented the Woningpas in early 2018. It was implemented with the aim of minimalizing the administrative burden on citizens. Building, renovating or buying a house (or any other kind of building) is a complex administrative process with certain insecurities, e.g., regarding the future development of the energy and building material market or the housing market. The Woningpas aims to provide owners and buyers with a structured view and advice on relevant building aspects. It is sought to offer a transparent and efficient management and enhancement of properties.

Different governmental entities (Flemish Energy and Climate Agency (VEA), Department of Environment of the Flemish government, and the Public Waste Agency of Flanders (OVAM)) worked together on one building passport and were able to present the first official version in spring 2018. The initial version featured main elements:

- A Dashboard with relevant data on
  - Energy
  - Insulation and installations (data provided by VEA)
  - Soil (data provided by OVAM)
  - Solar potential
  - General building information

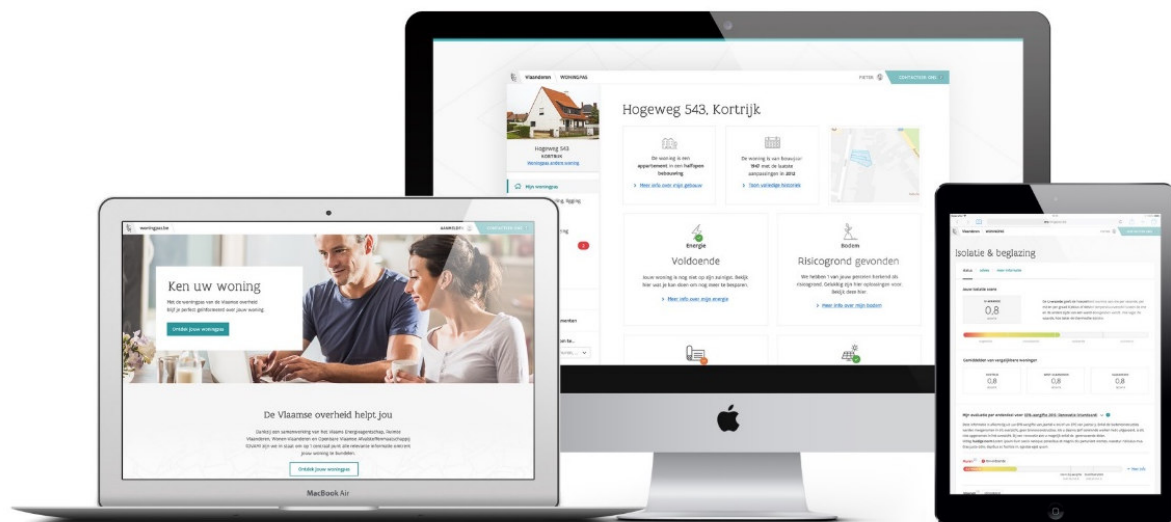


Figure 1: Exemplary content of the Flemish Woningpas. Copyright: Vlaams Energie- & Klimaatagentschap, 2024

## Content

The data from the *Energy Performance Certificate* (Energieprestatiecertificaat, EPC, see Figure 2) is a key element of the Woningpas. It provides information on the energy efficiency of a property, rated on a scale from A (very energy efficient) to G (least energy efficient) as shown in Figure 3. The EPC includes specific recommendations for improving energy efficiency, such as insulating roofs and walls, replacing windows, or modernizing heating systems.

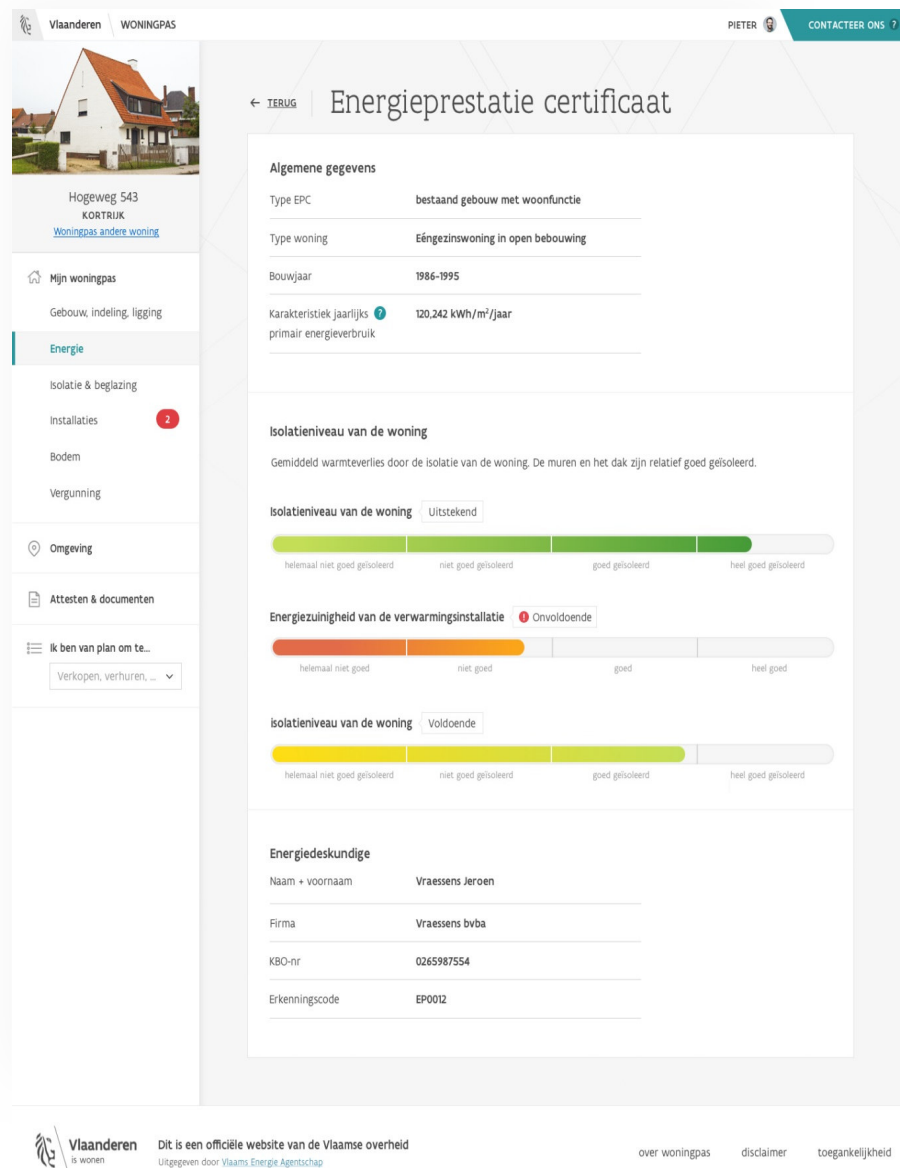


Figure 2: Exemplary screenshot of the embedded EPC in the Flemish Woningpas. Copyright Vlaams Energie- & Klimaatagentschap, 2024

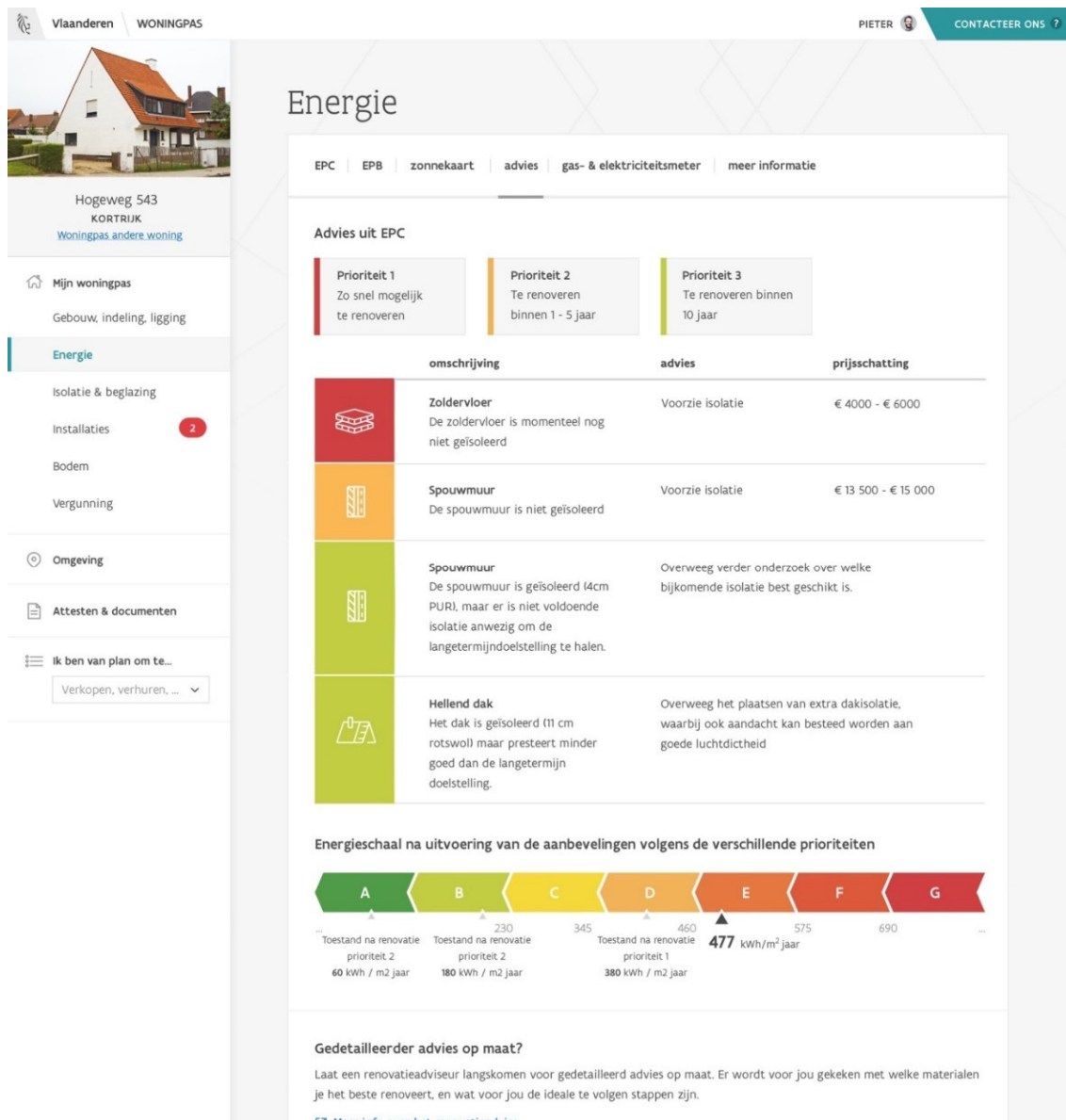


Figure 3: Exemplary screenshot from the Flemish Woningpas. Page on possible energy savings and status quo. Copyright Vlaams Energie- & Klimaatagentschap, 2024

## Guidance for users

The Woningpas also lists concrete measures for energy savings, based on the EPC recommendations, including:

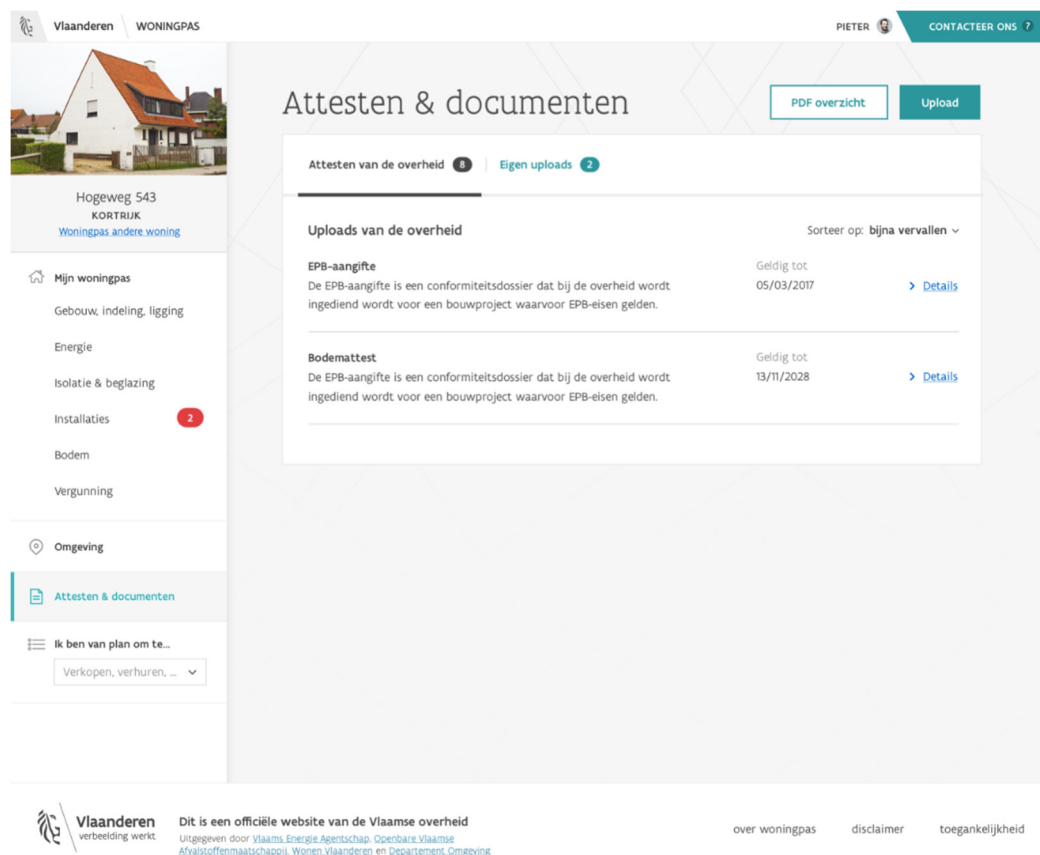
- Insulation - improving the thermal insulation of roofs, exterior walls, and floors to reduce heat loss.
- Windows and doors - replacing old, poorly insulated windows and doors with modern, energy-efficient models.
- Heating and ventilation systems - modernizing or replacing boilers, installing efficient heating and ventilation systems, and using renewable energy sources like solar thermal energy.
- Electrical installations - optimizing lighting and electrical appliances by using LED lights and energy-efficient household appliances.

The user of the passport is also provided with information about financial incentives like tax reduction, possible grants and subsidies available for implementing energy-saving measures. This includes government subsidies, low-interest loans, and tax incentives specifically aimed at energy renovations.

With the Woningpas, owners can plan and monitor the progress of their property's energy renovation in the long term. The document provides an overview of measures already taken and allows for strategic planning of future investments in energy efficiency. Additionally, regular updates of the EPC can be stored in the Woningpas to document the current state of energy efficiency.

Further environmental information is also included, that may be considered for the long-term planning of a building. Users have access to official data about spatial planning in the region of their building, buildings of immovable heritage and flood sensitivity of the area.

The idea of the Woningpas also comprises a roadmap for the user. This roadmap contains instructions for certain scenarios i.e. what to do in case of (re)building or (re)buying. The roadmap guides the user along administrative hurdles to overcome such as which certificates to get and where to apply for them. Additionally, an overview of all energy related digital certificates like historical building permits or inspection of boilers and heating systems is available on the dashboard (Figure 4). The passport offers an interpretation of the available data, too. These digital certificates also include a renovation passport and the possibility to follow up on or adjust the latter. An interpretation of the available data is given, too. The passport interprets, e.g., whether a certain component of the building is already sufficiently insulated or if it meets current and future regulations and where and how components of the building can be enhanced in the most efficient way (Figure 5). The Woningpas also includes a digital vault, where sensible data like plans, invoices, or building documents can be stored.

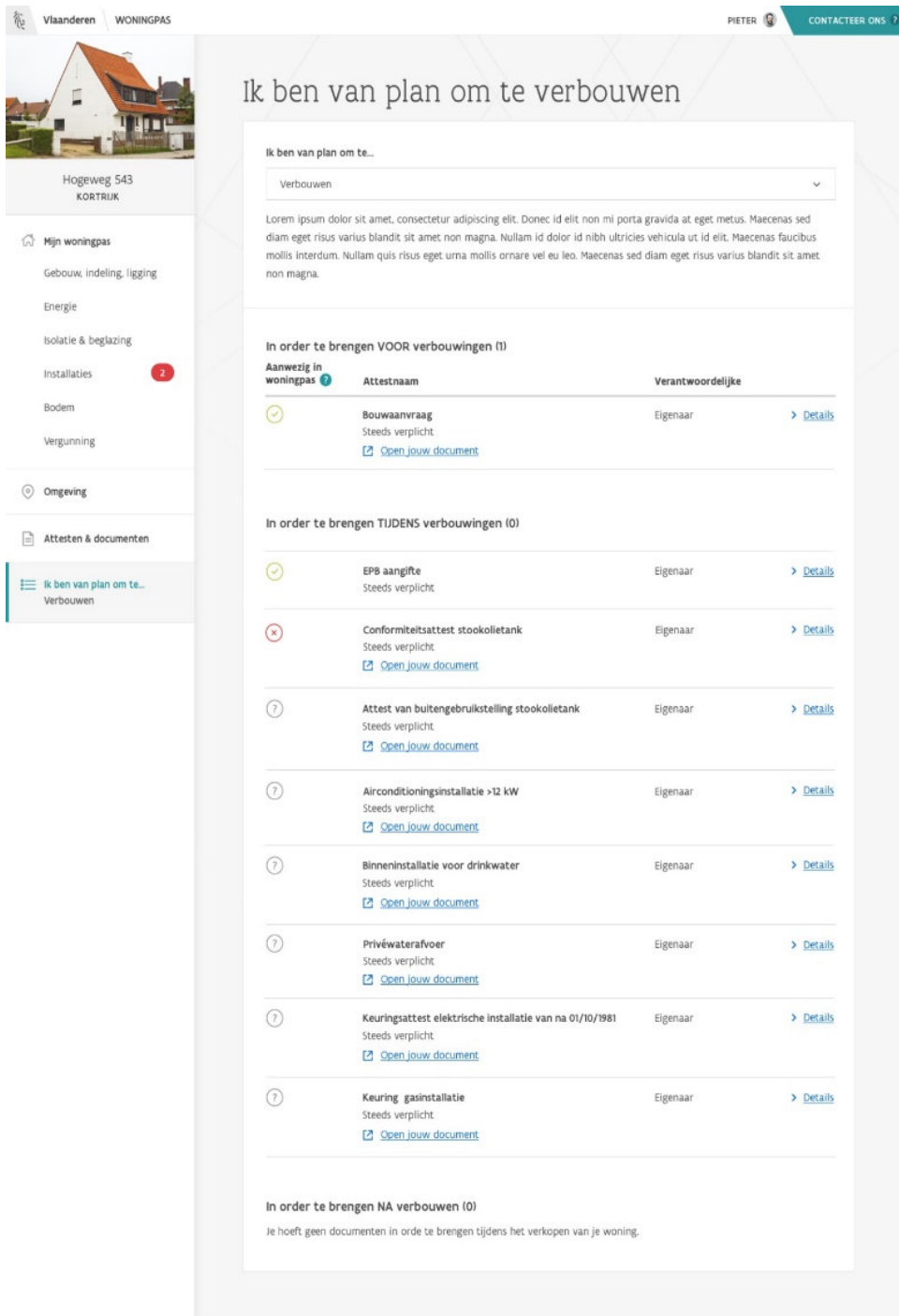


The screenshot shows the 'Attesten & documenten' page in the Woningpas interface. The page is for a property at Hogeweg 543, Kortrijk. The main content area is titled 'Attesten & documenten' and has two tabs: 'Attesten van de overheid' (3) and 'Eigen uploads' (2). Under 'Uploads van de overheid', there are two entries:

Document	Geldig tot	Details
<b>EPB-aangifte</b> De EPB-aangifte is een conformiteitsdossier dat bij de overheid wordt ingediend wordt voor een bouwproject waarvoor EPB-eisen gelden.	05/03/2017	> Details
<b>Bodemattest</b> De EPB-aangifte is een conformiteitsdossier dat bij de overheid wordt ingediend wordt voor een bouwproject waarvoor EPB-eisen gelden.	13/11/2028	> Details

At the bottom of the page, there is a footer with the Vlaanderen logo and text: 'Dit is een officiële website van de Vlaamse overheid. Uitgegeven door Vlaams Energie Agentschap, Openbare Vlaamse Afvalstoffenmaatschappij, Wonen Vlaanderen en Departement Omgeving'. There are also links for 'over woningpas', 'disclaimer', and 'toegankelijkheid'.

Figure 4: Exemplary screenshot from the Woningpas. Page on certificates and documents about the building. Copyright: Vlaams Energie- & Klimaatagentschap, 2024



Vlaanderen WONINGPAS

PIETER CONTACTEER ONS ?

## Ik ben van plan om te verbouwen

Ik ben van plan om te...

Verbouwen

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**In order te brengen VOOR verbouwingen (1)**

Aanwezig in woningpas ?	Attestnaam	Verantwoordelijke	
✓	Bouwaanvraag Steeds verplicht <a href="#">Open jouw document</a>	Eigenaar	<a href="#">Details</a>

**In order te brengen TIJDENS verbouwingen (0)**

✓	EPB aangifte Steeds verplicht	Eigenaar	<a href="#">Details</a>
✗	Conformiteitsattest stookolietank Steeds verplicht <a href="#">Open jouw document</a>	Eigenaar	<a href="#">Details</a>
?	Attest van buitengebruikstelling stookolietank Steeds verplicht <a href="#">Open jouw document</a>	Eigenaar	<a href="#">Details</a>
?	Airconditioningsinstallatie >12 kW Steeds verplicht <a href="#">Open jouw document</a>	Eigenaar	<a href="#">Details</a>
?	Binneninstallatie voor drinkwater Steeds verplicht <a href="#">Open jouw document</a>	Eigenaar	<a href="#">Details</a>
?	Privéwaterafvoer Steeds verplicht <a href="#">Open jouw document</a>	Eigenaar	<a href="#">Details</a>
?	Keuringsattest elektrische installatie van na 01/10/1981 Steeds verplicht <a href="#">Open jouw document</a>	Eigenaar	<a href="#">Details</a>
?	Keuring gasinstallatie Steeds verplicht <a href="#">Open jouw document</a>	Eigenaar	<a href="#">Details</a>

**In order te brengen NA verbouwen (0)**

Je hoeft geen documenten in orde te brengen tijdens het verkopen van je woning.

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over woningpas disclaimer toegankelijkheid

Figure 5: Exemplary screenshot from the Woningpas. Page including the interpretation of the current building status. Copyright: Vlaams Energie- & Klimaatagentschap, 2024

## Progression and dissemination

In 2014, the Flemish Agency on Energy and the Flemish Agency on Dwelling-quality signed the so called “Renovation pact” together with more than 30 stakeholders to increase the renovation rate in Flanders. The initial Woningpas was a starting point that is systematically and continuously enriched by new content. For example, in 2019 further housing aspects were included. This covers the mapping of

water use, the housing quality itself and the availability and quality of electrical installations. The owner of the building was further enabled to allow external persons like buyers, tenants, reporters, planners etc.) to consult the Woningpas. These external users can also be authorized to add information to the Woningpas or upload document into the digital vault. Further development of the Woningpas aims to include non-residential buildings.

## Implementation challenges

The main challenge during the implementation of the Woningpas was to solve data availability and quality. Data was by a large amount not digitalised and, when digitalised, often only qualitative. The data challenge was tackled by a holistic approach with the aim to add as many information and themes in the Woningpas as possible. While this was realised, a business plan was developed in parallel to split this challenge in small steps, starting with the data that was available. Hence, other data-sources started digitalising themselves or ameliorating their data on their own.



