



Guide on Promoting Prefabricated Refurbishment

Initiative Wohnungswirtschaft Osteuropa (IWO)

March 2025



About RenoWave

The project entitled “One-Stop-Shop extended model to increase the multi-apartment building stock renovation in the BSR” (RenoWave) is designed to bring homeowners, construction companies, energy agencies and public authorities together to initiate more energy-efficiency renovations in multi-apartment buildings. The main outcome of the RenoWave project will be a one-stop shop (OSS) model that includes both traditional and additional OSS services covering all the steps necessary to initiate and implement energy-efficiency renovation projects in multi-apartment buildings. The RenoWave project is being delivered as part of the Interreg Baltic Sea Region Programme 2021–2027 with the support of the European Regional Development Fund and is being implemented between January 2023 and December 2025.

Project partners

1. County Board of Dalarna (Sweden)
2. City of Lappeenranta (Finland)
3. Vidzeme Planning Region (Latvia)
4. Association of Municipalities and Cities of the Małopolska Region (Poland)
5. Municipal Administration of the City of Bremerhaven (Germany)
6. Baltic Environmental Forum Latvia (Latvia)
7. Housing Initiative for Eastern Europe (Germany)
8. “Let’s renovate the city” NGO (Lithuania)
9. Polish Foundation for Energy Efficiency (Poland)
10. North Sweden Energy Agency (Sweden)
11. Development Centre of Võru County (Estonia)

Summary of deliverables

This guide focuses on one particular approach to deep renovation, specifically the prefabricated refurbishment of buildings. It explains the approach and its implications and benefits as well as existing and potential barriers to its wider adoption. Examples from different parts of Europe are provided to demonstrate the potential impacts of prefabricated refurbishment approaches in different national contexts and climate conditions. Finally, the guide offers a set of tools for encouraging the broader adoption of prefabricated refurbishment for building renovation.

Who is the guide for?

One-stop shops, municipalities and any other entities involved in building renovation that may be interested.

The RenoWave project is designed to bring homeowners, construction companies, energy agencies and public authorities together to initiate more energy-efficiency renovations in multi-apartment buildings.



www.interreg-baltic.eu/project/RenoWave

Introduction

Improving the condition of buildings represents an important opportunity to improve people's health, quality of life and overall socio-economic conditions and make a bigger contribution to climate action. Currently, 75% of the building stock in the European Union (EU) is energy-inefficient, which is reflected in the fact that buildings are responsible for 40% of the EU's entire energy consumption and 36% of its carbon emissions. Renovating existing building stock would enable energy consumption to be cut by 5–6% and carbon emissions by approximately 5%. Many previous policy initiatives in the EU have been aimed at tackling the issue of energy-inefficient building stock. The Energy Efficiency Directive (EED) and Energy Performance of Buildings Directive (EPBD) are both key policy documents guiding the efforts being made that were revised as part of the Clean Energy for All Europeans Package. The Renovation Wave is a separate, designated part of the Green Deal, while REPowerEU places great emphasis on the importance of saving energy and using it more efficiently [1].

Although the importance of building renovation is recognised across the EU, approaches for tackling it differ, and there are various renovation options available. Partial renovation implies intervention work on separate elements of a building; it may appear more cost-effective than comprehensive deep renovation but is unable to achieve an ambitious level of energy savings. By contrast, deep renovation results in high energy savings and upgrades the entire building system but costs more. With respect to energy savings and ensuring a long-term reduction in energy costs, however, this renovation type is preferred and encouraged by policymakers [2]. The high cost means that, in a lot of cases where e.g. homeowners are responsible for the building and their own property and obliged to pay for retrofit measures (either with or without regional or national funding), deep renovation is not an option. The EU's "Fit for 55" vision is making cheap, smart solutions more and more attractive and impossible to ignore, even though the state of the art favours deep renovation.

Contents

Introduction	2
What is Prefabricated Refurbishment?	4
Definition.....	4
Features and Benefits.....	4
Examples from Different National Contexts	6
Southern Europe.....	6
Northern Europe.....	7
Central and Western Europe	8
Current Barriers	10
How to Promote Prefabricated Refurbishment	10
Start with Some Research	10
Understand the Market and Technology Adaptation Lifecycle	11
Do Stakeholder Mapping	12
Work on Engagement and Promotion	13
Good Example: First prefabricated refurbishment of a panel building in Germany	14
Conclusion	16
Bibliography	17

List of Abbreviations

BIM	Building information modelling
BSR	Baltic Sea Region
CLT	Cross-laminated timber
EPBD	Energy Performance of Buildings Directive
EPC	Energy performance contracting
EPS	Expanded polystyrene sintered
EU	European Union
nZEB	Nearly zero-energy building
RC	Reinforced concrete
TRC	Textile-reinforced concrete
UK	United Kingdom

What is Prefabricated Refurbishment?

Definition

Prefabricated or modular building renovation is an energy retrofit approach based on using modular mass-produced solutions. The key here is the façade, which is retrofitted with prefabricated elements for the building systems, the existing building envelope and structural improvements. The prefabricated façade modules that form a new envelope are a concept geared towards standardised apartment buildings, which represent around 40% of the EU's building stock. The prefabricated modules include all functional components (e.g. windows, ventilation, energy generation and distribution systems) and are placed on the existing building envelope, with an adaptation layer connecting new and existing façades [3]. The design of structural components (e.g. walls, roofs, floors, balconies, façades) is also produced in the factory and applied to the existing building elements. The market for prefabricated construction is relatively mature across Europe, where there are multiple examples in Ireland, the Netherlands, Italy, the UK and Scandinavia. However, the market for prefabricated renovation remains undeveloped [4].

Features and Benefits

- The time required for onsite work is reduced. Installing mass-produced modules allows projects to be completed much faster. The length of onsite construction work can be cut by 20% to 50% on average. The reduced duration of onsite work also means less disruption to residents' lives and lower labour costs (and less demand for labour in a sector where workers are increasingly hard to find and employ) [5].
- The potential for harnessing digitalisation is increased. Prefabricated renovation allows innovative technologies, such as 3D scanning and printing and simulations, to be applied, while building information modelling (BIM) and digital building logbooks enable synergy effects between the different technologies to be leveraged [5].
- Demand for building materials can be predicted. A reliable supply of materials for production facilities is crucial for keeping projects cost-effective and scaling them up. Solution providers and manufacturers need to be confident about their demand in order to ensure supply. Creating the demand for prefabricated solutions is thus key and can be achieved by long-term planning and, at the same time, involving multiple projects on a larger scale involving more than one building [5]. Examples of good practice from across Europe also show that the cost of prefabricated refurbishment reduces as market uptake and production capacity increase [4]. This has the potential to offer significant promise over the long term, because one of the main considerations when deciding in favour of or against this type of refurbishment is whether it would cost the same as traditional and well-known approaches.
- The opportunity for deep-level renovation is opened up. Prefabricated solutions enable deep levels of energy retrofit to be achieved and pave the way for nearly zero energy buildings (nZEBs) [6].
- Prefabricated refurbishment provides a route to standardisation. Standardised modules can be applied to specific building typologies, which allows larger project scopes to be organised and managed more efficiently and the overall management of renovation projects to be optimised. Manufacturers adopt corresponding design and engineering features and thus ramp up the process literally to an industrial scale, moving away from considering one individual building at a time [4].
- The increased adoption of prefabricated solutions helps to create jobs. Different estimates suggest that between ten and twelve jobs can be created for each €1 million invested, also taking into account the fact that fewer hours of labour

are needed [4]. To prevent jobs from being lost in traditional refurbishment sectors, however, it is important to provide training and other opportunities to acquire the new skills needed.

- Some projects do not require residents to move out. Depending on the overall situation and planning for the project, prefabricated renovation may allow onsite work to be carried out without having to relocate people living in the building and the disruption to their lives to be minimised. Nevertheless, some measures involving temporary relocation may have to be taken where the spaces inside apartments are being changed, communal areas redesigned or the shape of the building modified.
- Prefabricated renovation provides an additional way to stimulate renovation work at the wider levels of whole housing estates or districts. Standardisation can act as a catalyst for planning and implementing broader renovation projects and scopes.

Examples from Different National Contexts

Southern Europe

A study from **Italy** evaluated the potential of renovating buildings using a prefabricated approach. The pilot building was a reinforced concrete (RC) framed apartment block built in 1964 and located in Via Acquicella Porto in the city of Catania (see Figure 1). Applying a double-skin façade enabled **surface heating to be reduced by 66% and cooling by 25%**. Panels based on cross-laminated timber (CLT) technology were used for the outer walls and connected to RC beams by seismic energy dissipation devices. The design not only improves energy efficiency but also makes buildings more resistant to earthquakes. Two renovation solutions were applied, e-CLT and e-PANELS. The former is placed on the outer windowed walls, while the latter are new windows that replace the existing ones [7]. Thermal simulations carried out for another case study in Italy revealed that the overall **annual energy demand for heating and cooling fell by up to 56%** in standard five-storey buildings, while the largest energy savings were observed during the winter heating period on the intermediate floors. The thermal insulation that was fitted to the roof at the same time reduced energy demand by 10% [8].