Figure 6: Stepwise approach to developing the Woningpas. Copyright: Vlaams Energieagentschap, 2017

## Suitability for municipalities

In summary, the Woningpas in Flanders offers a comprehensive platform for information and promotion of energy savings in properties. The user of the passport gets access to all relevant building information that is kept by the government and can add additional personal building information. A unique digital logbook of each building is created and can be enhanced by using various modules. Through clear recommendations, financial incentives, and long-term planning capabilities, the Woningpas supports owners and buyers in making their properties more sustainable and energy efficient.

A major prerequisite for the Woningpas is the availability of building data on several levels (energy, dwelling quality, water, soil, environment). In Flanders, this data is available on federal level. Communities or municipalities will have to clarify how they can access the required data. This can be challenging especially when the data needs to be processed to fit the requirements of a unified platform.

Once implemented, the Woningpas can provide considerable benefits for Communities. It can be linked to district heating, which is explicitly mentioned in the passport covering all topics such as potential connection to a heating grid, spatial development of the area, and status of the buildings.

## casA+ (Portugal)

### General information

The casA+ portal<sup>9</sup> is a digital platform developed by ADENE in Portugal under the Horizon 2020 project ReAct<sup>10</sup> and designed to align with the EPBD framework. Its primary objective is to address and encourage the implementation of over 1.5 million improvement measures identified by EPCs. Directed at homeowners (or tenants), the platform centralizes all relevant information about the house in one place. casA+ was developed to bridge the communication gap between various stakeholders, including consumers, service providers, companies, qualified experts, and other relevant actors, providing numerous advantages for all involved. The portal was launched in April 2021. The project garnered significant traction, with over 3,000 registered companies, more than 28,000 homeowners/tenants, and over 7,000 requests for proposals made. Another primary objective is to become the leading platform for integrating BRPs in Portugal, thereby fostering the development of new areas of expertise such as nZEB and ZEB. The casA+ hub aims to achieve ambitious targets, including receiving approximately 15,000 requests for proposals from 60,000 homeowners/tenants and facilitating € 6 million in investments in sustainable energy projects. This significant investment in building renovations is expected to create a secondary effect of promoting new job opportunities, contributing to economic growth and sustainability.

casA+ enables homeowners to access detailed information about their properties, including energy efficiency performance and building characteristics, and offers a comprehensive set of data and insights aimed at enhancing performance and achieving savings. Users can register equipment (e.g., electrical appliances, lighting systems, water use devices) and relevant housing documentation (e.g., building registers and technical files). If users link their EPC to their profile, much of this information is automatically filled in, streamlining the user experience and enabling a direct connection to the qualified expert who issued the EPC. This feature facilitates easy communication to clarify doubts, request corrections, and seek advice on implementing improvement measures.

### Content

The portal is structured around five core axes that contain valuable information and may trigger synergies between the different axes:

1. **Synergies:** Integrating various ADENE initiatives, such as the Energy Certification System of Buildings, the CLASSE+ Energy Labelling System, the Poupa Energia tariff comparison platform, and the AQUA+ Water Classification System.
2. **Trust:** casA+ ensures that only recognised and reliable companies/brands are featured, offering consumers security when selecting service providers.
3. **Information:** The platform aims to reduce energy and water illiteracy by providing news, tips, and best practice guides focused on building efficiency.
4. **Circularity:** casA+ opens new areas of action related to sustainability and efficiency, supporting broader objectives like Carbon Neutrality.
5. **Mitigation:** By promoting rapid implementation of improvement measures, supported by accessible incentives and financing options, the platform helps reduce energy poverty.

In summary, the casA+ portal not only aligns with the goals of the European Green Deal, particularly regarding building renovation and decarbonisation, but also serves as a comprehensive one-stop-shop for energy and water efficiency, bridging gaps between key actors and promoting long-term sustainability in the building sector.

The expertise areas available in the portal casA+ are described in Figure 7.

<sup>9</sup> <https://portalcasamais.pt/>

<sup>10</sup> <https://react2020.eu/>



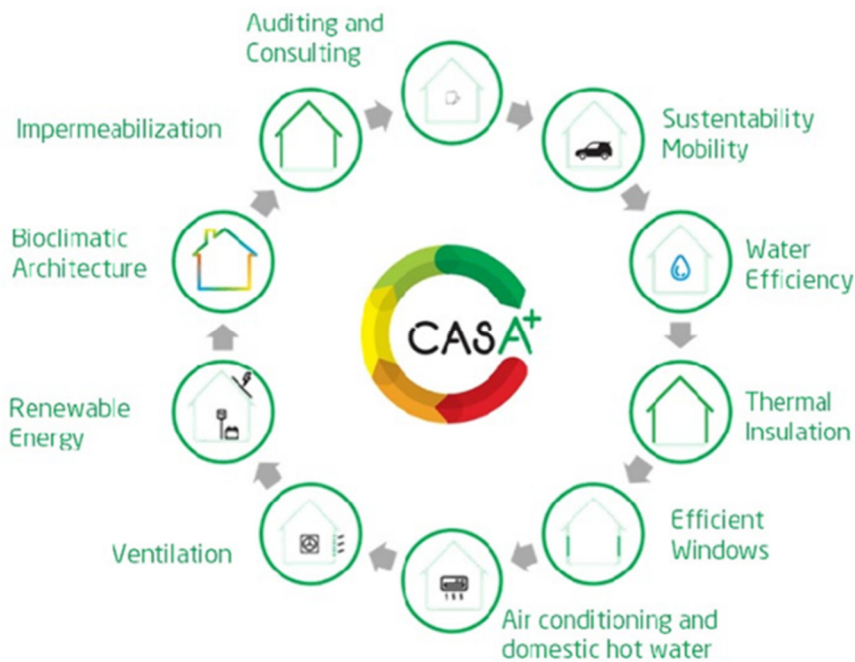
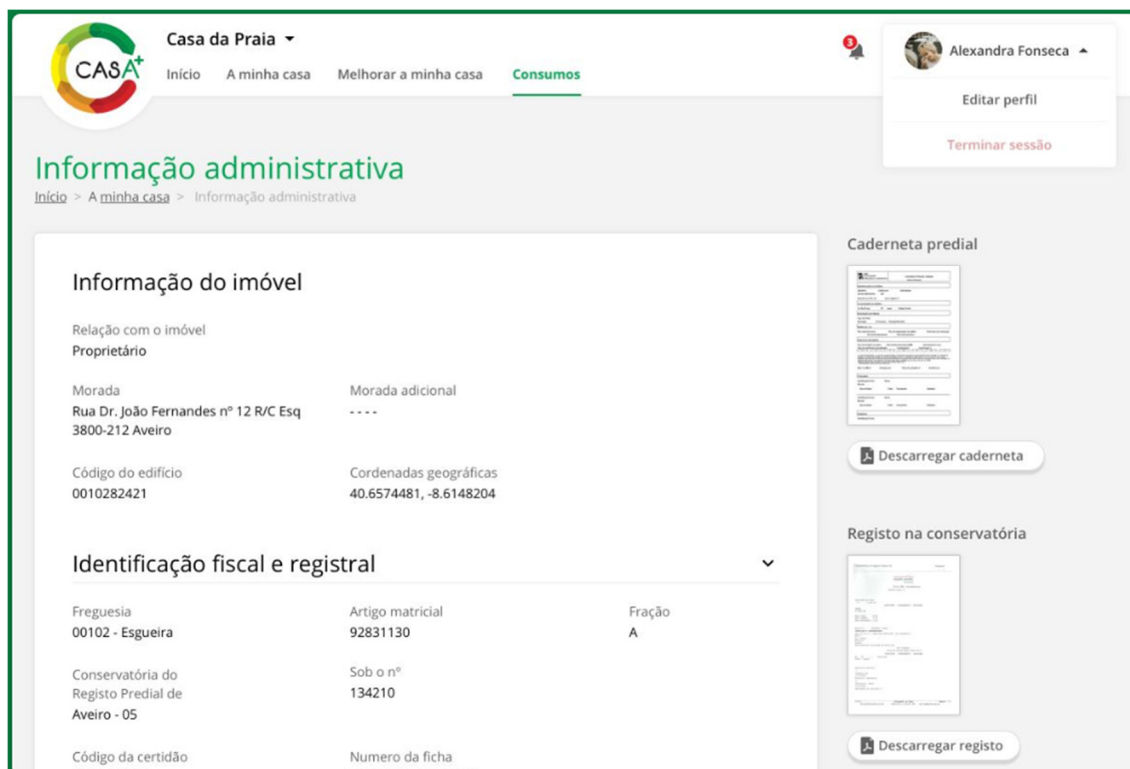


Figure 7: Expertise areas of the casA+ Portal. Copyright: ADENE

For each expertise area, specialized companies are available, and it is possible to request proposals and adjudicate services by interacting directly with the companies. The portal also provides, in its public area, a company directory. Through the directory consumers can consult the companies available to implement improvement measures and through the search filters it is possible to select the expertise and the geographic area, leading to a faster and accurate search.



**Casa da Praia** | Início | A minha casa | Melhorar a minha casa | **Consumos**

Alexandra Fonseca | Editar perfil | Terminar sessão

### Informação administrativa

Início > A minha casa > Informação administrativa

#### Informação do imóvel

Relação com o imóvel  
Proprietário

Morada  
Rua Dr. João Fernandes nº 12 R/C Esq  
3800-212 Aveiro

Morada adicional  
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Código do edifício  
0010282421

Cordenadas geográficas  
40.6574481, -8.6148204

#### Identificação fiscal e registral

Freguesia 00102 - Esgueira	Artigo matricial 92831130	Fração A
Conservatória do Registo Predial de Aveiro - 05	Sob o nº 134210	
Código da certidão parcelsamento	Numero da ficha Métrica da habitação	

Caderneta predial  
[Imagem de caderneta predial]  
Descarregar caderneta

Registo na conservatória  
[Imagem de registo na conservatória]  
Descarregar registo

Figure 8: Sample of general and administrative information about a building in the casA+ Portal. Copyright: ADENE



**CASA+** Casa da Praia ▾

Início **A minha casa** Melhorar a minha casa Consumos

**Certificação energética**  
Início > A minha casa > Certificação energética

Pedidos de certificação Pedidos de esclarecimento **Atualizar Certificado Energético**

**Certificado Energético SCE1234567890**

Fotografia do imóvel Classe energética **D** Enquadramento da certificação **Novo**

 Data de emissão 22/10/2016 Data de validade 19/01/2019

**Dados do processo de certificação**

Data da visita ao imóvel 21/10/2016 Hora de início da visita 10:30 Hora de fim da visita 11:00

**Dados do Perito Qualificado**

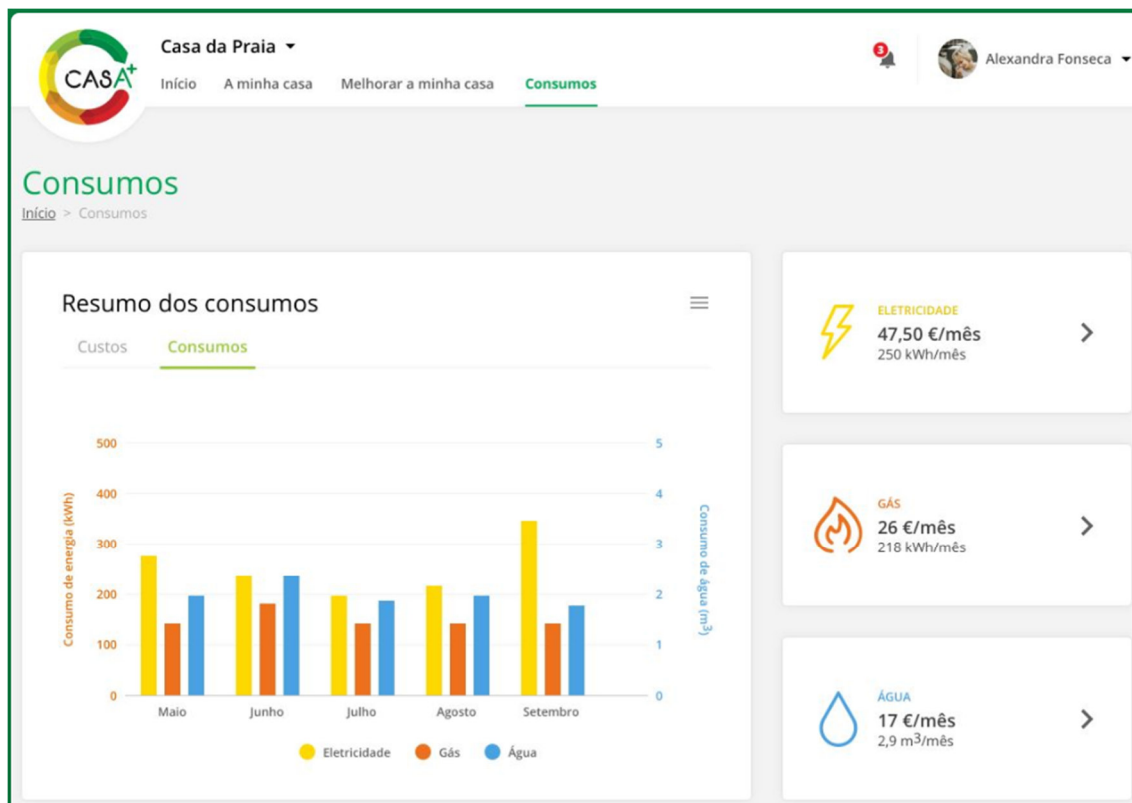
Carteira profissional Nome António Manuel Fernandes Número de identificação 2020190

 Contacto telefónico Email

**Certificado energético**  
  
**Descarregar certificado**

**Relatório do processo de certificação**  
  
**Descarregar relatório**

Figure 9: Sample of energy-related information in the casA+ Portal. Copyright: ADENE



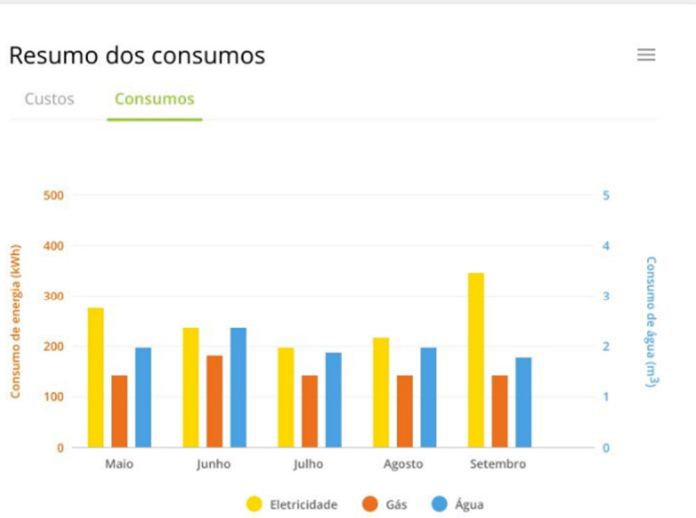
**CASA+** Casa da Praia ▾

Início A minha casa Melhorar a minha casa **Consumos**

**Consumos**  
Início > Consumos

**Resumo dos consumos**

Custos **Consumos**



**ELETRICIDADE**  
47,50 €/mês  
250 kWh/mês

**GÁS**  
26 €/mês  
218 kWh/mês

**ÁGUA**  
17 €/mês  
2,9 m³/mês

Figure 10: Sample of the assessment of energy consumption in the casA+ Portal. Copyright: ADENE



**Casa da Praia** | Início | A minha casa | **Melhorar a minha casa** | Consumos | Alexandra Fonseca

## Melhorar a minha casa

Ver histórico de pedidos de propostas

**A MINHA CASA** (D) | **CASAS SIMILARES À MINHA SÃO** (B) | **MEDIDAS DE MELHORIA DISPONÍVEIS:** 7 | **O QUE A MINHA CASA PODE SER** (A+)

5 do Certificado energético  
2 do Portal casA+  
0 da sua lista

**Medidas de melhoria identificadas no Certificado Energético**

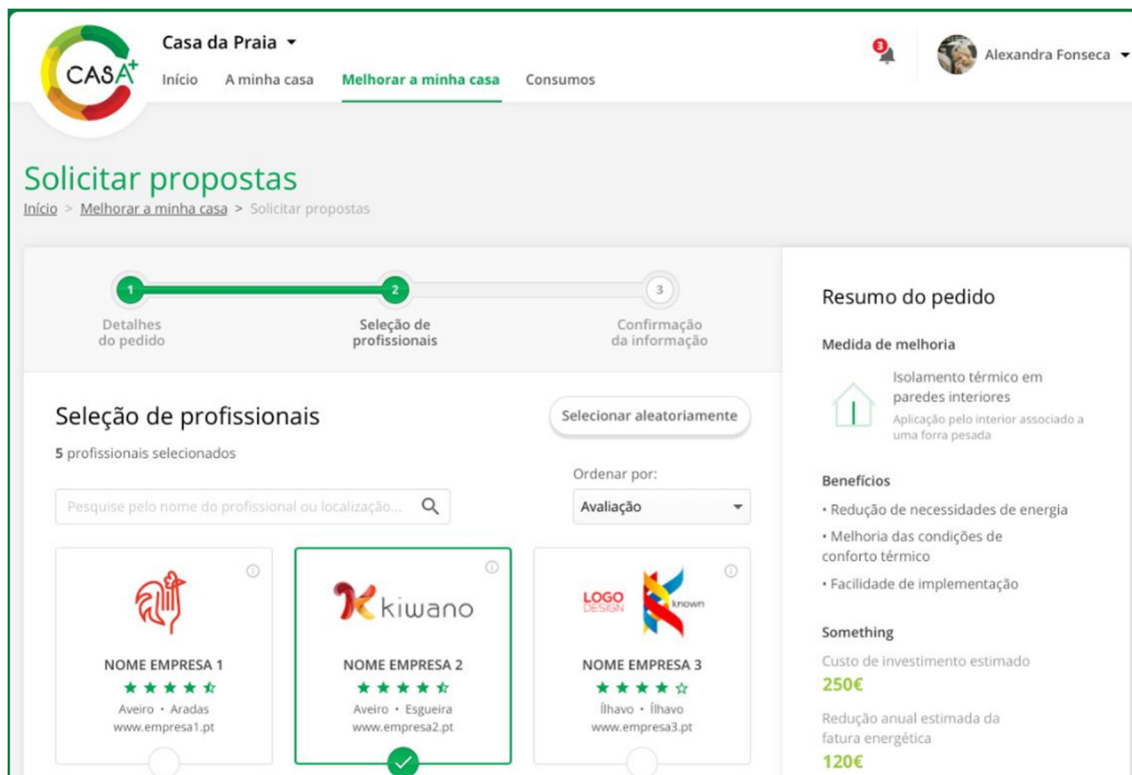
Nesta secção são apresentadas as medidas de melhoria que constam do certificado energético da sua habitação, identificadas pelo Perito Qualificado aquando da visita ao imóvel.

Estas medidas terão o seguinte impacto a nível financeiro e de desempenho energético:

- 12.300€** CUSTO TOTAL ESTIMADO DE INVESTIMENTO
- até 800€** REDUÇÃO ANUAL ESTIMADA DA FATURA
- A+** CLASSE ENERGÉTICA APÓS CONJUNTO DE MEDIDAS

- Isolamento térmico em paredes exteriores**  
Aplicação pelo exterior com revestimento aplicado sobre o isolante | Ver propostas
- Isolamento térmico em paredes interiores**  
Aplicação pelo interior associado a uma forra pesada | Solicitar propostas
- Substituição de janelas existentes por novas janelas**  
Substituição de vãos envidraçados existentes por novos vãos envidraçados de classe energética A (classificação SEEP) | Solicitar propostas

Figure 11: casA+ displays renovation recommendations from the EPC and identifies additional renovation measures automatically based on the consumption profile and further data from the profile. Copyright: ADENE



**Casa da Praia** | Início | A minha casa | **Melhorar a minha casa** | Consumos | Alexandra Fonseca

## Solicitar propostas

1 Detalhes do pedido | 2 Seleção de profissionais | 3 Confirmação da informação

### Seleção de profissionais

5 profissionais selecionados

Selecionar aleatoriamente

Ordenar por: Avaliação

Pesquise pelo nome do profissional ou localização...

- NOME EMPRESA 1** (Aveiro · Aradas) | www.empresa1.pt
- NOME EMPRESA 2** (Aveiro · Esgueira) | www.empresa2.pt
- NOME EMPRESA 3** (Ílhavo · Ílhavo) | www.empresa3.pt

### Resumo do pedido

**Medida de melhoria:** Isolamento térmico em paredes interiores (Aplicação pelo interior associado a uma forra pesada)

**Benefícios:**

- Redução de necessidades de energia
- Melhoria das condições de conforto térmico
- Facilidade de implementação

**Something**

Custo de investimento estimado: **250€**

Redução anual estimada da fatura energética: **120€**

Figure 12: casA+ lists companies that offer services which fit to the customer needs. Copyright: ADENE

## Guidance for users

One of the most valuable features of casA+ is its ability to connect users directly with registered and validated companies and professionals, facilitating the seamless implementation of efficiency improvement measures. ADENE validates these entities according to strict criteria to ensure compliance with legal obligations. Homeowners can request proposals, ask for clarifications, and initiate collaborations with service providers directly through the platform.

Additionally, casA+ serves as a centralised resource for information on housing, incentives, and financing. By consulting the guides, tips, and simulators provided, users can determine the most effective measures to reduce energy and water consumption in their homes and estimate potential savings. The platform's focus on promoting energy and water efficiency through newsletters, guides, and tips aims to enhance the environmental literacy of Portuguese citizens, fostering more sustainable decision-making and encouraging a conscious approach to resource use.

Serving as the national reference one-stop-shop for energy and water efficiency, casA+ hub is recognized for its integration of EPC information within the community. It is cited in the Long-Term Strategy for Building Renewal (ELPRE) and referenced in Recommendation (EU) 2019/786, guiding the transposition of the EPBD.

## Progression and dissemination

The portal is under constant development. To name some of the developments undertaken, a further integration with incentive schemes is aimed for, homeowners will gain easy access to duplicates of their EPCs, renovation guides<sup>11</sup> are connected to the portal, an API will be developed that shall enable companies to integrate a better customer relation management. The demand for building renovation and energy performance improvements will be stimulated by providing more relevant information on funding and finance opportunities and alleviating energy poverty. The pace of constant need of growth of casA+ shall be kept up and the portal will be upgraded to offer a better response to all agents involved (homeowners, companies, auditors, service suppliers). casA+ will be also further developed to better meet market needs and facilitate the decision process of homeowners. Also, the water efficiency expertise area<sup>12</sup> in casA+ will be expanded as water availability is an urgent topic in Portugal. The developers also aim to upgrade the digital building logbook to a dynamic model, taking recent trends into account.

## Implementation challenges

The implementation process of casA+ took approximately four years in total starting from the contextual development until the full deployment. Figure 13.

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<sup>11</sup> The portal is linked to the iBRoad2EC project and can directly use data from issued iBRoad2EPCs.

<sup>12</sup> <https://www.aquamais.pt/>

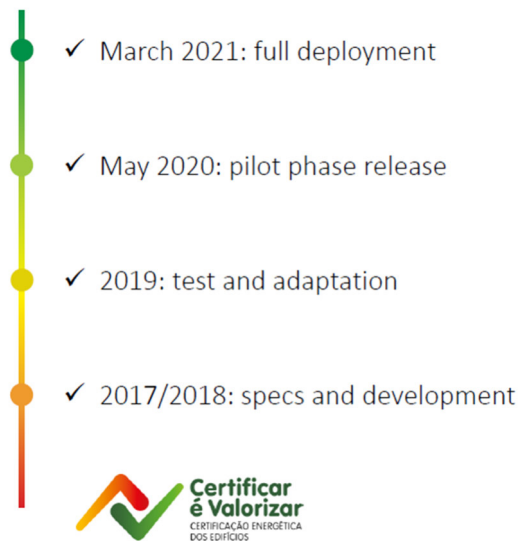


Figure 13: Developing and implementation process of the casA+ Portal. Copyright: ADENE

The process was supervised by ADENE. Due to the specific approach of casA+ (e.g. the subscription system) obstacles occurred. **Three major obstacles** were identified during the implementation process.

#### Attracting companies to paid plans

The casA+ portal offers three annual paid plans for companies. The plans differ in extent and price (Table 1). The registration for companies in the public directory is always free, as is using casA+ for private consumers.

Table 1: casA+ membership plans for companies. Copyright: ADENE

Features included in the subscription plan	Directory	Basic	Excelece
Presence in public directory	Yes	Yes	Yes
Access to portal (incl. leads and other features)	No	Yes	Yes
Number of affiliated companies allowed	-	5	Unlimited
Association with casA+ (logo)	No	Yes	Yes
Highlight in website and portal	No	No	Yes
Discount if member of partner association	n.a.	5%	10%
Annual fee	Free	1600€	4900€

The three types of subscription plans for companies are the result of an iterative process that aimed to find a solution for companies' conservative reaction on the subscription system. Each plan has different benefits. A free plan simply makes the company part of the public directory of casA+ companies. Paid plans give access to other benefits and tools available on the OSS, such as the request for proposal platform. In the initial phase of the OSS (which casA+ is), the paid plans were very expensive, which meant that very few companies opted for one of the paid plans. To resolve this issue, the values were readjusted associated with the subscription plans, as well as their value proposition. As the value dropped considerably, a growth rate of more than 2000% was achieved, going from around 10 companies with paid plans to more than 200.

### Expanding the tool for proposal requests and ensuring its continued use by both the consumer and the company

Despite the availability of this tool and the fact that most companies use it to receive requests for proposals, one of the main obstacles was that companies use it not only to respond but also to monitor the entire process. Most of the time after a company receives the request for proposal, it called the client directly and didn't finalise the process through the portal. Since companies cannot be forced to use the tool along the entire process chain, a solution was needed. In this case a value for the companies and consumers was added to the tool. In the first instance, the tool was simplified regarding the number of steps a user had to take. Secondly, casA+ was enabled to monitor and support the preparation of applications for national funding sources. The company was hence enabled to respond to any request with its budget proposal and submit certain documents that will be required for a given source of funding

### **Guaranteeing the quality of services and companies registered in casA+**

The registration process was not accompanied in the beginning. This led to issues with the service quality. To guarantee the quality of the services provided by the portal several checks on the quality of the companies and the procedures of the portal itself were conducted. All actions carried out on casA+ now require validation by the administrations team, e.g. for the check if a company fulfils all requirements to be registered on the portal. This involves many administrative processes, which lead to another obstacle. The administrative work now consumed a lot of workforces. To streamline the processes, various types of automation have been implemented to make administrative processes easier, from answering an email with a question to checking the quality of a company.

### **Suitability for municipalities**

The casA+ portal follows a bidirectional approach on green building development. On the one hand it allows users to pose a request for a certain service pro-actively. On the other hand, companies are provided with a marketing platform to offer their building related service to the exact target group. This approach eliminates various hindrances between companies offering services and consumers demanding them. It also minimizes bureaucratic work for consumers by only asking for each document once, allocating it to the individual building and making the information available for everyone offering a service.

The concept of combining low-threshold access for the consumer side and efficient information flow towards the companies does not depend on a broad market coverage and can also be transferred to community level. However, restricting the service to a smaller area may also reduce the choice of providers. This may mean that some services are not covered or are only provided by a single company, which would then become a monopoly.

90% of the dwellings in the pilot communities (Burgas in Bulgaria, Józsefváros in Hungary, and Elektrėnai and Kaišiadorys in Lithuania) are condominiums, the remaining 10 % are social housing. This ownership structure fosters renovation solutions that aggregate all relevant data at one central digital storage. Once a casA+ tool is in place, property managers could join forces to submit a joint refurbishment proposal. Companies (or a consortium of companies) that focus on such projects could make a coordinated offer for a structured deep renovation of the community. The specific peculiarities of property managers were analysed in the GREEN Home project. The idea of casA+ seems applicable to the pilot communities of ComActivate.

## urbanZEB | urban3R (Spain)

### General information

Two main tools are currently at service in Spain, i.e. urbanZEB and urban3R. These tools are based on the Urban Building Energy Model (UBEM) platform, which is led by the MIT Sustainable Design Lab<sup>13</sup> (SDL). The initial development was supported via the MIT Energy Initiative<sup>14</sup> as well as the Government of Portugal via the MIT Portugal Program<sup>15</sup>. Additional support was provided by the National Science Foundation Graduate Research Fellowship under Grant No. 2141064. (SDL n. d.) UBEM creates so-called 2.5D models of urban areas (Reinhart and Davila, 2016) (Figure 14).



Figure 14: massing model of South Boston from GIS (left) and urban massing proposal for the Boston Innovation District (right). Copyright: Reinhart & Davila (2016)

An UBEM is a combination of mass model and a thermal model. The cubes in the mass model represent a building in length, width and height. The thermal modelling is done by defining building archetypes and allocating archetype specific thermal properties to all buildings gathered within the archetype. According to Reinhart and Davila (2016) an archetype can represent “less than 50 up to 500,000 buildings”. While the archetype approach meets measured data sufficiently precise on the level of a group of buildings, the error increases significantly for individual buildings (ibid.) (Table 2).

Table 2: Reported simulation errors for multiple UBEM studies. Copyright: Reinhart and Davila (2016)

City/Region	# of measured buildings <sup>a</sup>	Simulation outputs	Validation scale	Reported error range	Reference
Osaka	1128	Total EUI	Aggregate	18%	[43]
Houston	<sup>b</sup>	Total EUI	Aggregate	10-13%	[35]
Carugate	1320	Heating	Aggregate	10%	[29]
Milan	<sup>b</sup>	Total EUI	Aggregate	4%	[44]
Sicily	<sup>b</sup>	Heating	Aggregate	8%	[32]
Los Angeles	27	Total EUI	Building	11-23%	[58]
Thessaloniki	4	Heating	Building	12-55%	[45]
Ludwigsburg	35	Heating	Aggregate/Building	21%/5-50%	[47]
Karlsruhe	22		Aggregate/Building	7%/18-31%	
Freiburg	22	Heating	Building	1-60%	[63]
Navy yard	200	Total EUI	Building	5-69%	[37]
Arlington county	6		Building	5-50%	
Swiss village	100	Heating	Aggregate/Building	8%/6-88%	[67]
Swiss district	22	Heating Total EUI	Building Aggregate/Building	9-66%	[61]
				1-19%/8-99%	

<sup>a</sup> Number of buildings to be represented by archetypes.

<sup>b</sup> Number of buildings not available in the study.

<sup>13</sup> <http://web.mit.edu/SustainableDesignLab/index.html>

<sup>14</sup> <https://energy.mit.edu/>

<sup>15</sup> <https://www.mitportugal.org/>



In Spain UBEM models provide the basis to four tools: urban3R<sup>16</sup>, which is a web viewer on Long-term Renovation Strategy (LTRS) 2020 data for urban areas; urbanZEB, which is the first tool that was developed based on UBEM methodologies in Spain; BETTER stock, which is the regional roadmap tool developed for the Basque Government (not publicly available yet), and BETTER communities, which is a simplified version of a BRP, connected to the OPENGELA, i.e. the one-stop-shop model of the Basque government. urbanZEB and urban3R are explained in more detail in the following chapters.

## Content

### urbanZEB

The available data in the Spanish tools depends on the respective tool. urbanZEB is an interactive tool available to citizens, the commercial sector, administrations, and investment agents in Catalunya which aims to reach decarbonization objectives set by the European Union and Government of Catalunya by 2050. urbanZEB is currently running on a demo version. All data in urbanZEB is simulated floor by floor based on the UBEM platform. The demo was developed to a point where users can give the tool a try and it includes the region of Menorca. Various building types, e.g. residential, cultural, commercial, and industrial buildings are covered (Figure 15).

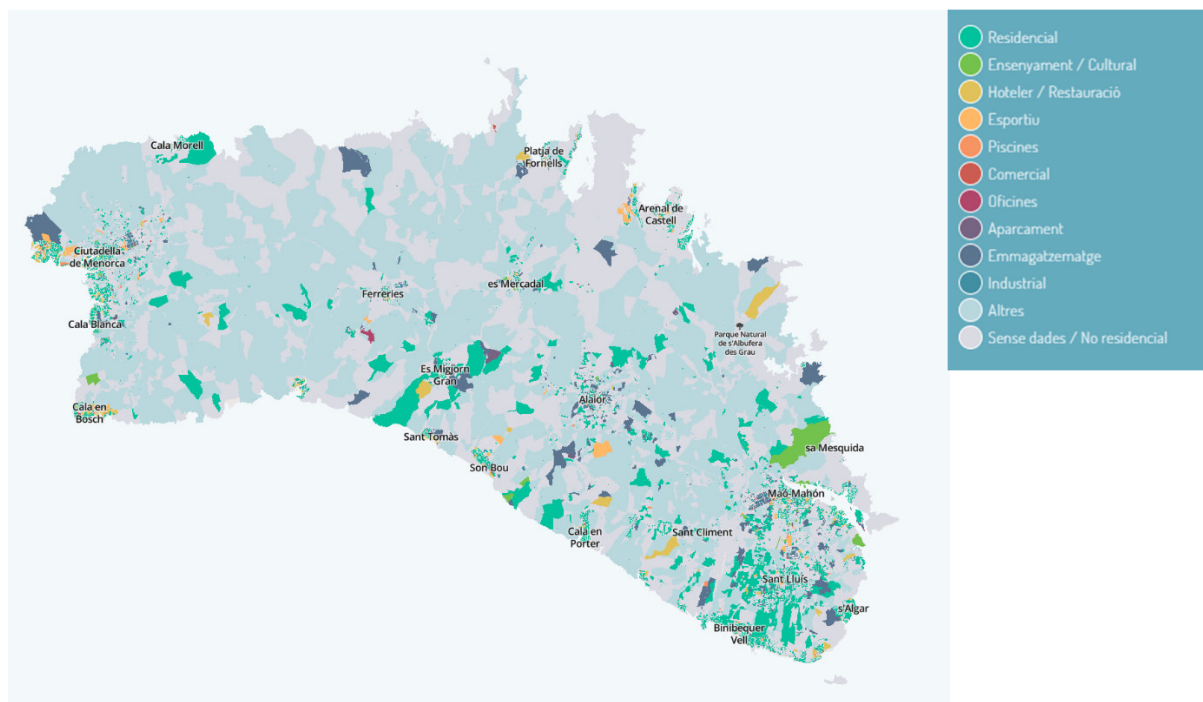


Figure 15: Screenshot of from the urbanZEB tool (left) Island of Menorca. Legend (right). Copyright: urbanZEB

The user may choose any building from the map and is directed to the building specific landing page. The page includes three information categories, i.e. architectural (red ring), energetic (green ring), and economic (blue ring). The front page includes the location and full address of the building as well as a picture of the building and a unique reference code (Figure 16).

<sup>16</sup> <https://urban3r.es/>

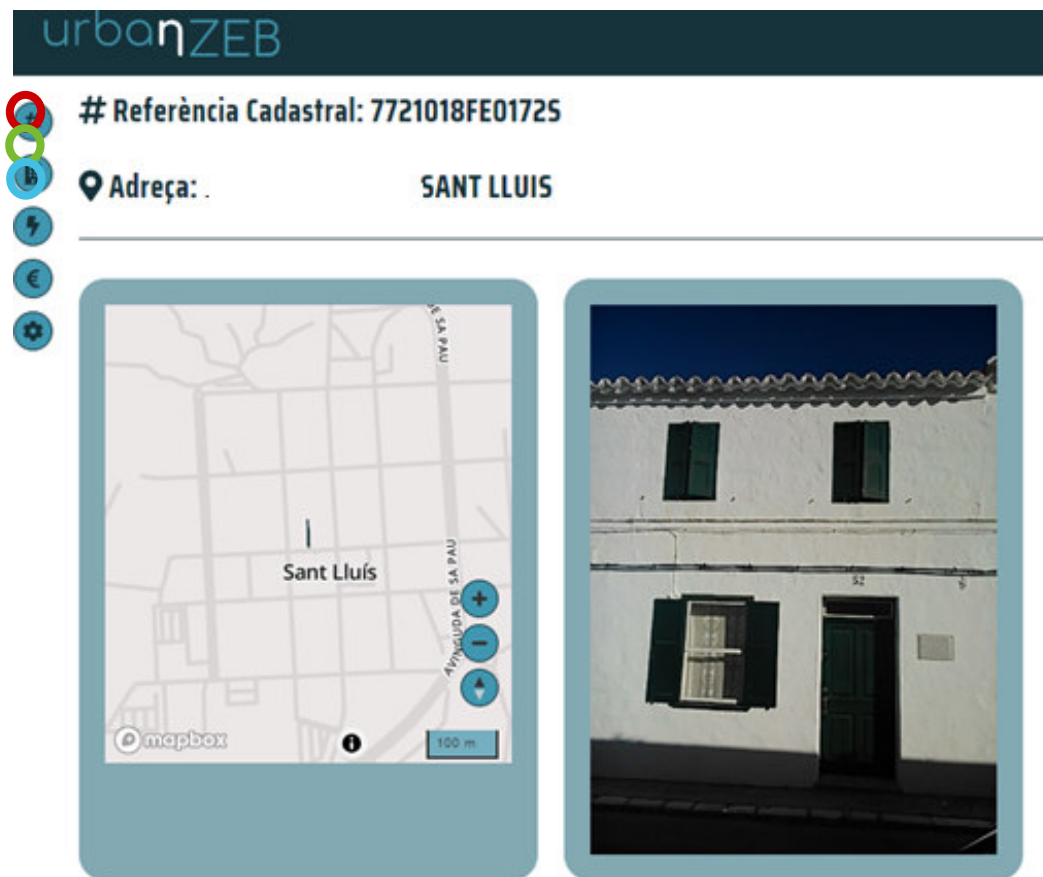


Figure 16: Screenshot from the urbanZEB. Building specific landing page. Copyright: urbanZEB

The architectural information is the main use of the building (e.g. residential) as introduced in the legend to Figure 15. They comprise the building subtype (e.g. rental or condominium for apartments), the building type (e.g. single-family house), year of construction (in classes as defined in the TABULA database<sup>17</sup>, number of dwellings (only applicable to semi-detached houses and bigger), number of storeys, typological cluster, and gross floor area (Figure 17).

<sup>17</sup> [Access the Spanish building typology here](#)

## Informació Arquitectònica

Indicador	Opció	Valor
ÚS PRINCIPAL		Residencial
TIPUS D'IMMOBLE RESIDENCIAL		Exclusivament Residencial
TIPUS DE PROPIETAT RESIDENCIAL		Unifamiliar
ANY DE CONSTRUCCIÓ	Categoritzat	De 1901 a 1940
NOMBRE D'HABITATGES	Categoritzat	Unifamiliar
NOMBRE DE PLANTES	Categoritzat	De Planta Baixa a PB+2
CLÚSTER TIPOLÒGIC		B
SUPERFÍCIE CONSTRUÏDA	Sobre rasant	130 m <sup>2</sup>
SUPERFÍCIE RESIDENCIAL CONSTRUÏDA		130 m <sup>2</sup>

Figure 17: Screenshot from the urbanZEB. Architectural information about a building. Copyright: urbanZEB

Furthermore, the database includes simulated energy data for every single building. The values are shown per building before (actual) and after (post) a renovation. They include the heat demand (demanda de calefacció), cooling demand (demanda de refrigeració) and energy class (qualificació energètica) (Figure 18). The user can choose the reference unit for the energy related information to refer to the building, the dwelling or square metre.

## Informació Energètica

Indicador	Opció	Valor actual	Valor post-intervenció
DEMANDA DE CALEFACCIÓ	Per immoble	18.946 kWh/imm-any	2.333 kWh/imm-any
DEMANDA DE REFRIGERACIÓ	Per immoble	4.061 kWh/imm-any	2.999 kWh/imm-any
QUALIFICACIÓ ENERGÈTICA: DEMANDA DE CALEFACCIÓ		G	C

Figure 18: Screenshot from the urbanZEB tool. Energetic information about a building. Copyright: urbanZEB

At last, urbanZEB provides information on the energy cost. Including the annual cost for heat consumption (cost del consum de calefacció) before (actual) and after (post-intervenció) with the option of estimating the cost for different energy carriers (electricity/gas), the capital expense (inversió en la intervenció) per dwelling (hab), and the employment creation (creació de llocs de treball) triggered by the renovation of the building, the economic information in the urbanZEB combine building related data for the investor with socio-economic information that might be relevant for the community. The user can

choose the reference unit for the economic information to refer to the building, the dwelling or square metre.

### € Informació Econòmica

Indicador	Opció	Valor actual	Valor post-intervenció
COST DEL CONSUM DE CALEFACCIÓ	Per immoble Hipòtesi Vector energètic electricitat Consum teòric	2.328 €/any	93 €/any
INVERSIÓ EN LA INTERVENCIÓ	Vector energètic electricitat		51.505 €/hab
CREACIÓ DE LLOCS DE TREBALL PER LA INTERVENCIÓ	Vector energètic electricitat		351 hores/immoble

Figure 19: Screenshot from the urbanZEB tool. Economic information about a building. Copyright: urbanZEB

### urban3R

Based on the Spanish LTRS 2020<sup>18</sup>, urban3E visualises the data for currently approximately 60 % of the Spanish municipalities (processed municipalities are marked yellow in Figure 20). The main objective is to facilitate decision-making on an urban scale, based on the exploitation by building typology of the results obtained in the ERESEE 2020 project<sup>19</sup> for the “Renovation of priority envelope” package.

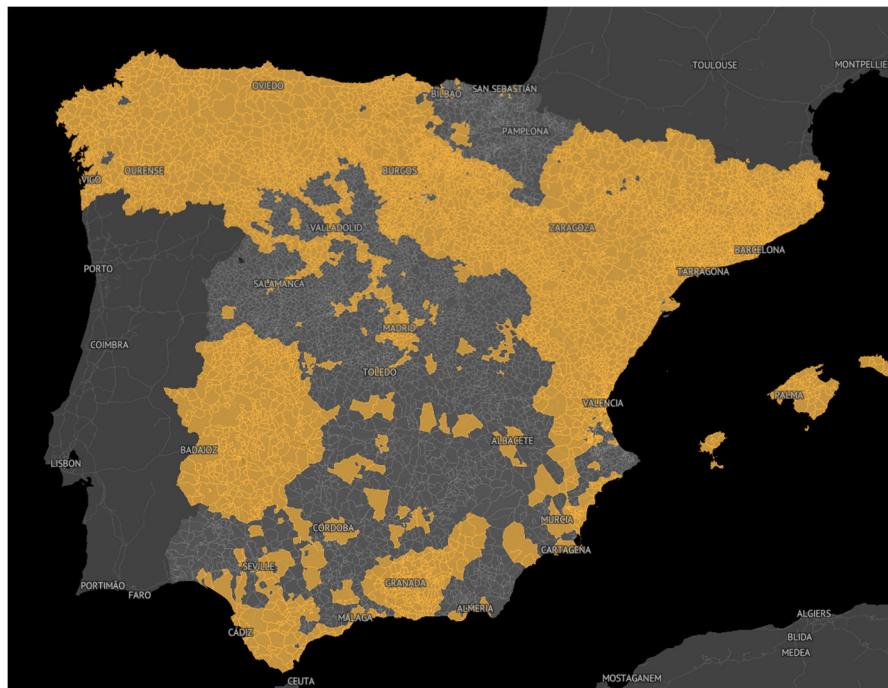


Figure 20: Screenshot of from the urban3R platform. Status quo of data processing within the platform. Copyright: urban3R

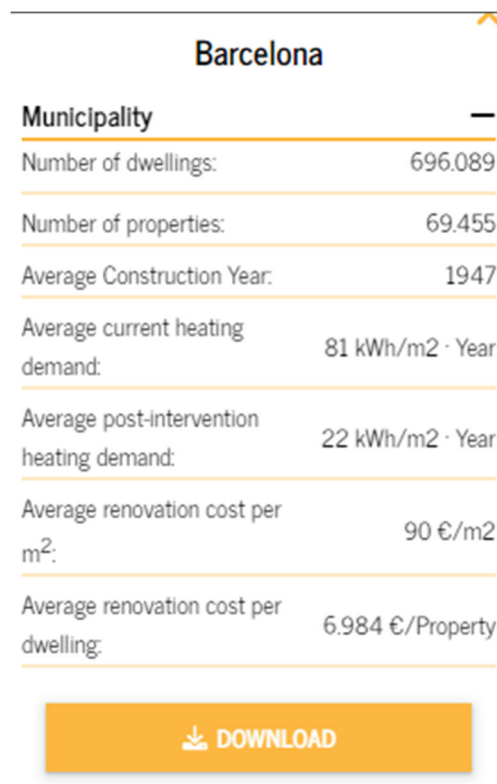
<sup>18</sup> [https://energy.ec.europa.eu/document/download/35ac6823-6ce8-47db-a796-6be8f9b81146\\_en?filename=es\\_2020\\_ltrs\\_en\\_version.pdf](https://energy.ec.europa.eu/document/download/35ac6823-6ce8-47db-a796-6be8f9b81146_en?filename=es_2020_ltrs_en_version.pdf)

<sup>19</sup> 2020 update to the energy renovation in the building sector in Spain

After registration, the tool provides users with information from three categories, these are:

- Architectural information
- Energetic information
- Economic information

urban3R allows for an analysis at a larger scale. Notably, it provides data for the LTRS at municipality level, i.e. number of dwellings and properties, average construction year, average current/post-intervention heating demand as well as the average renovation cost per square metre/dwelling (Figure 21). However, the large scale comes at different level than in urbanZEB. The data included in urban3R are archetype-based data from the LTRS while for urbanZEB every single building is simulated. Registered users can download the information.



Barcelona	
<b>Municipality</b>	
Number of dwellings:	696.089
Number of properties:	69.455
Average Construction Year:	1947
Average current heating demand:	81 kWh/m <sup>2</sup> · Year
Average post-intervention heating demand:	22 kWh/m <sup>2</sup> · Year
Average renovation cost per m <sup>2</sup> :	90 €/m <sup>2</sup>
Average renovation cost per dwelling:	6.984 €/Property

[↓ DOWNLOAD](#)

Figure 21: Screenshot of from the urban3R platform. General LTRS data about the Municipality of Barcelona. Copyright: urban3R

One level deeper into the tool, the information is categorised similar to urbanZEB. However, urban3R was developed based on urbanZEB and provides users with further capabilities. It allows for spatial analysis of large areas or municipalities, e.g. if the main use of the buildings in the area is residential, industrial, or commercial (Figure 21). It also provides estimated renovations cost per square metre or dwelling (Figure 22).

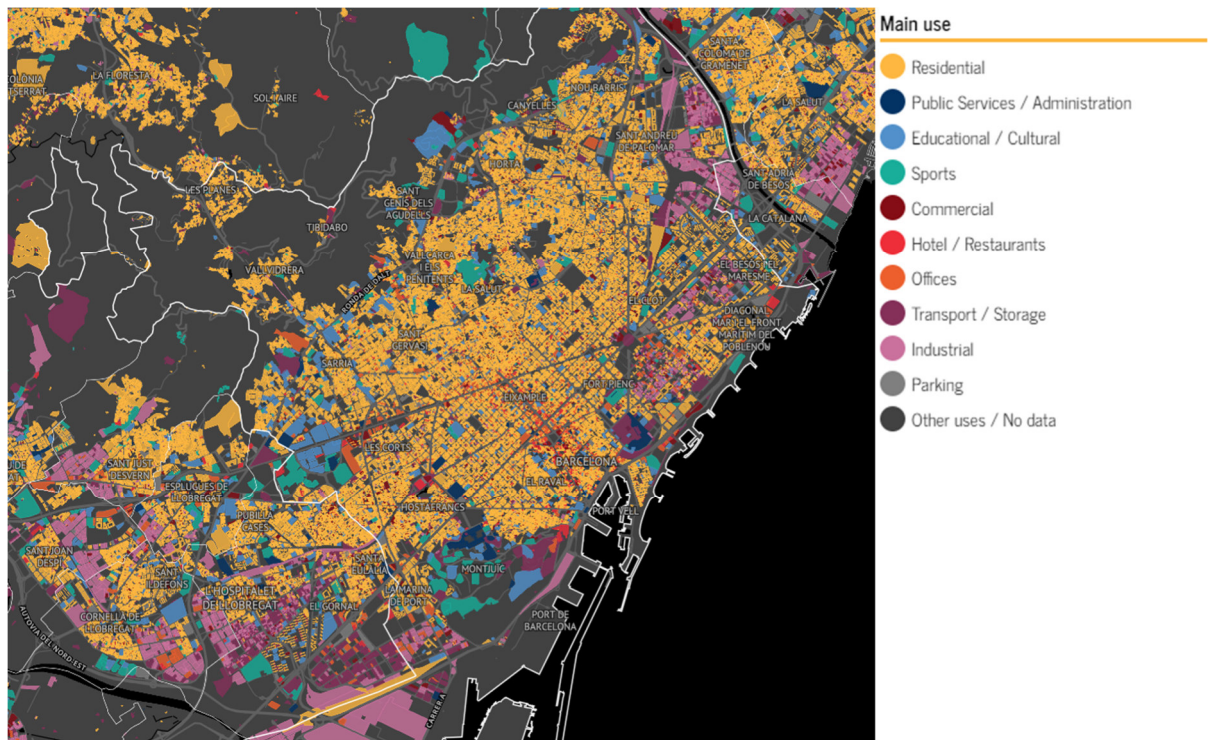


Figure 21: Screenshot of from the urban3R platform (left). Legend (right). Main use of buildings in the Municipality of Barcelona. Copyright: urban3R

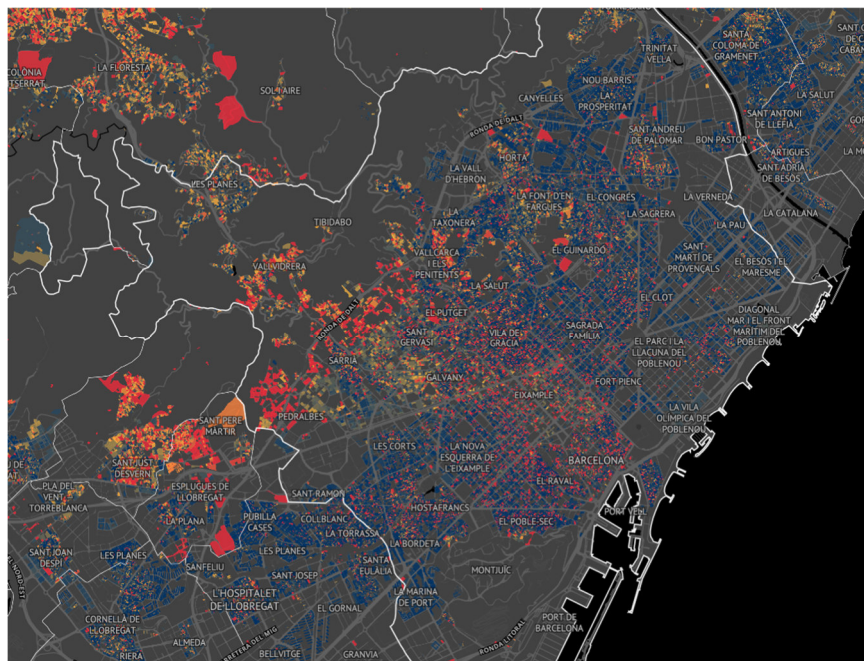


Figure 22: Screenshot of from the urban3R platform (left). Legend (right). Renovations cost per dwelling in the Municipality of Barcelona. Copyright: urban3R

By switching from “current...” to “post intervention...” users can compare the data from the platform for whole municipalities, e.g. heating demand before (Figure 23) and after an LTRS conform renovation (Figure 24).

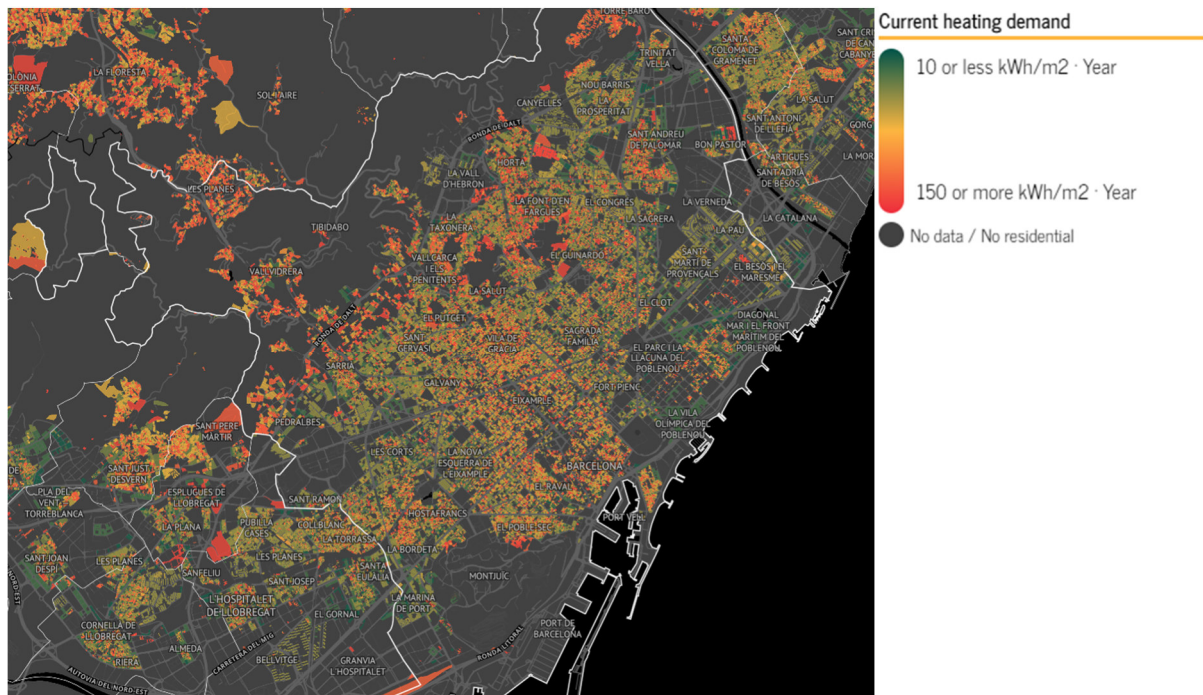


Figure 23: Screenshot of from the urban3R platform (left). Legend (right). Current heat demand of buildings in the Municipality of Barcelona. Copyright: urban3R

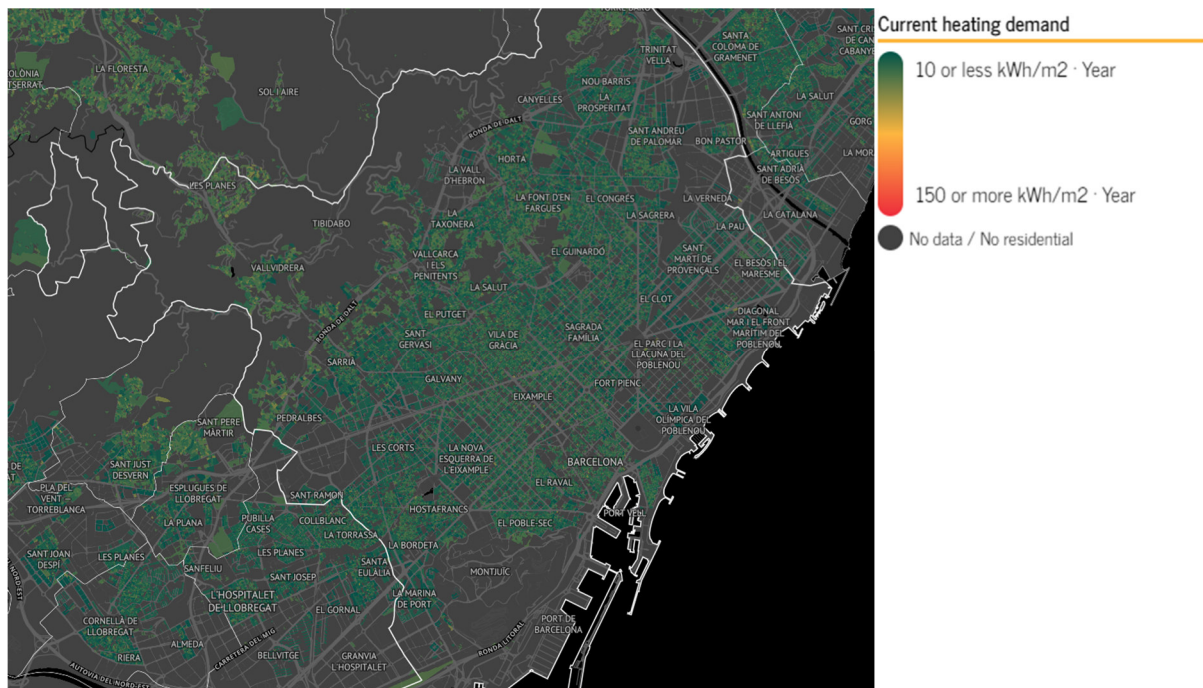


Figure 24: Screenshot of from the urban3R platform (left). Legend (right). Post intervention (LTRS goal) heat demand of buildings in the Municipality of Barcelona. Copyright: urban3R

The building fact sheets as introduced by urbanZEB (see Figure 17) are also included in urban3R, now displayed in one table per building (Figure 25).

Cadastral reference	2360708VK4726A
Main use	Residential
Number of floors	2
Type of building	Single-family dwelling
Year of construction	1950
Number of dwellings	1
Built residential area	1.401m <sup>2</sup>
Typological cluster	Uu 41-60
Current heating demand	169 kWh/m <sup>2</sup> · Year
Post intervention heating demand	39 kWh/m <sup>2</sup> · Year
Current heating demand rating	E
Post-intervention heating demand rating	B
Renovation cost	152 €/m <sup>2</sup> - 212.728 €/Dwe
NOTE: The data for this property seem to indicate that it is a special situation that would require a detailed analysis. For example, it may be a multi-family residential building with no horizontal division or with a sole proprietorship, or a property whose surface is mainly intended for non-residential use, but which includes some housing (home for the doorman/janitor, or workers, etc. ).	

Figure 25: Screenshot of from the urban3R platform. Building fact sheet of a building in Madrid. Copyright: urban3R

## Guidance for users

urbanZEB aims to develop tools that support renovation consultation and assessment, taking information from communal energy transition programs into account (Cíclica n. d.). urban3R being based on urbanZEB includes indirect renovation advice. The model uses the renovation menus for building envelopes developed under the ERESEE 2020 project (Spanish Ministry of Transport, Mobility and the Urban Agenda, 2020).

Both tools act as a national database for LTRS related data about buildings, especially in urban areas. Building owners and municipalities may derive overarching strategies for the renovation of their buildings from the available data. The underlying UBEM methodology fosters the focus on public administration and urban planning and architecture teams working on projects at the urban area level.

The workflow for any interested municipality starts with an overall analysis of their region in urban3R. Once the municipality has an overview about the energetic renovation to be conducted at urban scale, the municipality can contract Cíclica to run the simulations for the region. These simulation results are then imported to urbanZEB, showing a higher level of detail<sup>20</sup> within the information and in parallel providing more realistic energetic values. These values can be compared with the LTRS data to outline a roadmap.

<sup>20</sup> Urban3R shows two energetic and one economic indicators. urbanZEB can show up to 25 indicators from which the implanting municipality can choose.



## Progression and dissemination

urban3R has already been developed to a high level of detail. However, the ongoing development of urban3R is geared towards strengthening its alignment with both national and European Union directives, such as the 2024 EPBD and the Circular Economy Action Plan<sup>21</sup>. urban3R will integrate these features, being better positioned to facilitate the implementation of key policies and contribute to achieving sustainability objectives across urban settings. In parallel, the platform urbanZEB, which focuses on energy efficiency in buildings, serves as a complementary tool, enhancing the overall capacity for compliance with such directives within urban environments.

One of the primary enhancements to urban3R will involve the incorporation of advanced data analytics and artificial intelligence. These capabilities will provide users with more granular insights into urban resource flows, the condition of buildings, and prioritised areas for renovation. By delivering real-time data and actionable intelligence, the platform will empower municipalities, planners, and building owners to make informed decisions, like the way urbanZEB supports data-driven approaches in achieving energy efficiency in buildings.

In terms of user experience, significant improvements are planned to make the urban3R interface more intuitive and accessible. The development will focus on enhancing visualisation tools and streamlining access to critical information for various user groups. This user-centric approach aligns with the design philosophy of urbanZEB, which prioritises ease of use and effective communication of complex building performance data.

Moreover, urban3R will broaden its functional scope beyond energy efficiency to encompass other vital urban resources, such as water management, waste reduction, and material reuse. This expanded focus will facilitate a more holistic approach to urban sustainability, complementing urbanZEB's targeted contributions to decarbonising the building sector.

To promote collaboration among key stakeholders, urban3R will introduce new features designed to support joint efforts between local governments, private enterprises, and citizens. The platform will offer shared workspaces, project management tools, and communication channels that facilitate multi-stakeholder engagement. This collaborative element mirrors the integration efforts seen in urbanZEB, where cooperation among various actors is key to successful building renovations.

Finally, urban3R's development strategy includes the initiation of pilot projects and the documentation of case studies. These initiatives will showcase the platform's real-world effectiveness and provide valuable references for other cities considering the adoption of urban3R. The lessons learned from these practical applications will also inform the ongoing enhancement of urbanZEB, ensuring that both tools evolve in response to the needs of sustainable urban development.

## Implementation challenges

### Market readiness

The UBEM methodology is an excellent base for spatially resolved data models like urbanZEB and urban3R. The main barrier for the use of an UBEM is the availability of relevant data to build the model. Given the data availability, the level of detail and consistency of the data might also be insufficient. While municipalities have started to gather these data at the needed level of detail, older data might disclose minor or major inconsistencies.

The Spanish methodology integrates different data types (alphanumeric, graphic, and georeferenced) originally gathered for different purposes, like the national cadastre, urban planning, socio-economic analyses, and building construction. The propriety, availability, and digitalisation of this data in order to use it in an extensive manner differs at least amongst member states. To trigger a European renovation wave, this data challenge needs to be tackled, even though it might be already solved at national level.

<sup>21</sup> The Circular economy action plan (CEAP) fosters initiatives along the lifecycle of products within the EU, covering the design, production, consumption, and waste treatment ([https://environment.ec.europa.eu/strategy/circular-economy-action-plan\\_en](https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en))

The development of urbanZEB began in 2018 making it the pioneer tool in this realm. The architecture professionals at Cíclica supervised the implementation of the tools and stated that at that point in time not many public administrations were aware of the challenges on building renovation. The availability of urbanZEB and urban3R encouraged some pioneer public (regional or local) organisations to ask for these kinds of digital services, which is considered to possibly trigger a demand wave for these solutions in Spain. Still, there are reoccurring questions regarding the simulation engine and socio-economic data to define the right energetic and economic indicators as well as the criteria for intervention priority for the tools. Nevertheless, the latter is more interesting for clients and can be defined without major obstacles.

What caused the initial spark in Spain was the huge interest of the Basque Government in UBEM based OSS. This interest allowed for a development phase of four years, provided with leadership and commitment, facilitating a creative and efficient development of the tools.

### Suitability for municipalities

The UBEM based Spanish tools urbanZEB and urban3R provide users with LTRS related data on building and community level. The available datasets allow – given that the data is correct and up to date – for spatially resolved analyses of the building stock aligned with the renovation state aimed to achieve by the Spanish LTRS until 2050.

These tools and the underlying methodology, in the case of urban3R specifically developed for analyses of larger building aggregations, are very good examples of how a database for energy sufficiency roadmaps at community level may be structured. On the condition of sufficiently available, technically correct, validated and digitalised data, potentials of larger areas and possible synergies within districts can be visualised and leveraged. However, the smaller the number of participating municipalities, the higher the relative cost of implementing such a tool.

## SFP (Germany/Baden-Württemberg)

### General information

The Building-Specific Energy Renovation Roadmap (SFP) for the federal state of Baden-Württemberg in Germany is an advisory tool designed for property owners that serves as a compliance option under the Renewable Heat Act (EWärmeG). Its purpose is to develop and communicate a tailored renovation strategy for individual buildings, thereby supporting the German government's energy policy goal of achieving a nearly climate-neutral building stock by 2050. The regulation concerning the Baden-Württemberg Renovation Roadmap (SFP-VO) was approved by the cabinet on 28 July 2015 and came into force retroactively on 1 July 2015.

A SFP is issued by certified energy advisors for existing residential and non-residential buildings in Baden-Württemberg. For these properties, presenting a Renovation Roadmap reduces the mandatory renewable energy requirement under the Renewable Heat Act (EWärmeG) from 15% to 10%. It also serves as a valuable complement to several compliance options outlined in the Act.

The general concept of the Baden-Württemberg SFP has been adopted on national level as the Individual Renovation Roadmap (see chapter on iSFP).

### Content

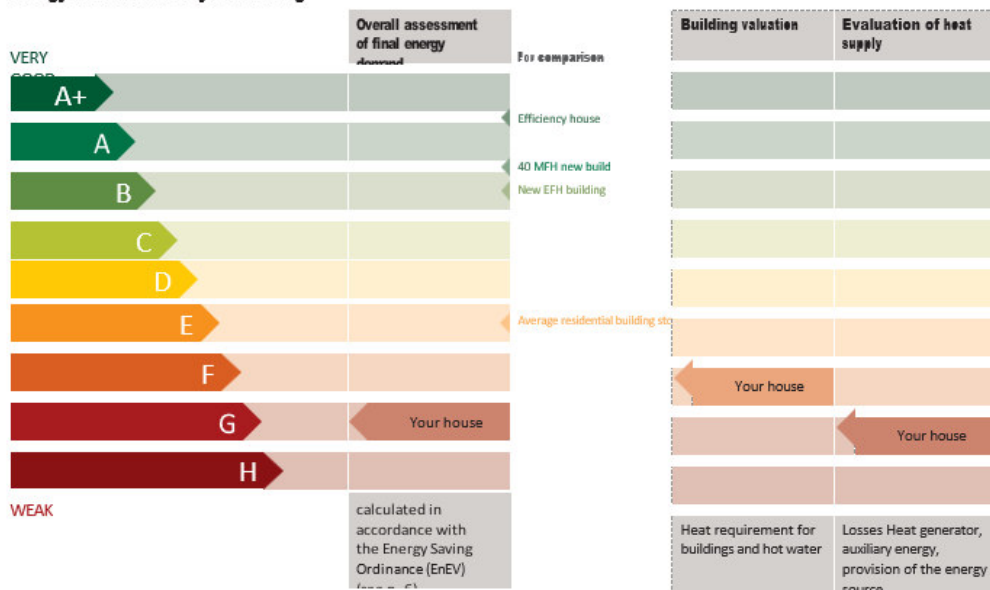
The SFP includes at least the following key aspects.

- Introduction to Energy Efficiency and Climate Protection
  - The roadmap begins with a comprehensive introduction, highlighting the significance of energy efficiency and climate protection measures.
- Energy Performance Assessment of the Current Building Condition (Figure 26)
  - It then provides a detailed evaluation of the building's current energy performance, serving as the basis for any recommended actions.
- Overview of Proposed Measures and Post-Renovation Condition (Figure 27)
  - A clear overview of potential renovation packages is offered, illustrating the building's expected energy performance and condition after implementing the measures.
- Detailed Breakdown of Renovation Steps (Figure 28)
  - The roadmap elaborates on each renovation step in detail, offering a step-by-step guide tailored to the specific needs of the building.
- Explanation of the Renovation Roadmap (Figure 29)
  - The roadmap includes a comprehensive explanation of the plan's methodology, ensuring that property owners fully understand the proposed measures and their benefits.
- Confirmation of the Energy Advisor's Competence
  - The roadmap also features a certification by the energy advisor, verifying their qualifications and expertise.
- Supporting Documents
  - Relevant attachments and supplementary documents are included to provide additional clarity and support.

## YOUR BUILDING TODAY

- Building envelope as at the time of construction and the following improvement: insulation of the top storey ceiling in 2007
- System technology: Low-temperature gas burner 1995
- Your primary energy requirement: 250 kWh/m<sup>2</sup>
- Your final energy requirement: 210 kWh/m<sup>2</sup>

### Energy assessment of your building



The modelled comparative values of the overall assessment refer to buildings in which the heat for heating and hot water is provided by boilers in the building. If the energy consumption of a building heated by district or local heating is to be compared, it should be noted that this is normally 15 to 30 % lower energy consumption can be expected than for comparable buildings with boiler heating. In the case of biomass heating systems, the assessment according to EnEV is generally worse than the individual assessment of the heat generator, as the former equates biomass with fossil fuels. In addition to the efficiency of the heat generator, the assessment of the heat supply also includes the proportion of renewable energies, the primary energy losses and the use of auxiliary energy and is also harmonised on a scale from A+ to H. It is therefore not possible to make a direct comparison with the European heating label.

### Heating costs

In recent years, your energy costs and consumption for heating and hot water have averaged 1,600 euros per year for a consumption of 24,000 kWh. If energy prices continue to develop as they have in recent years, your fuel costs will be as much as 3,700 euros per year in 25 years (assuming a 3.5 % price increase). The heating costs would add up to around 66,000 euros by then.

### Refurbishment roadmap

On the following pages you will find a proposal for a refurbishment roadmap with a sensible sequence of packages of measures that will help you to reduce heating costs by almost 80 % and primary energy requirements by over 90 %. The individual steps are chosen so that they build on each other. This means that all subsequent steps are considered and prepared from the very first step. The recommended times are based on the maintenance work that needs to be carried out anyway. This avoids unnecessary costs.

Figure 26: Screenshot of the SFP. Building status quo. Translated by ifeu. Copyright: Department of Environment, Climate and Energy economy of the state of Baden-Württemberg

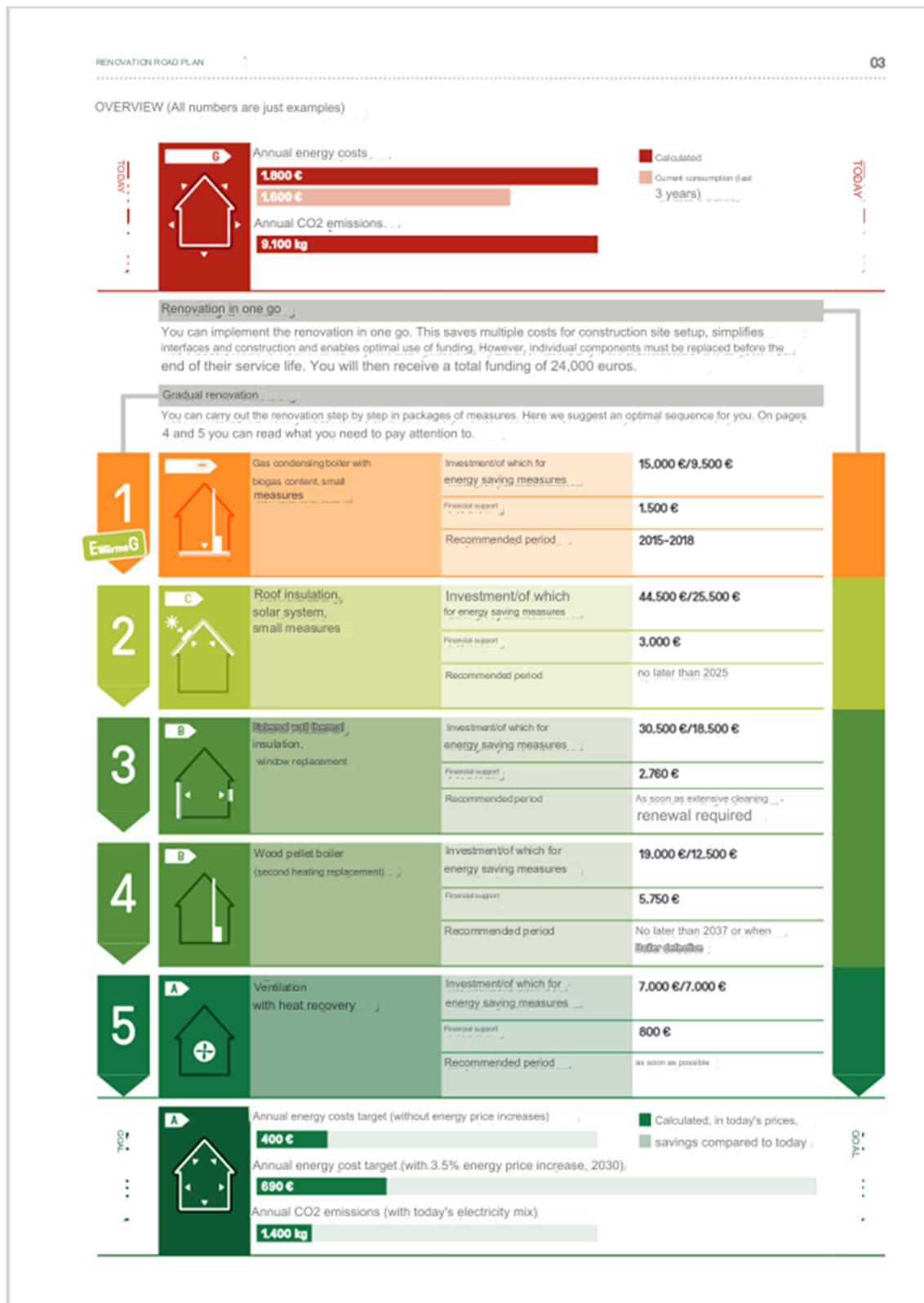


Figure 27: Screenshot of the SFP. Building overview (top) and outlined renovation roadmap (bottom). Translated by ifeu. Copyright: Department of Environment, Climate and Energy economy of the state of Baden-Württemberg

THE STEPS IN DETAIL



1		<b>Gas condensing boilers with biogas content and small-scale measures</b>	
 <p><b>Total</b></p> <p><b>Building</b></p> <p><b>Heat supply</b></p>		<ul style="list-style-type: none"> <li>→ Replacement of the existing boiler with a gas condensing boiler (operation with biomethane)</li> <li>→ Prepare pipes for a solar heating and domestic hot water system</li> <li>→ Hydraulic balancing of the heating circuit</li> <li>→ Insulation of pipework in unheated areas</li> <li>→ Insulation of the basement ceiling from the underside (new U-value = 0.25 W/m<sup>2</sup> K)</li> <li>→ Sealing the windows with milled sealing profiles</li> <li>→ Creation of a ventilation concept</li> <li>→ Insulate the radiator niches (new U-value = 0.8 W/m<sup>2</sup> K)</li> <li>→ Installation of water-saving shower heads</li> </ul>	
	<b>Recommended period</b>	2015-2018	
	<b>Energy requirement</b>	Primary energy: 180 kWh/m <sup>2</sup>	Final energy: 152 kWh/m <sup>2</sup>
	<b>Investment/of which for energy-saving measures</b>	15,000 €/9,500 €	
	<b>Subsidies</b>	For the new condensing boiler and the insulation of the basement ceiling, you can choose to receive a low-interest promotional loan or a grant from the KfW development bank (Energy Efficient Refurbishment, Individual Measures programme), or alternatively a further low-interest promotional loan from the L-Bank.	
	<b>Reason</b>	The existing boiler has exceeded its normal service life. Modern condensing boilers utilise the fuel much better. Hydraulic balancing adapts the heating system to the building. According to the Energy Saving Ordinance (EnEV), the pipework has had to be insulated since 2007. Insulating the cellar ceiling and sealing the windows are simple measures that can achieve high savings.	
	<b>Please note</b>	Even if the solar thermal system is not yet installed, pipework to the roof should be pre-installed. When the domestic hot water tank is replaced, a solar storage tank should be installed. Sealing the windows prevents draughts, but the ventilation behaviour may need to be changed in order to provide sufficient fresh air.	
	<b>Increased comfort</b>	Hydraulic balancing improves the regulation of room temperatures and eliminates background noise. Insulation measures ensure evenly warm rooms. This increases comfort. Tight windows prevent unpleasant draughts.	
2		<b>Roof and solar system</b>	
 <p><b>Total</b></p> <p><b>Building</b></p> <p><b>Heat supply</b></p>		<ul style="list-style-type: none"> <li>→ Renewal of the roof covering with over-rafter insulation (new U-value = 0.14 W/m<sup>2</sup> K)</li> <li>→ Replacement of the roof windows (new U-value = 1.0 W/m<sup>2</sup> K)</li> <li>→ Larger roof overhang</li> <li>→ Airtight connections to masonry</li> <li>→ Solar system for heating and domestic hot water</li> <li>→ Prepare pipework for ventilation system</li> <li>→ Customise the heating circuits</li> <li>→ Connection dishwasher/washing machine to hot water</li> </ul>	
	<b>Recommended period</b>	By 2025 at the latest	
	<b>Energy requirement</b>	Primary energy: 115 kWh/m <sup>2</sup>	Final energy: 99 kWh/m <sup>2</sup>
	<b>Investment/thereof for energy-saving measures</b>	44,500 €/25,500 €	
	<b>Subsidies</b>	You will receive a subsidy for the solar thermal system from the Market Incentive Programme for Renewable Energies at the Federal Office of Economics and Export Control (BAFA). For the insulation of the roof area, you can choose to receive a low-interest subsidised loan or a grant from the KfW development bank (Energy-efficient refurbishment programme, individual measures), or alternatively a further low-interest subsidised loan from the L-Bank.	
	<b>Reason</b>	The existing roof tiles have reached their normal service life in 2025. According to the EnEV, insulation must be installed when re-roofing. Above-rafter insulation offers complete thermal insulation. At the same time, roof windows should be replaced and solar collectors installed. Pipes for the ventilation system to be installed later, which run in the roof, can also be laid.	
	<b>Please note</b>	The roof overhang should be enlarged so that it can be connected properly when the exterior walls are insulated at a later stage. The connections of the airtight level to the external wall must be planned in such a way that they also merge seamlessly with the subsequent external wall insulation. The pipework for the future ventilation system can be laid between the rafters - this is easily possible in this context. The heating circuits and controls must be adapted to the building again as a result of the insulation.	
	<b>Increased comfort</b>	Insulation measures ensure evenly warm rooms. This increases cosiness. The new roof windows prevent overheating in the attic. Thanks to the solar system, the boiler can be switched off in the summer months.	

Figure 28: Screenshot of the SFP. Detailed description of the renovation steps. Translated by ifeu. Copyright: Department of Environment, Climate and Energy economy of the state of Baden-Württemberg

## WHAT ARE THE NEXT STEPS?

1. Plan your refurbishment measures. An experienced planner will support you.
2. Apply for subsidies with your planner.
3. Implement the planned measures with experienced craftsmen.
4. Look forward to your "new" modernised and economical home.

## WHERE CAN YOU FIND MORE INFORMATION?

The Zukunft Altbau programme provides you with neutral and competent information on the topic of energy-efficient building renovation and the next steps in renovation. You can obtain detailed information on insulation measures, heating technologies, subsidies and other contacts in the region at [www.zukunftaltbau.de](http://www.zukunftaltbau.de) or by calling the free advice hotline on 08000 / 123333.

The brochure "Renovation guide Baden-Württemberg - Successful renovation in 10 steps" will support you in the individual stages. You can obtain it at [www.sanierungsleitfaden-bw.de](http://www.sanierungsleitfaden-bw.de).



### Explanation of the refurbishment roadmap

- The colour symbolises the efficiency class of your building: red stands for high energy requirements, green for low energy requirements.
- The energy efficiency of your building is represented by three efficiency classes (Fig. 1): the first efficiency class The energy class refers to your demand for gas, oil, pellets, electricity, etc. for heating and hot water, the so-called "final energy demand". It must be stated in property advertisements, but does not take into account the price and pollutant differences between the various fuels. The second efficiency class shows how high the heat losses of the building and hot water preparation are. The third class assesses the efficiency of the heat generator, pumps and fans as well as the resources used to produce and transport the fuel or energy source. As energy sources are increasingly being provided using renewable energies, this third parameter will continue to improve in the future.
- **By the way:** It is possible that your final energy requirement will increase as a result of a refurbishment measure (for example example, if you switch to a climate-friendly but slightly less efficient wood boiler). The efficiency class of the heat generator will still improve, as you will no longer need exhaustible energy resources.
- The symbol describes the measures that are to be implemented in a stage (for example Insulation of the roof as in Fig. 2).
- The energy costs are calculated using the final energy requirement determined in accordance with the Energy Saving Ordinance and the energy price from your current energy bills. They will certainly differ from your actual heating costs. The calculation of the final energy requirement takes into account a uniform climate and average user behaviour for the whole of Germany. This means that all buildings in Germany can be assessed in a standardised way in terms of energy, for example for the energy performance certificate or for subsidies.
- The current energy costs also vary due to individual user behaviour and other factors. effects from these calculation results. This has an influence on the economic efficiency of the energy-saving measures. Lower energy consumption generally results in lower energy savings.
- The cost figures for investments are based on rough estimates and represent the 2014 cost status from. The funding relates to current funding programmes. You should obtain quotations for an exact cost calculation. Future energy price increases will further improve economic efficiency.
- The measures mentioned are suggestions and can also be replaced by comparable measures. become.
- The EWärmeG symbol (Fig. 3) in your refurbishment schedule means that you have fulfilled the Baden-Württemberg Renewable Heat Act from this stage onwards.



Fig. 1



Fig. 2



Fig. 3

### Imprint

**Concept:** Dr Martin Pehnt, Peter Miellwig (IFEU), Uli Jungmann, Klaus Lambrecht (ECONSULT)

**Graphic realisation:** Tina Wagner, Patrick Hubbuch (KontextKommunikation)

Figure 29: Screenshot of the SFP. Information on possible further steps and guidance. Translated by ifeu. Copyright: Department of Environment, Climate and Energy economy of the state of Baden-Württemberg

## Guidance for users

The Department of Environment, Climate and Energy Economy of the state of Baden-Württemberg provides users with a checklist<sup>22</sup> for the issuing of a SFP for their residential buildings. The issuance of a Renovation Roadmap typically follows a structured process designed to provide building owners with clear guidance and a strategic plan for energy-efficient upgrades. The process is described in the checklist and begins with an initial client consultation and the formalisation of a contract, which may include the application for available funding if not already secured. Following this, a detailed on-site assessment is conducted to gather comprehensive data on the building, while also considering the client's specific needs, expectations, and financial situation.

Based on the data collected and the client's wishes and requirements, a tailored renovation passport is developed, ensuring compliance with legal requirements. The results of this assessment are then compiled into a formal advisory report, which is prepared in accordance with the SFP-Ordinance (SFP-VO). This report, along with any relevant appendices, is sent to the client for review.

The process concludes with a consultation meeting where the issuer explains the advisory report in detail. During this session, the client is provided with a thorough understanding of the proposed measures and the steps necessary for implementation, helping them make informed decisions about the future of their property.

## Progression and dissemination

When it was launched in 2015, the SFP was one of the first consulting tools for individual buildings with a long-term perspective. In doing so, the Baden-Württemberg Ministry of the Environment provided the impetus for several similar tools at national and European level.

Following a revision of the Renewable Heat Act in Baden-Württemberg, the SFP was recognised as partially meeting the requirements. The Renewable Heat Act requires building owners who replace their boilers to use 15% renewable energy. If they have an SFP, a 10% share is sufficient. Making the SFP a fulfilment option for the Renewable Heat Act fostered the dissemination of the SFP in BW (Pehnt et al., 2018).

A further development to the SFP was proposed in the evaluation report. The SFP should continue to be recognised as a compliance option, as it serves as an accessible entry point, particularly for previously disengaged property owners. By introducing them to energy consulting, it helps stimulate greater renovation activity.

The shortcomings identified in the evaluation in both residential and non-residential SFPs should inform the further development of training and informational materials. These resources should focus on key areas such as the creation of plausible measure packages within a long-term strategy, accurate U-values for both current conditions and proposed improvements, and a stronger consideration of the actual building state and specific circumstances of the property owner. Additionally, justifications for the recommended renovation steps should be more detailed and contextually relevant. If the eligibility for issuing SFPs is demonstrated through references, the required number of references should be raised from one to three within the last two years.

The development of a renovation roadmap (SFP) in Baden-Württemberg faces several key challenges:

Firstly, the programme's uptake remains limited, with application and approval rates relatively low. Although the SFP does create renovation impulses that go beyond standard development, many of the supported SFPs primarily serve to meet the requirements of the Renewable Heat Act (EWärmeG). Beyond this legal framework, the incentive for broader renovation remains minimal.

Secondly, there are concerns regarding the cost-benefit balance. The SFP, due to its funding and its combination with other options (such as biogas or bio-oil blending), is currently the most cost-effective

<sup>22</sup> [https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/5\\_Energie/Beratung\\_und\\_Information/SanierungsfahrplanBW/160705\\_Checkliste\\_Wohngebäude.pdf](https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/5_Energie/Beratung_und_Information/SanierungsfahrplanBW/160705_Checkliste_Wohngebäude.pdf)



compliance solution. This has led to its perception as merely a “compliance tool,” similar to other mandatory measures under subsidy programmes like KfW. A pertinent question arises as to whether, without the current funding, alternative technical compliance options would be favoured.

Thirdly, quality considerations are paramount. Energy consultants highlight that funding plays a crucial role in ensuring the quality of SFPs, as it allows for more time to be dedicated to their preparation. However, it remains uncertain whether property owners would be willing to bear higher costs if the funding were to be discontinued, potentially compromising the quality of these plans.

## Implementation challenges

The implementation of the SFP in Baden-Württemberg encountered several key challenges. Despite financial support, the number of applications and approvals remained limited. Many property owners primarily used the SFP to comply with the Renewable Energy Heat Act, with limited interest outside this legal framework. The incentive primarily drove compliance rather than voluntary engagement in energy renovation, highlighting the need for a more compelling communication strategy about the broader benefits of SFPs.

The SFP was often chosen as the cheapest compliance option due to its subsidies, but this led to it being perceived as just another mandatory requirement rather than a genuine tool for energy improvement. The program’s structure and pricing meant that it was seen as a “checklist” item rather than an opportunity for comprehensive renovation. Pehnt (2017) emphasized that the program’s funding was crucial for maintaining high quality, as it allowed for more thorough planning and time investment. Concerns arose about whether building owners would continue to invest in quality if subsidies were reduced or removed. The introduction of a more attractive national subsidy, the iSFP (Germany), led to plans to phase out the state-level SFP by the end of 2018. This shift risked reducing the quantity and quality of renovation plans in the state.

To address these issues, the state government and stakeholders implemented improvements in communication strategies, enhancing the program’s visibility and clarifying its benefits beyond regulatory compliance. Additionally, focusing on the long-term cost savings and energy efficiency benefits shifted the perception from a mandatory cost to a valuable investment.

## Suitability for municipalities

The SFP has been developed with a focus on single-family homes and small multi-family buildings. Larger buildings may require a greater number of different components or technical details, which are shown in the roadmap. This target group can be taken into account when adapting the SFP concept to the building types in the municipality. The SFP is primarily aimed at owner-occupied residential buildings. If there is a high proportion of rented buildings in a municipality, the roadmap concept may need to be adapted accordingly. Several legal and processual obstacles arise when the house is jointly owned by multiple parties. Finding solutions to these hindrances was subject to the GREEN Home Project (see the dedicated chapter).

As a detailed consultation, which the SFP is, it involves a certain amount of work for the issuer. It is recommended that the SFP be subsidised with public funds to make it attractive to both issuers and clients. Local authorities should bear this in mind when introducing an SFP.

## iSFP (Germany)

### General information

The introduction of individual renovation roadmaps (individueller Sanierungsfahrplan iSFP) for building energy consultations represented a key implementation measure within the Energy Efficiency Strategy for Buildings and the Climate Action Plan 2050 in Germany. As part of the project "Development of Individual Renovation Roadmaps for Residential Buildings," a standardised methodology for staged energy retrofits of buildings was developed. This methodology is equally applicable for comprehensive renovations carried out in a single phase. The resulting tool, the iSFP, has been officially recognised since 1. July 2017 within the framework of an existing funding programme for "Energy Consultation for Residential Buildings". For single or two-family houses, the iSFP was initially subsidised up to a maximum of 800 €, and for residential buildings with three or more units, up to a maximum of 1,100 €<sup>23</sup>.

The iSFP is an advisory tool designed to guide the energy renovation of residential buildings in a clear and accessible format. It is suitable for both step-by-step and comprehensive renovations of single-family and multi-family homes. The iSFP focuses on long-term goals while considering the individual circumstances of property owners, helping them plan renovation measures in a coordinated and efficient manner.

The tool stands out by addressing common challenges in renovation, such as inefficient investments and potential building damage due to poorly planned measures. It supports property owners with clear recommendations and helps align renovation steps with available resources and goals.

The iSFP's development has been driven by the recognition that effective energy consultation with an eye on the climate targets is crucial for achieving climate targets.

### Content

The iSFP methodology introduced several key differences compared to previous energy consultation reports for buildings:

- Individual preferences and possibilities of the homeowner are more thoroughly integrated into the design of renovation packages and their future implementation.
- The consultation results are standardised within the software and presented in a consistent format, with the information visually summarised and graphically illustrated.
- Energy consultants are encouraged to focus on achieving the best possible efficiency standard for the building as a whole, as well as for specific building components.
- Renovation packages for staged refurbishments are planned with foresight, taking a holistic view of the building's long-term performance.

This structured and forward-looking approach ensures that energy renovations are both technically sound and aligned with the homeowner's unique circumstances, offering a clear pathway towards higher energy efficiency and long-term sustainability. As a result, the owner gets two documents. The „Mein Sanierungsfahrplan“ (roadmap overview), summarising and visualising the individual renovation roadmap for the building (Figure 30) and the “Umsetzungshilfe für Maßnahmen” (support for the implementation), explaining the measures and providing the owner with helpful hints.

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<sup>23</sup> From the 7<sup>th</sup> of August 2024 on the subsidy was reduced. for residential buildings is now 50 % (was 80 %) of the eligible consulting fee. The maximal subsidy amount per consultation is reduced by 50 %, i.e. 650 € for (semi-) detached houses and 850 € for residential buildings with more than three dwellings.

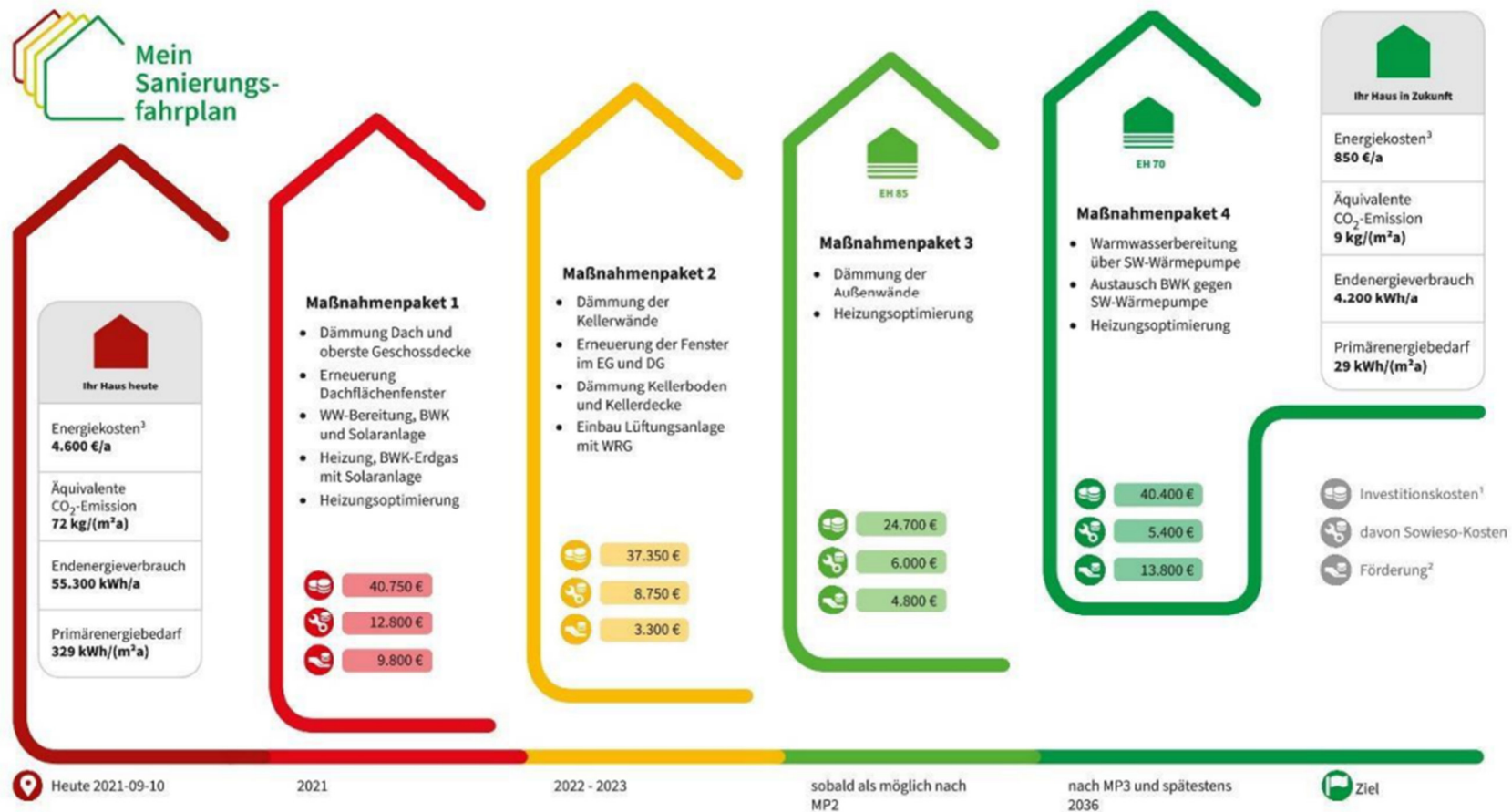


Figure 30: Sample screenshot from iSFP document. Visualisation of renovation steps including various data. Copyright: Gebäudeforum Klimaneutral



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## Guidance for users

Building owners are accompanied along the complete iSFP development process. In detail, a mandatory seven-stage process framework needs to be followed by the energy expert. These steps are subject to Figure 31.

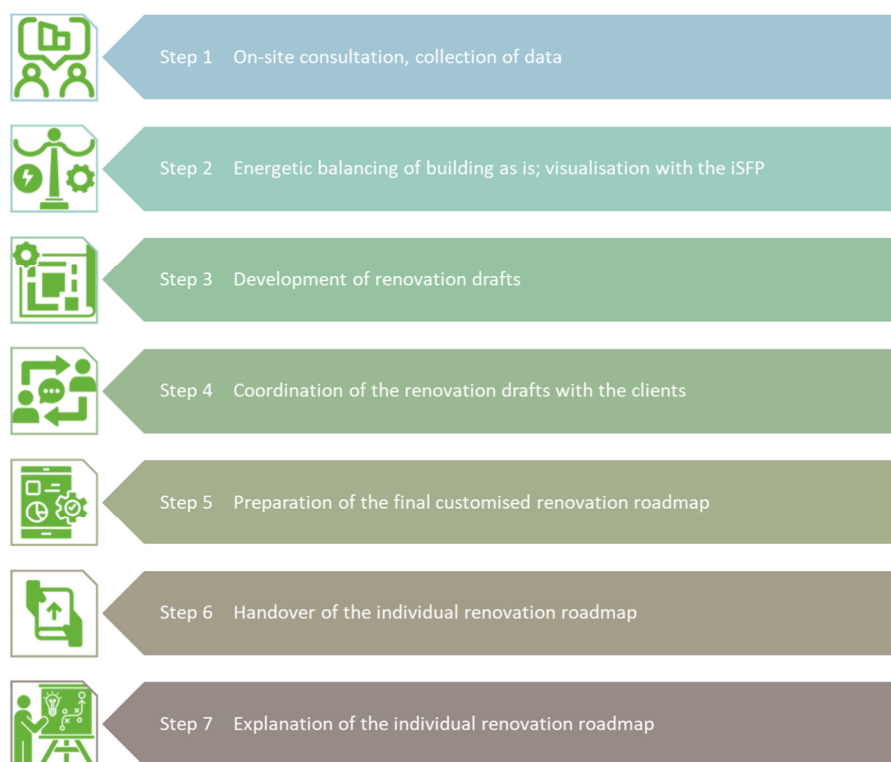


Figure 31: Seven-stage process of the German iSFP.

## Progression and dissemination

The iSFP is in place as the official renovation passport in Germany. The dissemination of the iSFP was embedded in a broad-based energy efficiency campaign<sup>24</sup> by the Federal Ministry of Economics<sup>25</sup>. This campaign aimed to raise awareness on national and federal level and addressed public authorities, consumer associations, and regional energy agencies. Since 2021, a bonus (5 %) was applied on subsidised loans for building renovations if the renovation roadmap was an iSFP. Since July 2023 an energy consultation can only be funded if a registered energy expert conducted the consultation and put the report in the format of an iSFP. It is under constant development by the German Energy Agency *dena*.<sup>26</sup>

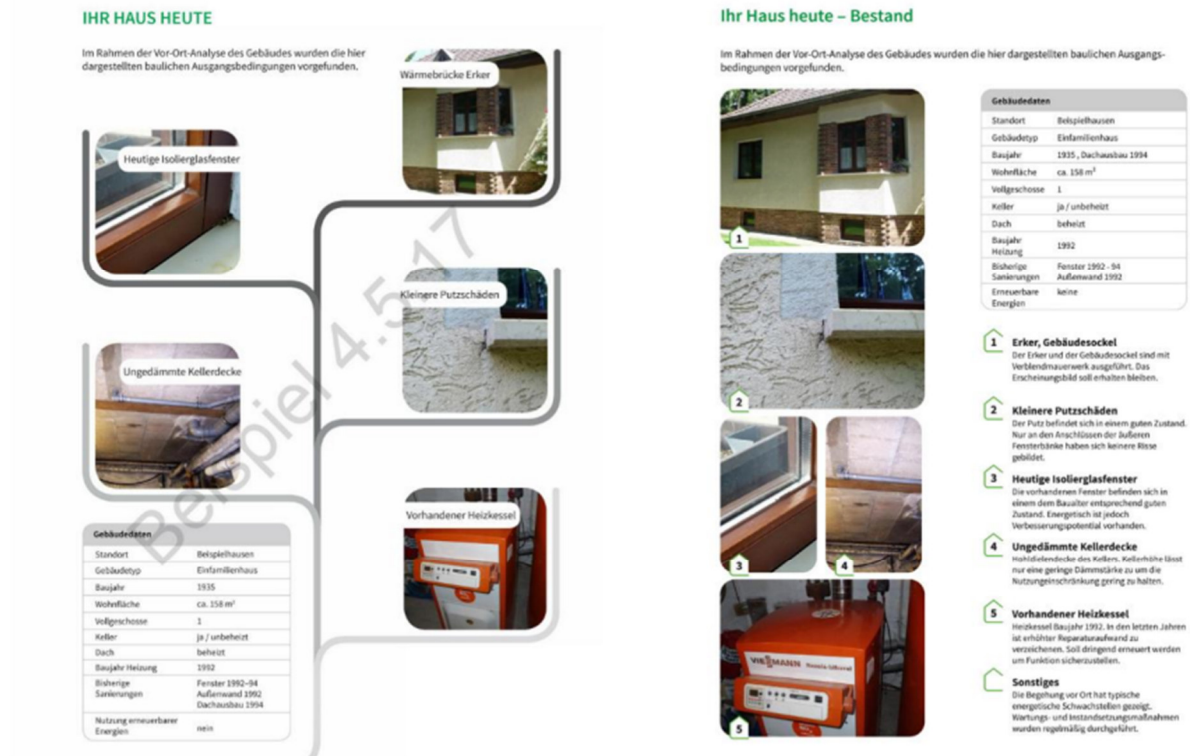
After a pilot phase including a field test evaluation and stakeholder consultations, (Bensmann et al., 2018) version 2.0 of the iSFP was launched in 2020. Next to various design adaptations (Figure 32; Figure 33) several new pieces of information were added. The new pages involve space for explanations and detailed descriptions of the current building state and the added value of the renovation, a visualisation and summary of the energetic target state of the building and the renovation and energy cost as well as hints for the day-to-day life in the new building, e.g. how to secure proper ventilation after new windows have been installed. Also, the printing application that secured a unified design despite different energy calculation software tools was enhanced. Energy experts were now able to create the iSFP within the software of his or her choice (given that the software developer designed an interface with the print application) and print it in the needed format directly from the software.

<sup>24</sup> Deutschland macht's effizient

<sup>25</sup> Historically, the German Ministry of Economics always covered energy related topics.

<sup>26</sup> The latest information about the iSFP is available [here](#).





iSFP 1.0

iSFP 2.0

Figure 32: Comparison of iSFP version 1.0 (left) and 2.0 (right). Sample screenshot of the page on the current building state Copyright: dena



iSFP 1.0

iSFP 2.0

Figure 33: Comparison of iSFP version 1.0 (left) and 2.0 (right). Sample screenshot of the roadmap page. Copyright: dena

## Challenges along the way

Version 2.0 of the iSFP is the direct outcome of the challenges that were identified during the pilot phase. The feedback from energy experts during the consultation process, analysis of the resulting iSFPs and evaluation of the surveys conducted with building owners, energy experts and software

developers clearly indicated room for improvement. Bensmann et al. (2018) evaluated 17 iSFPs in detail, accompanied by questionnaires for building owners, energy experts and software developers.

### **Analysis of 17 test iSFPs**

The implementation of the iSFP has revealed several issues related to both formatting and content, highlighting key areas for improvement in the tool's application and user understanding.

One of the challenges identified was the presence of formatting errors in the printed reports, where values were incorrectly applied or displayed. Additionally, inconsistencies in data transfer between software programmes led to inaccuracies within the iSFP documents. Notably, in 4 out of 17 cases reviewed, the iSFP did not align with the handbook guidelines, leading to incomplete or unclear explanations regarding critical elements such as the triggers for renovation and the proposed timelines. Experts suggested that these issues arose from an initial lack of understanding of the methodology.

Further analysis identified content-related errors. In several instances, the same renovation measures were redundantly proposed at different stages, indicating inconsistencies in the planning process. The roadmap also included inaccurate or imprecise references to funding programmes, which reduced its practical value for homeowners seeking financial support. In addition, key information regarding proposed measures was sometimes missing, limiting the clarity and usefulness of the recommendations. Some measures were also found to be technically implausible, raising concerns about the reliability of the roadmap's guidance. In certain cases, the roadmap deviated from the principle of achieving the best possible efficiency standard, without providing adequate justification for this departure.

Plausibility issues were also prevalent, such as mismatches in U-values when comparing the renovation steps with the expected outcomes. Cost declarations were partly found to be unclear, indicating the need for more concrete cost explanation. Moreover, the lifecycle of building installations was not sufficiently considered, which could lead to suboptimal long-term planning. Another issue involved the timing of renovation steps, where the intervals between actions were occasionally too short, potentially compromising the effectiveness of the overall renovation strategy.

### **Feedback from the energy experts**

Energy experts have highlighted three key improvements that would enhance the usability and effectiveness of the iSFP tool for them. Firstly, they expressed the need for an integrated FAQ section within the print application to provide immediate answers to common questions and clarify uncertainties during the printing process. Additionally, they suggested including space for personal notes, allowing to document their thoughts and provide detailed explanations for the recommended steps, thereby improving the transparency and customisation of the renovation plan. Finally, the experts emphasised the importance of a more refined display of costs within the software, facilitating a clearer and more precise presentation of financial details, which is crucial for guiding homeowners through the decision-making process.

### **Feedback from the building owners**

Building owners expressed a desire for more detailed explanations to better understand the suggested renovation steps and the reasoning behind them. Additionally, they requested clearer cost visualisation, allowing them to easily assess financial implications and plan accordingly. Moreover, they indicated a need for a more intuitive display of parameters within the technical documentation, i.e. the "Umsetzungshilfe", ensuring that the technical explanation is presented in a way that supports informed decision-making throughout the renovation process.

### **Proposed improvements**

Resulting from the gathered feedback and analysed iSFPs, Bensmann et al. (2018) proposed short-term and mid-term improvements to the iSFP. The suggestions aim to enhance the usability, clarity, and overall effectiveness of the tool, ensuring better alignment with user needs while maintaining methodological integrity.

In terms of **short-term improvements**, enhancements have been proposed for the **print application**. It is recommended to develop a comprehensive documentation that addresses error messages and provides a detailed explanation of text limitations for individual input fields used by energy experts. Additionally, an assessment should be conducted to determine which input fields could allow for more flexible text lengths to avoid unnecessary shortening. Improving the rounding mechanisms in the cost data within the iSFP, particularly for investment and maintenance costs, is also suggested.

For the **building owner documentation**, it is advisable to include clear reasoning for full renovations on the timeline page to help building owners understand the benefits of a comprehensive approach. The display of component names should be more prominent in the overall iSFP, making it easier to track individual measures. Enhancing the presentation of cost-related data, paired with improved explanatory text, will ensure homeowners fully grasp financial implications. Options for customising text fields where necessary should also be introduced, allowing for more personalised communication. Additionally, detailed explanations linking colour classes to average U-values would clarify why partial renovations, such as replacing roof windows, may result in only minor energy improvements. A minor review of customer-facing documents should be conducted, focusing on ensuring that technical terminology is easily understandable for non-experts. Reassessing the necessity of certain tables within the "Mein Sanierungsfahrplan" (My renovation roadmap) document could help streamline content where possible and exploring the possibility of enabling selective editing of individual pages within the "Mein Sanierungsfahrplan" document, particularly the "Quality assurance and optimization" ("Qualitätssicherung und Optimierung") section, is suggested. Several layout adjustments are recommended, including improving the readability of colours, enhancing contrast for footnotes, and refining the presentation of the cover page. Additionally, technical documentation should be updated to facilitate easier analysis by the Federal Agency for Economics and Export Control (BAFA), e.g. regarding average U-values. The visibility of available subsidies should be strengthened throughout the document.

In terms of improvements for the **energy expert documents**, it is recommended to provide clearer guidelines regarding character limits in free-text fields and captions. Expanding the checklist to include more space for personal notes would allow experts to better document their thoughts. A more detailed explanation of the "best possible principle" within a dedicated FAQ section is also advised. Elaborating on the assumptions on future energy price developments and presenting this information in a separate, detailed format is suggested. The creation of an index in the manual would improve navigation, while clarifying permissible simplifications in measurement processes would ensure consistency in evaluations. Additionally, adding guidance on converting to calorific value ( $f_{Hs/Hi}$ ) for calculations according to the German DIN V 18599<sup>27</sup> is recommended.

**Methodological adjustments** include recommending that software companies develop a step-by-step guide specifically focused on the input of cost data. Reviewing the possibility of making the cost calculations ("Kostendarstellung") page a customisable text field is also suggested, along with re-evaluating the valuation methodologies for heating system peripherals and ventilation systems to ensure accuracy. Updating technical documentation would reflect these revisions and the resulting improvements.

For **mid-term improvements**, **building owner documentation** could benefit from the introduction of a simplified comfort rating system, allowing building owners to more easily assess the non-financial benefits of renovation measures. Greater flexibility in the number of building photos that can be uploaded should also be allowed, as the current limitation can hinder document completion. Additionally, considering whether subsidies should apply not only to the first renovation package but extend to all subsequent packages would encourage continuous engagement in the renovation process.

From a **methodological perspective**, a reassessment of profitability calculations is advised, incorporating metrics such as cost-benefit ratios or payback periods. Investigating the integration of photovoltaic (PV) systems into building evaluations is also recommended, given their growing role in

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<sup>27</sup> The DIN V 18599 is the official norm for energy balances of buildings in Germany.

sustainable energy solutions. Furthermore, examining the basis for future energy price projections will ensure they remain relevant and realistic.

The insights gained from the pilot project will feed into the ongoing "Further Development of the iSFP Methodology" initiative. These refinements will play a critical role in enhancing the iSFP's effectiveness as a trusted tool in energy consultations, ultimately supporting broader climate and energy efficiency goals across the residential sector.

### **Suitability for municipalities**

Like the SFP, the iSFP focusses on single- and small multi-family buildings. Depending on the building stock in an individual municipality the roadmap may have to be adapted accordingly. Nevertheless, parallel to the SFP, the concept of the iSFP is valuable to any building owner looking for a renovation roadmap. The structured approach taking the owner's perspective can support the renovation wave in communities.

Like with the SFP, the implementation of an iSFP will require public funding, which must be considered in the municipalities' budget planning process.





## iBRoad (EU)

### General information

The iBRoad (individual Building Renovation Roadmap) project, funded under the Horizon 2020 programme, aims to tackle key challenges associated with deep, staged building renovations, with a primary focus on single-family homes. The initiative is designed to provide homeowners with a comprehensive and tailored renovation plan that spans 10 to 20 years, ensuring that renovation steps are strategically sequenced to avoid inefficiencies and ‘lock-in’ effects that can hinder future improvements.

Central to the project are two tools:

- The Individual Building Renovation Roadmap (iBRoad-Plan)
- The Building Logbook (iBRoad-Log).

The iBRoad-Plan offers a customised, long-term renovation strategy that considers the homeowner’s unique circumstances, including financial capacity, household composition, and future needs. Complementing this, the iBRoad-Log functions as a dynamic repository, storing detailed building-related information such as energy consumption, maintenance history, and essential property documents. The logbook also integrates links to financial resources like green loans and renovation incentives.

iBRoad directly addresses one of the major obstacles in building renovations: the complexity and uncertainty homeowners face when determining the optimal order of improvements. By offering a structured and step-by-step plan, the project empowers homeowners to enhance their property’s energy efficiency in a methodical and well-informed manner.

Drawing on best practices from successful initiatives in Germany, Portugal and Belgium (Flanders), iBRoad adapts these insights to varying European contexts. The tools developed through the project have undergone testing in Bulgaria, Poland, Portugal, and Germany, with broad stakeholder involvement across Europe to evaluate their adaptability and replicability for widespread EU implementation.



Figure 34: Screenshot from the iBRoad website. Main goal of the iBRoad project. Copyright: iBRoad

## Content

The iBRoad-Log complements the renovation strategy (Figure 36) by serving as a dynamic building logbook (Figure 39). It systematically stores and organises pertinent property information, including energy performance data, records of previous renovations, maintenance schedules, and financial documents like energy bills or links to renovation subsidies. The logbook is adaptable and can incorporate additional features over time, such as smart meter data, equipment management, and insurance details.

Through these tools, iBRoad aims to simplify the renovation process, facilitating easier access to essential information and supporting homeowners in making well-informed decisions. The project's modular and adaptable design is intended to be applicable across various national contexts in the EU.

## Renovation Roadmap

### Step by Step Plan

ENERGY CLASS	ENERGY CLASS	ENERGY CLASS	ENERGY CLASS
YOUR BUILDING TODAY	RENOVATION STEP 1 WHEN BOILER NEEDS TO BE EXCHANGED CHILDREN ARE MOVING OUT	RENOVATION STEP 2 WHEN WINDOWS NEED TO BE EXCHANGED HIGHER COMFORT DEMANDS	RENOVATION STEP 3 2044 BIRTH OF CHILD
	<b>WHAT TO DO?</b> <ul style="list-style-type: none"> <li>Improve the air permeability of the envelope</li> <li>Optimization control system</li> </ul>	<b>WHAT TO DO?</b> <ul style="list-style-type: none"> <li>Installation of a thermal insulating layer on top of concrete ground floor in contact with the ground</li> </ul>	<b>WHAT TO DO?</b> <ul style="list-style-type: none"> <li>Optimization control system</li> </ul>
	<b>INVESTMENT COSTS</b> 456555 zł  <b>COSTS FOR MAINTENANCE</b> 2467 zł  <b>ENERGY BILL</b> 246 zł/a	<b>INVESTMENT COSTS</b> 44 zł  <b>COSTS FOR MAINTENANCE</b> 44 zł  <b>ENERGY BILL</b> 143 zł/a	<b>INVESTMENT COSTS</b> 0 zł  <b>COSTS FOR MAINTENANCE</b> 0 zł  <b>ENERGY BILL</b> 143 zł/a



Figure 35: Sample overview page of renovation roadmap. Copyright: iBRoad




	ENERGY CLASS	ENERGY CLASS	ENERGY CLASS	ENERGY CLASS
	<b>Your Building</b> Moment of delivery	<b>Renovation Step 1</b> When Boiler needs to be exchanged Children are moving out	<b>Renovation Step 2</b> When Windows need to be exchanged Higher Comfort Demands	<b>Renovation Step 3</b> 2044 Birth of child
<b>Measures</b>		<b>Measures</b> <ul style="list-style-type: none"> <li>Improve the air permeability of the envelope</li> <li>Optimization control system</li> </ul>	<b>Measures</b> <ul style="list-style-type: none"> <li>Installation of a thermal insulating layer on top of concrete ground floor in contact with the ground</li> </ul>	<b>Measures</b> <ul style="list-style-type: none"> <li>Optimization control system</li> </ul>
<b>Energy Use</b>	<b>Primary Energy Demand</b> 123 kWh/m <sup>2</sup> a <b>Main Energy Source</b> Natural Gas <b>Final Energy Demand Main Source</b> 111 kWh/m <sup>2</sup> a	<b>Primary Energy Demand</b> 111 kWh/m <sup>2</sup> a <b>Main Energy Source</b> liquid Gas <b>Final Energy Demand Main Source</b> 111 kWh/m <sup>2</sup> a	<b>Primary Energy Demand</b> 111 kWh/m <sup>2</sup> a <b>Main Energy Source</b> liquid Gas <b>Final Energy Demand Main Source</b> 100 kWh/m <sup>2</sup> a	<b>Primary Energy Demand</b> 111 kWh/m <sup>2</sup> a <b>Main Energy Source</b> liquid Gas <b>Final Energy Demand Main Source</b> 100 kWh/m <sup>2</sup> a
	<b>Second Energy Source</b> Natural Gas <b>Final Energy Demand second Source</b> 121 kWh/m <sup>2</sup> a	<b>Second Energy Source</b> Lignite <b>Final Energy Demand second Source</b> 11 kWh/m <sup>2</sup> a	<b>Second Energy Source</b> Lignite <b>Final Energy Demand second Source</b> 11 kWh/m <sup>2</sup> a	<b>Second Energy Source</b> Lignite <b>Final Energy Demand second Source</b> 11 kWh/m <sup>2</sup> a
	<b>Third Energy Source</b> Hard Coal <b>Final Energy Demand third Source</b> 111 kWh/m <sup>2</sup> a	<b>Third Energy Source</b> liquid Gas <b>Final Energy Demand third Source</b> 432 kWh/m <sup>2</sup> a	<b>Third Energy Source</b> liquid Gas <b>Final Energy Demand third Source</b> 321 kWh/m <sup>2</sup> a	<b>Third Energy Source</b> liquid Gas <b>Final Energy Demand third Source</b> 321 kWh/m <sup>2</sup> a
	<b>Auxiliary Energy Source</b> Electricity <b>Final auxiliary Energy Demand</b> 11 kWh/m <sup>2</sup> a	<b>Auxiliary Energy Source</b> Electricity <b>Final auxiliary Energy Demand</b> 1 kWh/m <sup>2</sup> a	<b>Auxiliary Energy Source</b> Electricity <b>Final auxiliary Energy Demand</b> 1 kWh/m <sup>2</sup> a	<b>Auxiliary Energy Source</b> Electricity <b>Final auxiliary Energy Demand</b> 1 kWh/m <sup>2</sup> a
	<b>Energy Bill</b> 246 zł/a	<b>Energy Bill</b> 144 zł/a	<b>Energy Bill</b> 143 zł/a	<b>Energy Bill</b> 143 zł/a
<b>CO<sub>2</sub></b>	<b>Carbon Emissions</b> 12 kg/(m <sup>2</sup> a)	<b>Carbon Emissions</b> 11 kg/(m <sup>2</sup> a)	<b>Carbon Emissions</b> 11 kg/(m <sup>2</sup> a)	<b>Carbon Emissions</b> 11 kg/(m <sup>2</sup> a)
<b>Costs</b>		<b>Investment Costs for Renovation Step</b> 456555 zł <b>Included Costs for Maintenance</b> 2467 zł	<b>Investment Costs for Renovation Step</b> 44 zł <b>Included Costs for Maintenance</b> 44 zł	<b>Investment Costs for Renovation Step</b> 0 zł <b>Included Costs for Maintenance</b> 0 zł
<b>Subsidies</b>		<b>Name of Incentives</b> sadf <b>Incentives</b> 1234 zł	<b>Name of Incentives</b> inc <b>Incentives</b> 432 zł	<b>Name of Incentives</b> <b>Incentives</b> 0 zł
<b>Comfort Changes</b>		<b>Changed Comforts</b>  	<b>Changed Comforts</b> 	<b>Changed Comforts</b>

Figure 36: Sample detailed building renovation roadmap with measures, expected energy use, CO<sub>2</sub>, costs, subsidies and comfort improvements. Copyright: iBRoad

The iBRoad Logbook is a digital building repository for information such as the energy-related building state, building plans, works implemented, energy consumption and production, etc. The Logbook's "everything in one place" approach is particularly useful for homeowners. It can also help technicians called in for home maintenance or improvements, as well as energy auditors and other service providers. The iBRoad Logbook organises the building's history in "snapshots", allowing homeowners to revisit each stage in their building's evolution.

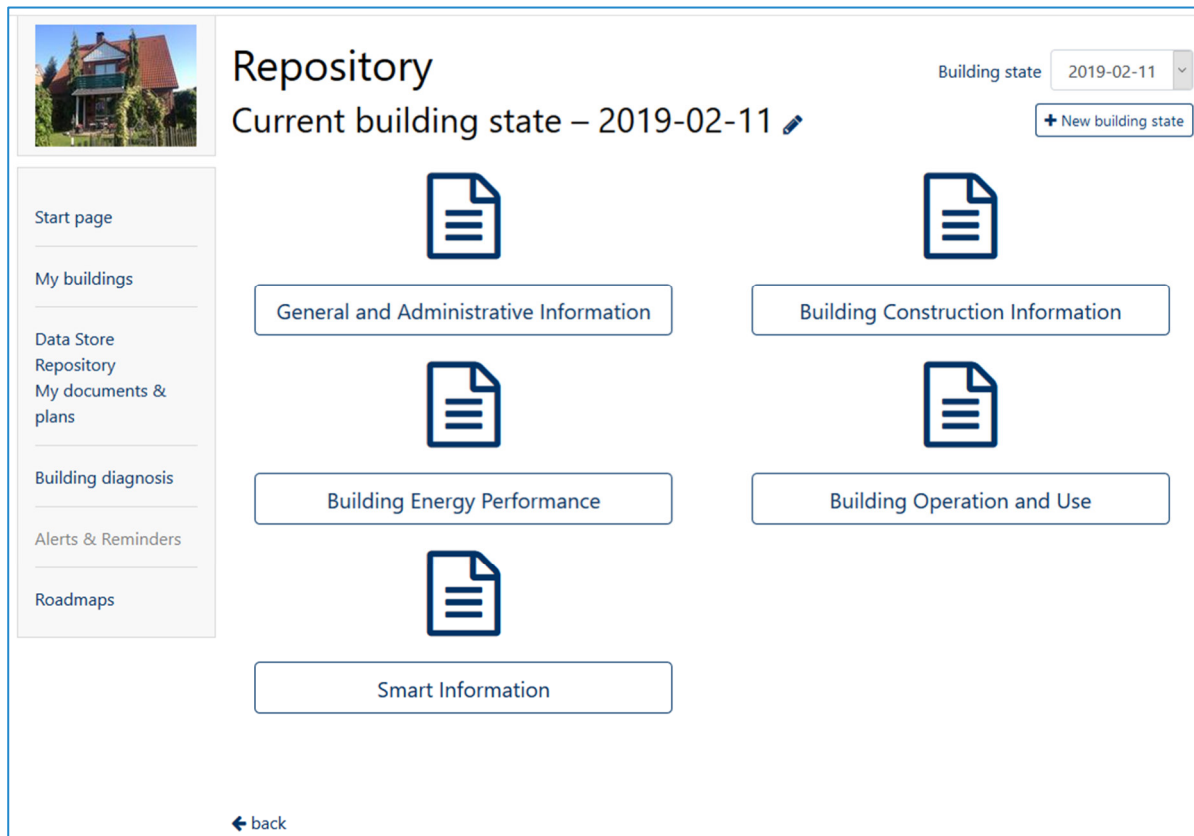



Figure 37: main menu of the iBRoad Logbook, Copyright: iBRoad



Start page

My buildings

Data Store  
Repository  
My documents & plans

Building diagnosis

Alerts & Reminders

Roadmaps

Glossary

## Building state – 2027-02-13

### Building Construction Information

Wall Types

**Wall Types**  
Wall Type 1

Name / Specification:

Description of the constructive solution:

Orientation:

Surface area:  m<sup>2</sup>

Structural material type:

Environment on backside of component:

Insulation type:

Insulation thickness:  m

Insulation thermal conductivity:  W/mK

Figure 38: Sample page from the iBRoad Logbook for data entry of external walls. Copyright: iBRoad



Start page

My buildings

Data Store  
Repository  
My documents & plans

Building diagnosis  
Overall Performance  
Envelope Performance  
Equipment Performance

## Envelope Performance

	2019-02-11	2021-02-13	2027-02-13	...	2050
Walls	●	●	●	...	●
Roof	●	●	●	...	●
Windows	●	●	●	...	●
Floor	●	●	●	...	●

Figure 39: Sample pages from the iBRoad Logbook, diagnosis of the building envelope performance with resolution of building components and temporal improvement. Copyright: iBRoad

## Guidance for users

The primary aim of iBRoad is to provide a structured renovation passport. Together, the iBRoad-Plan and the iBRoad-Log offer building owners extensive information about their property. The iBRoad-Plan (Figure 35 and Figure 36) outlines a detailed path towards achieving a nearly zero-energy building (nZEB), offering guidance over a process that may extend up to 20 years or more. This roadmap ensures planning security tailored to the homeowner's specific needs, including financial capacity, household composition, and future requirements.

The iBRoad-Log (Figure 37 to Figure 39), a digital building logbook, complements this roadmap by storing all the relevant data. It provides current and future building owners, as well as planners, with access to the technical history of the property. By preserving all data, the logbook prevents loss of information and supports both occupants and planners throughout the renovation process. It allows for real-time access to the building's status, including details on upcoming and subsequent renovation steps.

## Progression and dissemination

The tools are fully developed and ready for use in member states. They have been implemented in Bulgaria, where energy consultants can offer the iBRoad tools to building owners. The tools are designed in such a way that they can be easily adapted to the framework conditions and particularities of countries who wish to adopt the system. The basic version is in English. Both tools can be easily translated into the respective national language. The steps to implement the iBRoad system in a country are described in a dedicated report (iBRoad 2020).

## Implementation challenges

The iBRoad tools, consisting of the individual Building Renovation Roadmap and Logbook, were field-tested in Bulgaria, Poland and Portugal during the period March -May 2019. Prior to field-testing, project partners from the pilot countries received an online train-the-trainer seminar. During the field test, 15 - 20 buildings per pilot country were examined in cooperation with local certified energy auditors. In total, 27 energy auditors participated in the iBRoad field test. Energy auditors received comprehensive training before the field test: in each pilot country, a one-day face-to-face auditors' training was given. The training events were organised locally by the country partners ADENE (Portugal), EnEffect (Bulgaria) and KAPE (Poland). One trainer from ifeu carried out the training in all three pilot countries in cooperation with the respective country partner. With the training, auditors received the iBRoad handbook and the training presentation explaining all relevant details.

Overall, the partners from the pilot countries considered the field test a success: the field test process, the training as well as the preparation and training material for energy auditors were appreciated. No major problems occurred during the field test, and the developed iBRoad tools were in principle positively received.

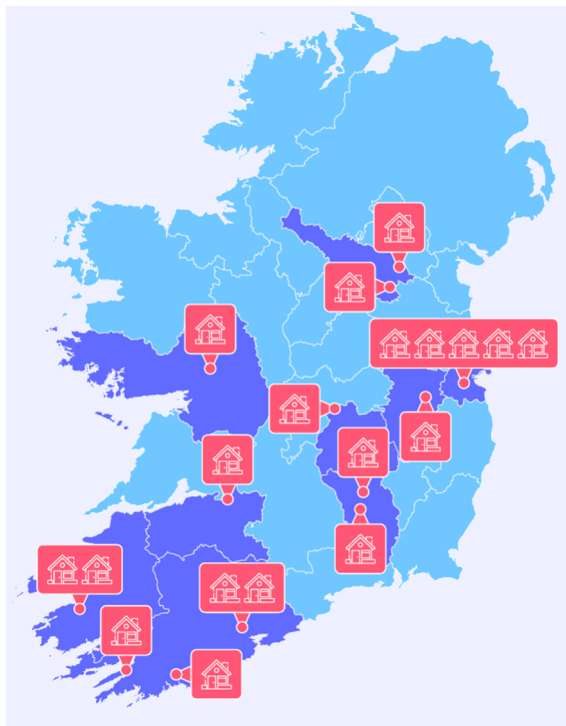
The experience from the field test was used to identify potential obstacles and their solutions. The field test showed that missing incentives for energy audits can hamper the market deployment (Werle et al., 2019a). Potential solutions are setting incentives, e.g. funding, subsidised loans or tax advantages for iBRoad. In general, incentives should address the content of iBRoad, e.g., better interest rates for renovation steps that are in line with the renovation roadmap. In Germany, a bonus was granted on top of renovation funding under the prerequisite that a renovation roadmap existed. This coupling to the sheer existence instead of the contents of the roadmap led to little interest in the content from both building owners and energy experts and, consequently, the quality of roadmaps dropped.

Field test participants remarked that iBRoad was available only in English language. Both sides, owners and experts said that they would prefer the tool and contained information in their national language. When a country actually implements the iBRoad system, the tools are translated into the local language. For the field test, only the English version was used.

Many energy experts who participated in the field test suggested that an automatic interface between the EPC software and the iBRoad tools should be provided. Such an interface would allow existing data from the EPC software to be used to create an iBRoad roadmap, thus avoiding duplicate data entry. It

would have been too costly for the field test to provide an individual interface for each participating country. When the iBRoad tools are introduced in a country and higher issuing numbers are expected, an automated interface would be the standard solution.

Although Ireland was not a pilot country in the project, the Sustainable Energy Authority of Ireland (SEAI) requested a separate field test. Eleven Irish energy experts were trained to use iBRoad. During the piloting phase between February to August 2020, the iBRoad Roadmap was tested on 20 single-family houses across Ireland (Figure 40). 89 % of the involved homeowners and 78 % of the energy experts said after the field test that the iBRoad enables and motivates the homeowner to realise concrete renovation measures in the near future.



*Figure 40: Locations of the 20 single-family houses tested during the pilot phase of iBRoad in Ireland. Copyright: IGBC*

iBRoad fits very well to the Irish building stock, because 62 % of it are detached dwellings with another 20 % being terraced (IBSO, 2024; Figure 41). 82 % percent of the Irish building stock are hence subject to the main focus of the iBRoad project.

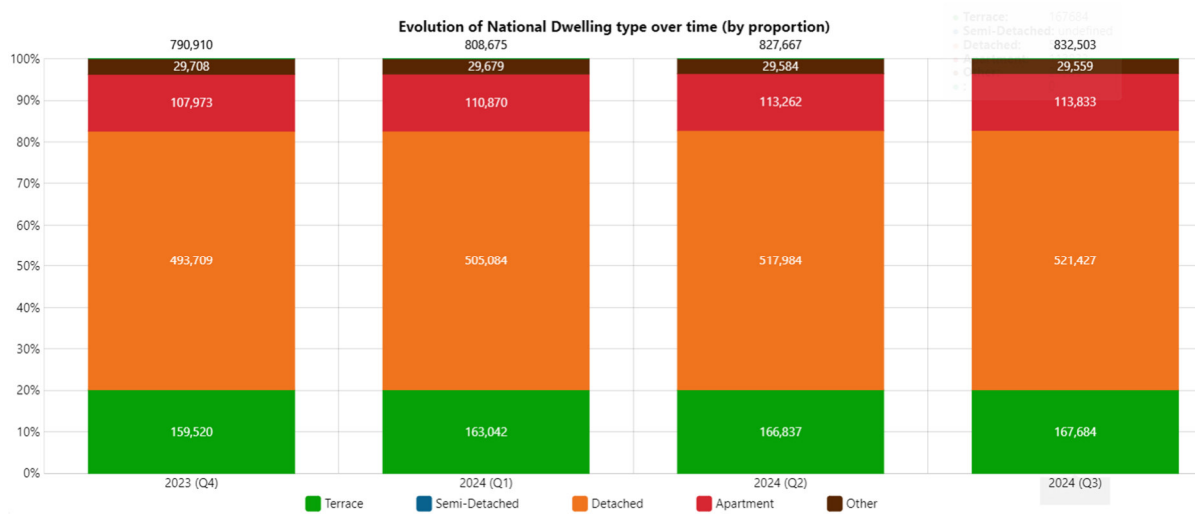


Figure 41: Evolution of Irish Dwelling types over time (by proportion). Copyright: IBSO

In Ireland, some key elements for iBRoad to be further disseminated were identified. First there are informational campaigns to make decision makers aware of its benefits and expert training to ensure a high quality and correct issuing of the roadmap (IGBC, 2020; Werle et al., 2019b). Second economic incentives are needed. This may include funding for building owners when renovating according to an iBRoad roadmap. Tax advantages may be granted with an iBRoad roadmap. The roadmap may be linked with energy audits or comparable services that require an auditor to visit the building (ibid.).

Accompanying regulatory instruments can also support the dissemination of iBRoad. Renovation targets in national building codes and renovations obligations for certain building classes create a safe environment for owners, experts, and other stakeholders like banks, the building material industry, or energy audit software developers. Obligations for renewable heating like the case is in Germany (The Federal Government of Germany, 2023) could be combined with an iBRoad, to achieve decarbonisation from both sides, the energy production and the energy demand.

### Suitability for municipalities

The iBRoad renovation passport focusses on single buildings and small multi-family buildings (similarly to the SFP and iSFP). If the concept is extended to other building types, adaptations may need to be made.

The iBRoad Roadmap and the iBRoad Logbook are sophisticated online tools. They can easily be adapted to the needs of an implementing country.

It is recommended that the production of an iBRoad roadmap is subsidised by public funds (see SFP and iSFP).



## Tested Renovation Passports

### iBRoad2EPC

#### General information

iBRoad2EPC is the follow-up project to iBRoad and has further developed the methodology, appearance and integration options in EPCs. iBRoad2EPC combines the core information of a renovation passport (like the iBRoad roadmap) with the wide market coverage of the EPC. It is an energy consultation tool for building owners, issued by building professionals. It outlines an initial renovation strategy on how a building can become climate neutral in the long-term. The strategy can include a full renovation in one step, but also a renovation in several steps. The long-term perspective means that the individual renovation steps build on each other, connections between components can be prepared in good time and future renovation obligations can be considered well in advance. iBRoad2EPC follows a modular approach, providing member states with the possibility to choose which modules of the tool to implement.

iBRoad2EPC is very much aligned with and fulfils most requirements on Renovation Passports (RPs) as defined in Article 12 of the EBPD. It provides a reliable and flexible approach for introducing and positioning RPs in relation to existing EPCs. This can be achieved by integrating iBRoad2EPC as a mandatory or voluntary component of the EPC, or as an independent and comprehensive RP.

Numerous tailored solutions can be implemented within this range, considering the balance between the effort (and cost) for the issuance on the one hand and the market penetration on the other. The iBRoad2EPC approach also includes an on-site visit as a minimum requirement. Energy experts can combine this on-site visit with the on-site visit for the EPC to save time. They use the so called iBRoad2EPC Assistant tool to issue the iBRoad2EPC in a unified design. The iBRoad2EPC Assistant supports the experts with numerous automated features, i.e. aligning renovation recommendation with the national targets as laid down in the Long-Term Renovation Strategies (LTRS) or National Building Renovation Plan (NBRP). Furthermore, the iBRoad2EPC Assistant offers standard text blocks to describe the renovation recommendations, national climate targets, legal requirements, and preparatory measures to avoid lock-in situations in staged renovations.

The iBRoad2EPC concept, implementation and how it can be embedded in the framework conditions of the pilot countries are described in detail in the following reports:

- [“Conceptualising iBRoad2EPC: can EPCs be upgraded to include building renovation passport elements?”](#)
- [“iBRoad2EPC in depth”](#)
- [“National initial guidelines”](#).

#### Content

iBRoad2EPC is designed to answer the core questions building owners have about the long-term renovation strategy for their buildings.

	Explanation	Example
what?	Description of measures	insulate the roof replace the heat generator install a ventilation system
when?	Likely time span to implement measures	before 2030 before 2040 before 2050
how?	technical specifications according to LTRS, NBRP, NECP	roof: 24 cm polystrene heating: heat pump ventilation: 85% heat recovery
what to beware of?	foreseeable obligations	MEPS: your building has to fulfil at least efficiency class F in 2030
what to pay attention to?	notes to prevent lock-in situations	if you insulate the roof make sure that the overhang is sufficient for the wall insulation at a later stage

Figure 42: iBRoad2EPC answers the core questions building owners have about the long-term renovation strategy for their buildings.

iBRoad2EPC follows a modular approach and can be adapted to the different requirements in implementing Member States; the basic module comprises the general renovation plan and related advice, with automated processing to minimize costs. The iBRoad2EPC module can therefore complement national EPC schemes or even become a mandatory part of EPCs.

Member States may choose to enlarge the basic module with several additional modules. These add information about energy demand, energy consumption, renovation costs, smart readiness, indoor environmental quality and measured energy performance into the iBRoad2EPC. Through the additional modules, iBRoad2EPC covers a whole range of the topics relevant for a BRP in the context of the EPBD.

iBRoad2EPC provides the following added value for building owners:

- Better renovation recommendations in EPCs through the integration of BRP elements
- Outline of an individual long-term renovation strategy considering:
  - Step-by-step renovations that lead to deep renovation
  - Avoidance of mistakes, lock-in effects and wasted costs through early preparation of later renovation measures
  - Alignment with overarching national building targets, future requirements and obligations (e.g., fossil fuel phaseout, minimum energy performance standards (MEPS)) to fulfil all legal requirements.

According to Annex VIII EPBD, RPs shall include certain information as already described before. iBRoad2EPC already contains a lot of these mandatory and optional information, i.e. the current and stepwise achievable energy performance of the building, a graphical representation of the renovation roadmap including detailed description and succession of single steps, and target values from the NBRPs. iBRoad2EPC fulfils almost all requirements that are connected to the Renovation Passport framework within the EPBD (Table 3).

*Table 3: How can iBRoad2EPC help to implement the common framework for Renovation Passports set out in Annex VIII of the 2024 EPBD? Copyright: BPIE*

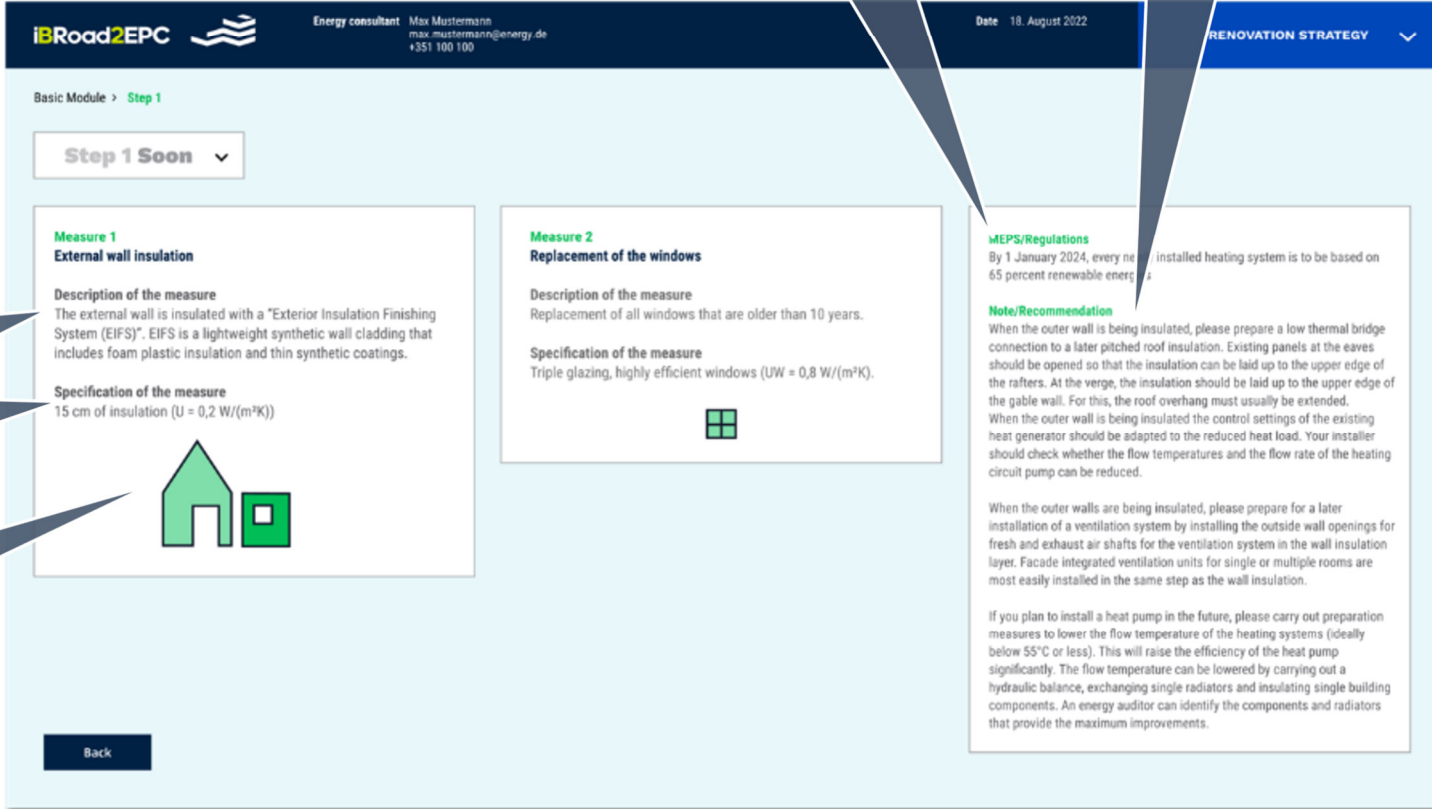
	Total paragraphs/ requirements	Mostly fulfilled	Partially fulfilled / future optional module	Out of scope
Article 12	8	8		
Annex VIII 1 (Requirements that need to be met)	14	11	3	0
Annex VIII 2 (Requirements that may be met)	18	7	9	2
Annex VIII 3	1		1	0
Annex VIII 4	1	1		0

### Guidance for users

The following pages show the online output forms of the iBRoad2EPC basic module and the information they provide. The overview page presents the whole renovation strategy at a glance. Building components that have been renovated to a target-proof standard turn green. When the whole building is green in the target year it means the building will have achieved the national climate goals of the respective Member State. For every renovation step there is a subpage explaining in detail what, when and how to renovate, what to beware of and what to pay attention to.



Figure 43: Overview page of the iBRoad2EPC online output form. Copyright: iBRoad2EPC



The screenshot shows the 'iBRoad2EPC' interface. At the top, it displays 'Energy consultant: Max Mustermann, max.mustermann@energy.de, +351 100 100' and 'Date: 18. August 2022'. The main content area is titled 'Step 1 Soon' and contains three columns of information:

- Measure 1: External wall insulation**
  - Description of the measure:** The external wall is insulated with a "Exterior Insulation Finishing System (EIFS)". EIFS is a lightweight synthetic wall cladding that includes foam plastic insulation and thin synthetic coatings.
  - Specification of the measure:** 15 cm of insulation ( $U = 0,2 \text{ W}/(\text{m}^2\text{K})$ )
  - Icon:** A green house icon with a square window.
- Measure 2: Replacement of the windows**
  - Description of the measure:** Replacement of all windows that are older than 10 years.
  - Specification of the measure:** Triple glazing, highly efficient windows ( $UW = 0,8 \text{ W}/(\text{m}^2\text{K})$ ).
  - Icon:** A green window icon.
- MEPS/Regulations:** By 1 January 2024, every newly installed heating system is to be based on 65 percent renewable energy.
- Note/Recommendation:**
  - When the outer wall is being insulated, please prepare a low thermal bridge connection to a later pitched roof insulation. Existing panels at the eaves should be opened so that the insulation can be laid up to the upper edge of the rafters. At the verge, the insulation should be laid up to the upper edge of the gable wall. For this, the roof overhang must usually be extended.
  - When the outer wall is being insulated the control settings of the existing heat generator should be adapted to the reduced heat load. Your installer should check whether the flow temperatures and the flow rate of the heating circuit pump can be reduced.
  - When the outer walls are being insulated, please prepare for a later installation of a ventilation system by installing the outside wall openings for fresh and exhaust air shafts for the ventilation system in the wall insulation layer. Facade integrated ventilation units for single or multiple rooms are most easily installed in the same step as the wall insulation.
  - If you plan to install a heat pump in the future, please carry out preparation measures to lower the flow temperature of the heating systems (ideally below  $55^\circ\text{C}$  or less). This will raise the efficiency of the heat pump significantly. The flow temperature can be lowered by carrying out a hydraulic balance, exchanging single radiators and insulating single building components. An energy auditor can identify the components and radiators that provide the maximum improvements.

Callout boxes provide additional context:

- Future requirements:** Information about content and timing
- Preparation for later renovation steps:** reach deep renovation and avoid lock-in
- Description of the measures:** What should be renovated?
- Specification of the measures:** Renovation depth according to NBRP
- Icon:** same as in the overview for easy orientation

Figure 44 Page 2 of the iBRoad2EPC output form presents detailed information for each renovation step. Copyright: iBRoad2EPC



The iBRoad2EPC is created with an online tool called the iBRoad2EPC Assistant. The main objectives of this tool are to:

- Create the iBRoad2EPC in a uniform design
- Output the iBRoad2EPC in an online version
- Provide clear and intuitive user guidance
- Facilitate issuers in assigning renovation measures at specific points in time
- Automatically pre-select
  - time steps
  - specifications of renovation measures that are aligned with national targets
  - recommendation texts to prepare for later renovation measures
- Enable issuers to easily overwrite all default texts
- Allow easy expansion with additional modules.

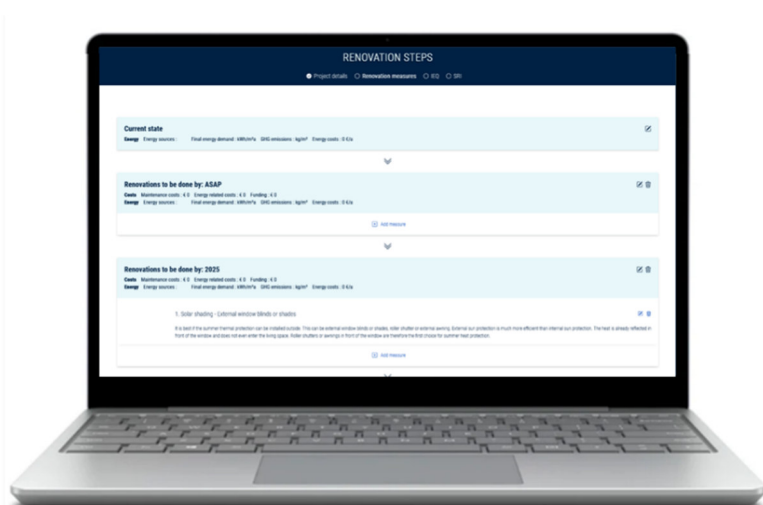


Figure 45: The iBRoad2EPC Assistant is an online tool to process and issue the iBRoad2EPC. Copyright: iBRoad2EPC

iBRoad2EPC adds an extra page to the EPC which contains a link to the individual online document.

The iBRoad2EPC Assistant comes with various potential interfaces for coupling with the national software tools, i.e. EPC software. An API interface allows for direct data exchange with external software, however national software has to adapt to the API. Existing formats for data exchange can also be used. In general, these are existing MS excel or XML interfaces to upload EPC data to national EPC databases.

## Progression and dissemination

The iBRoad2EPC project ended in August 2024. An analysis of the lessons learnt from 3 years of experience with iBRoad2EPC in six pilot countries summarises the main findings and recommendations for future improvements to the iBRoad2EPC concept and tools.<sup>28</sup>

The iBRoad2EPC software tools will be kept active for two years after the project duration, i.e. until August 2026, including some basic maintenance. During this period, an iBRoad2EPC pilot country could continue to test the tool, if desired and to a certain extent, without further updates or support. This gives pilot countries sufficient opportunity and time to test, if necessary, in order to decide whether iBRoad2EPC is suitable, and prepare for the roll out of iBRoad2EPC, as the official renovation passport, by the deadline set in Art. 12 of the 2024 EPBD recast (29 May 2026).

<sup>28</sup> The report “Revamping the iBRoad2EPC concept” is available at the [iBRoad2EPC website](#).

The deployment strategy for iBRoad2EPC is described in the project's final reports.<sup>29</sup> There are different options.

If an additional MS decides to test iBRoad2EPC, an English version of iBRoad2EPC can be used for testing.

If a (pilot) country considers deploying the software at scale, the relevant authorities should contact the iBRoad2EPC consortium and together examine the options on a case-by-case basis.

## Field test results

Energy experts in Bulgaria, Greece, Portugal, Romania and Spain have successfully tested and positively assessed the iBRoad2EPC model building renovation passport, developed as part of the iBRoad2EPC Horizon 2020 funded project. The comprehensive field test involved 48 energy experts and 37 building owners who evaluated the application of iBRoad2EPC in 57 residential and non-residential buildings between July 2023 and March 2024. Energy experts found iBRoad2EPC easy to use, and building owners found the output extremely informative and useful in planning a stepwise deep renovation of their building.

## Suitability for municipalities

Like iBRoad, iBRoad2EPC is focused on single buildings. It needs an EPC for a single building and an energy expert to design a renovation roadmap tailored to this building. With its time efficient workflow, it is able to leverage building stock decarbonisation with the large number of buildings that the joint issue of iBRoad2EPC and EPC addresses. If the concept is extended to other building types, adaptations may need to be made.

The iBRoad2EPC Assistant is a sophisticated online tool which can be adapted to the needs of an implementing country.

The issuance of an iBRoad2EPC is less complex than with other roadmaps, depending on the scope of its content. If only the minimum content is implemented the extra cost for building owners is comparably low. In this case, the iBRoad2EPC should be able to run without public funding. If optional modules are implemented, it is recommended to subsidise it by public funds.

An iBRoad2EPC could be issued for all buildings in a community. The resulting certificates and roadmaps would need to be analysed by an expert to identify possible synergies. From this, a community roadmap might be developed or enriched with this information. The analysis has the potential to avoid lock-in situations on community level and make sure, that building owners understand the process.

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<sup>29</sup> All public iBRoad2EPC reports can be accessed through the [iBRoad2EPC website](#).

## GREEN Home - German Roundtables on Energy Efficiency in Homeowner Associations

### General information

The Horizon 2020-funded project (2021-2024) was designed to elevate the renovation rate particularly in condominiums by initiating a national stakeholder dialogue and developing targeted financial instruments for energy-efficient renovations in condominiums. The objective was to meet the European target of a climate-neutral building stock by 2050, which necessitates a substantial reduction in energy consumption and a significant enhancement in energy efficiency across residential buildings. In Germany, of the 19 million residential buildings, 1.8 million buildings are organised as condominiums. This segment accounts for nearly a quarter of the German total housing units. Notably, the renovation rate of these multi-family buildings is lower than the national average.

In 83 per cent of condominiums, property management companies are entrusted by the owners to manage and maintain the common property. The property manager is often situated between the priorities of the condominium owners, the jointly owned property and laws and acts (Figure 46)

Owners' meetings serve as the central platform for consultation, raising awareness, and decision-making among unit owners. It is within these meetings that property managers facilitate discussions and guide the decision-making processes regarding energy-efficient renovations. By providing well-founded advice and effectively moderating these sessions, property managers can significantly influence the adoption of sustainable renovation strategies within condominiums.

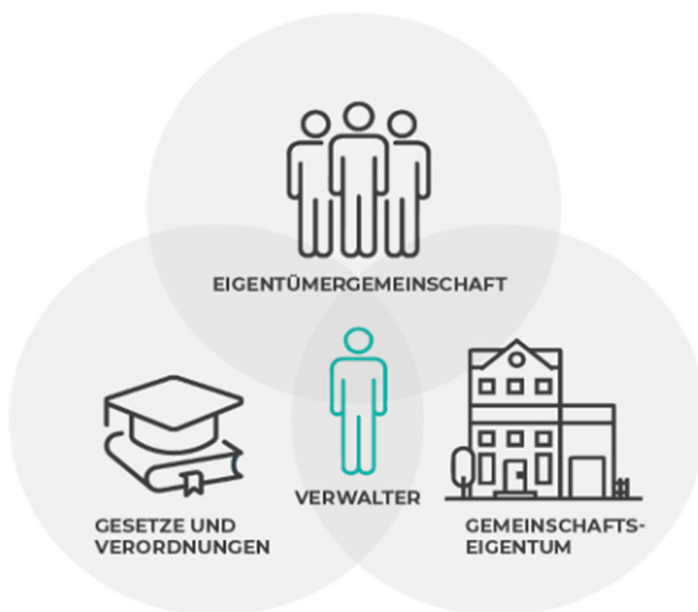


Figure 46: Property manager in the centre of attention between the unit owners, the buildings value and laws.  
Copyright: GREEN Home

The professional management of shared property includes:

- Preparing owners' meetings
- Drafting resolutions for the condominium association
- Moderating the decision-making processes within the owner's meeting
- Involving external experts (e.g., energy consultants, financial advisors, and funding specialists)
- Overseeing the implementation of resolutions passed by the condominium association



The GREEN Home project operates on the assumption that property managers play a pivotal role in the implementation of energy-efficient renovations within condominiums. Consequently, they must be equipped with effective financial instruments and appropriate informational materials to advocate for sustainable renovation measures during owners' meetings.

The project also focuses on adapting and enhancing the German Individual Renovation Roadmap (iSFP) to better serve the needs of this specific context. The primary target groups for this initiative are condominiums and property managers, who are essential for coordinating and executing energy upgrades within these buildings. By addressing the unique challenges condominiums have to face and improving decision-making processes, the project aims to promote more effective and widespread energy renovations, thereby advancing the broader goal of improving energy efficiency in the residential sector. The EU-funded project aimed to lever the renovation rate in jointly owned multi-family houses by establishing a national stakeholder dialogue and developing financial instruments for the energetic renovation of condominiums and enhancing the iSFP for this use case.

## Content

One of the core components of GREEN Home is a step-by-step instruction guide for the renovation of buildings, specifically addressed to property managers. This guide aims to streamline the renovation process, providing clear, actionable steps to ensure effective implementation of energy upgrades.

The project has also developed a detailed pain point list that encapsulates the urgent political measures required to elevate the renovation rate of jointly owned buildings. This list highlights critical issues and provides a framework for policy interventions to support and accelerate renovation efforts.

In addition, the GREEN Home project showcased successful case studies of energy-efficient renovations in condominiums, offering valuable insights and practical examples of effective renovation strategies. The workshops conducted as part of the project have produced substantial material on business cases for renovating jointly owned buildings, offering practical guidance and proven strategies for property managers and unit owners.

The project has further refined its approach through the development of personas representing unit owners and property managers, which has facilitated a more targeted and user-centric approach to its tools and services. The results from network meetings and digital round tables, as well as regional round tables, have been instrumental in shaping the project's offerings, ensuring they meet the needs and address the concerns of the target groups.

All of the content is available at the [GREEN Home project website](#).



Images of building components

Overview of present and target quality

Figure 47: Sample of GREEN Home development of the iSFP for condominiums: present and target quality of energy-related components. Copyright: GREEN Home

### Guidance for users

GREEN Home aimed to support property managers and condominiums with the renovation of their building following a five-stage process.

First, a status quo analysis is conducted. It involves collecting data and information on the interests and needs of stakeholders, current framework conditions such as market conditions, and existing financial instruments. Regional specificities in Germany are taken into account, with a focus on the federal states of Berlin/Brandenburg, North Rhine-Westphalia, and Baden-Württemberg. Through expert interviews, both the needs and interests of stakeholders, as well as their practical experiences and perspectives

on promoting comprehensive energy renovations in condominiums, are examined. Based on the insights gained from these interviews, a quantitative survey was developed and conducted. The data gathered served to derive criteria and requirements for energy efficiency investments within condominiums.

Second, insights from national and international projects were analysed. The developed catalogue of criteria and requirements, alongside the identified needs of property owners and property managers, was further evaluated against national and European best practice projects. The GREEN Home project integrates experiences from other EU projects in the field of financing and promoting energy renovations in condominiums, analysing to what extent these experiences can be transferred and utilised in the German context.

Following, the status quo analysis, incorporating the insights from national and international projects, is structured around the following key action areas:

- Financing and funding
- Building technology and energy efficiency
- Legal aspects
- Communication and process support

The project published an overview of documents for property managers, where the provided tools are summarised. The tools address three main subjects.

A digital version of the individual building renovation roadmap (IRR) for condominiums offers comprehensive information to support informed renovation decisions within condominium associations. This tool outlines various renovation strategies, details combinations of measures, provides cost estimates, and projects potential energy savings, thereby equipping unit owners with the necessary data to evaluate and choose optimal renovation paths.

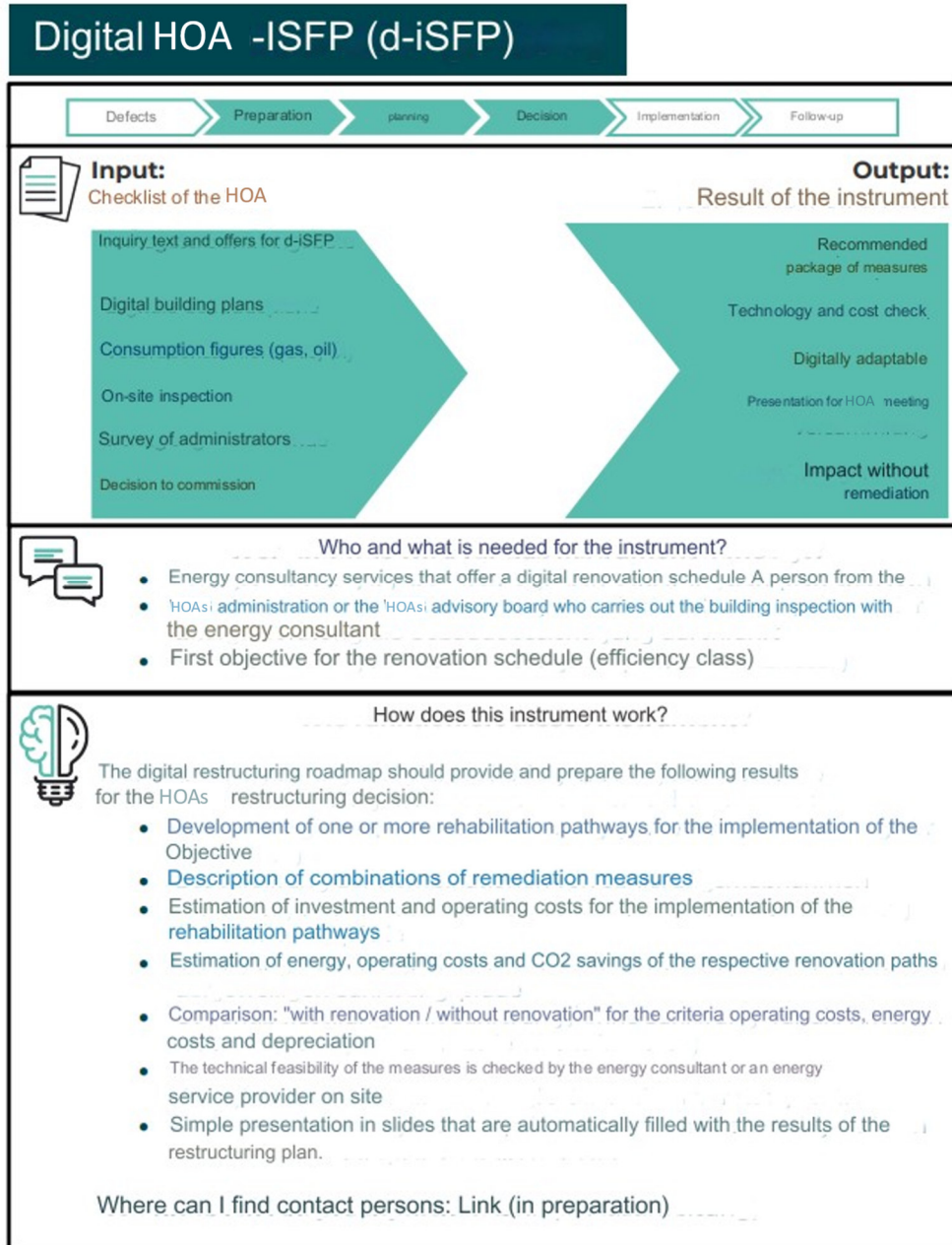
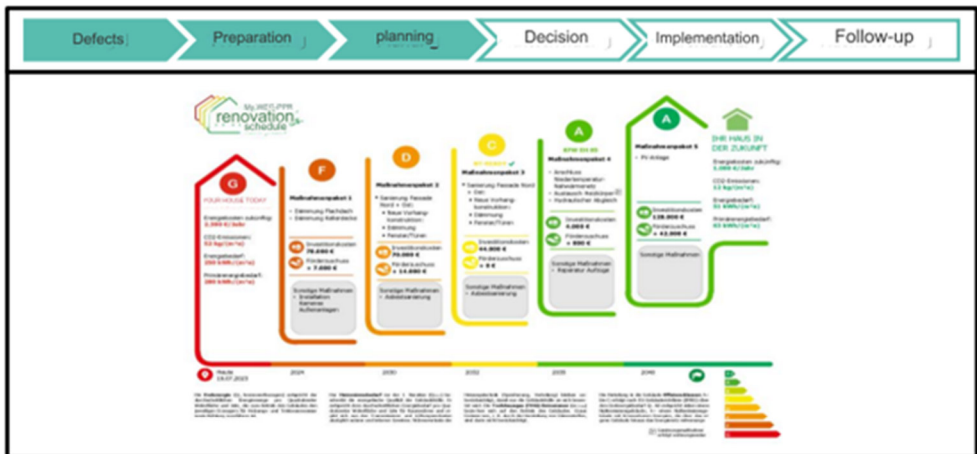


Figure49: One-pager on digital iSFPs for jointly owned buildings. Copyright: GREEN Home (translated by ifeu)

# HOA -iSFP



Who do I need for this?

- Energy consultancy services that offer a renovation roadmap

Processual: What happens in the model?

The HOA -iSFP is a conceptual iSFP that addresses content, innovations and the specific needs of a WEG.

- The HOA -iSFP offers the optimal combination of renovation measures and combines high energy savings and economic benefits
- The "Contact persons for your HOA" page familiarizes all owners with the most important players in the HOA and removes barriers
- On the "Reason for renovation" page, owners can see individual advantages for themselves;
- Administrations receive an overview of the individual condition of each apartment;
- Owners keep track of current legal regulations, subsidies and financing options that apply to HOA



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033878

Figure 48: Blank digital iSFP for jointly owned buildings. Copyright: GREEN Home (translated by ifeu)

## Progression and dissemination

In total, GREEN Home was promoted at ten events. These events focused on property management companies and other interested stakeholders from finance, energy services, energy consulting, and science. These information events were in some cases also offered as upskilling events for energy consultants.<sup>30</sup> Main hindrances for the dissemination of the projects outcome were also identified and are presented in the following chapter.

## Implementation challenges

Kicking off the renovation wave for jointly owned buildings in Germany still faces various obstacles. The GREEN Home project identified these pain points and proposed solutions accordingly. Solving these points would lead to a considerable spread of the GREEN Home approach across Germany, followed by an increase of the renovation rate in condominium owned buildings.

### Lack of knowledge prevents initiatives and decisions to initiate a renovation programme - make funding for condominium-iSFP fairer

Unit owners in condominium associations often have limited knowledge regarding the energy and climate performance of their properties, current legal requirements such as the amendments introduced by the Second Building Energy Act (GEG), and the opportunities provided by available funding schemes. While the connection between the level of energy-efficient renovation and property value is acknowledged within the real estate sector, this awareness has not fully reached unit owners in condominiums. Surveys indicate that existing information is often not adequately tailored to this target group (VDIV, 2023).

Due to the lack of information, information asymmetry, and knowledge deficits, differing assessments arise among members of a condominium. The available information is complex and often creates significant uncertainty about whether a renovation is necessary and, if so, which measures are both sensible and economically feasible. As a result, renovation decisions are frequently postponed or not implemented at all, contributing to the persistently low renovation rate in condominium buildings. Additionally, around 59% of property managers report feeling inadequately qualified to support and implement comprehensive energy renovations (ibid.).

To facilitate renovation decisions, the following recommendations are proposed. Firstly, the introduction of an addendum to the Federal Energy Advice Scheme for Residential Buildings (EBW) or within the Federal Efficient Buildings Scheme (BEG) specifically for homeowners' associations. In addition to the current funding, two bonuses should be granted:

- under the EBW, when the renovation roadmap is created as an open data file, exportable and available online
- under the BEG, a 10% bonus instead of the current 5% if the roadmap results in initiating a renovation. This acknowledges the significantly higher effort involved in the creation, presentation, and follow-up of the roadmap, and provides a strong incentive for successful, implementation-oriented consulting by energy advisors.

Second, making the iSFP funding more attractive for large condominiums: Expanding the iSFP funding for larger condominiums. The current funding cap for multi-family buildings under EBW should be raised, taking into account that larger buildings impose higher requirements for creating the roadmap.

## Suitability for municipalities

The GREEN Home project analysed the specific peculiarities of property management companies. While technical issues and hindrances are often the focus of projects covering the renovation of buildings, when it comes to condominiums, organisational and legal obstacles occur more often.

<sup>30</sup> In Germany, energy consultants have to prove a certain number of upskilling hours per year to ensure that they are up to date with the latest developments in building technology, material, funding, and sustainability.

The project developed a high-quality platform for knowledge, stakeholder consultation, concrete tools to support property managers and others during the renovation process of jointly owned buildings, focusing on the organisational and legal problems. The results of the project should be subject to a detailed analysis when developing neighbourhood energy sufficiency roadmaps. The technical aspects of single buildings are covered by various renovation passports presented in this report, while the processual obstacles may pose the bigger problem to renovations at municipality level. Moreover, the instruments and advice from GREEN Home are partly based on the learnings from European best practices on the renovation of condominiums.

These good practices already cover a substantial number of countries in Eastern Europe and found a way to cope with the specific conditions within the realms of building renovation in the area. They all contributed to the results of GREEN Home, making the GREEN Home toolbox very suitable for the specific obstacles of the Eastern European building stock, especially coping with the speciality of condominiums.

## Conclusion

This report shows that there is a wide variety of roadmap concepts. They range from the bundling of information that is already available about a building in various databases (Woningpas), to a platform that connects building owners and service providers in a targeted and quality-assured manner (casA+), to spatially resolved, in-depth building information (urbanZEB), to individual renovation roadmaps with different levels of detail and objectives (SFP, iSFP, iBRoad, iBRoad2EPC, GREEN Home). Although some of these tools take very different approaches, they all make a valuable contribution to achieving long-term goals in the buildings sector. The tools presented have been developed at the level of the whole country. They can be applied to varying degrees at the municipal level. Their applicability at the local level depends on the need to involve national agencies, the availability of data, or the availability of budgets for development and deployment. In principle, the concepts and intentions of the tools also work at the municipal level. For implementation at the municipal level, the tools may need to be adapted to the needs and circumstances of the municipalities.

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