Another example of using prefabricated renovation solutions is located in Cinisello Balsamo near Milan. Two prefabricated building systems – both preassembled panels – were used to retrofit a three-storey residential building constructed in 1971:

the first insulated the façade, while the second replaced the pitched roof. The materials used for the preassembled panels were textile-reinforced concrete (TRC) layers together with expanded polystyrene sintered (EPS) insulation as well as silicon and polyurethane. The combination of the two prefabricated construction systems **cut primary energy consumption for heating by 82%** [9].

In Brescia, likewise in Italy, a two-storey social housing building constructed in 1960 was renovated in an integrated manner using a CLT prefabricated exoskeleton solution. A significant reduction in primary energy demand was achieved, especially during the cold months. The heat load fell from 54 MWh to 15 MWh/year, corresponding to **energy savings of 72%**. The exoskeleton was designed to account for seismic activity in the region so as to ensure that the building could resist both moderate and stronger earthquakes [10].

In the **Croatian** capital Zagreb, a five-storey building constructed in 1961 was analysed for renovation using prefabricated panels. Two techniques were compared. Panels were filled with mineral wool and a layer of air, while the load-bearing façade panel contained reinforced concrete, mineral wool and metal flashing. Simulations applied to different renovation scenarios revealed that improved façade options would permit **reductions of more than 40%**



Figure 1. The pilot building. Source: Evola, G., Costanzo, V., Urso, A., Tardo, C., & Margani, G. (2022), "Energy performance of a prefabricated timber-based retrofit solution applied to a pilot building in Southern Europe".

in the heating load and 30% in the cooling load. The investment cost for the whole façade and windows with a panel system was estimated at €113.8 per m² [11].

In Porto in **Portugal**, energy simulations were used to analyse a three-storey building that was constructed in 1997 and is typical for the country's stock of buildings dating from 1991–2012 – 40% of multi-family dwellings in Portugal have this design. Many apartments did not have central heating,

Northern Europe

One example from **Estonia** that furnished significant insights involved the modernisation of a five-storey dormitory building (see Figure 2). The building was constructed in 1986 and is typical of mass-produced apartment buildings (series 111–121) dating from 1960–1990. The building was characterised by high energy inefficiency and energy consumption as well as poor thermal comfort. The heating system and ventilation were replaced as part of the renovation process, and the preheated air supply ducts were integrated into renovation module panels. Solar collectors and panels were installed on the roof, and a wastewater heat recovery system was installed. The prefabricated modular panels consisted of a timber frame structure filled with mineral wool. The building was originally intended to achieve nZEB status, which in Estonia is defined as a building with an Energy Performance Value (EPV) of less than 100 kWh/m², with ventilation representing a normal level of expectation for indoor climate category II (ICC II) [13]. According to subsequent studies, however, the example showed that – **nZEB renovations were still not cost-effective for building owners** in Estonia. The reduction in energy costs alone is not enough to make nZEB renovation profitable for owners. The degree of renovation that represented an optimum cost situation for owners was 120 kWh/m² of primary energy (PE), which is the requirement for low-energy apartment buildings. In other studies that considered smaller apartment buildings (with a net area < 1,000 m²), the degree of deep retrofit that represented this optimum cost situation corresponded to energy class C [14].

there was mould on the walls and windows, and the overall degree of thermal discomfort experienced by residents was high. The renovation solution simulated comprised a wooden frame, an internal/external cladding made of Coretech® sheets and a polyurethane foam filler. The use of solar power was also included. In all the renovation scenarios, **energy use could be reduced by an average of 86%.** The results showed that integrating renewable energy sources in renovation processes can reduce non-renewable primary energy use [12].



Figure 2. Overview of the pilot building (dormitory) before renovation from the outside (left) and in thermal camera images (right). Source: Pihelo, P., Kalamees, T., & Kuusk, K. (2017), “nZEB Renovation with Prefabricated Modular Panels”, in: *Energy Procedia* (vol. 132, pp. 1006–1011). Elsevier BV. <https://doi.org/10.1016/j.egypro.2017.09.708>

Another case study from Estonia relates to a five-storey panel building dating from 1986 that is representative of type series 111–121 apartment buildings constructed in the 1960s and 1970s. The building envelope was first laser-scanned to enable design work to then proceed. The building was insulated with prefabricated modular panels containing timber and mineral wool, while the roof elements were installed on the built timber frame and the ventilation was integrated into the wall module. Renewable energy integration was also part of the design, with solar panels and collectors being installed on the roof. A wastewater heat recovery system was installed for pre-heating incoming cold water. The building achieved EPC class A. The renovation took around three months, although estimates suggest that this will be reduced to no more than three weeks in future scenarios of scaled-up prefabricated refurbishments. Prefabricating the pilot building cost € 180 per m² of wall, including installation and taxes. Using simpler insulation panels would reduce the cost to an estimated €150 per m² of wall including installation and taxes [15]. It is worth noting that these prices were estimated in 2019, i.e. before annual inflation in the EU reached a record 9.2% in 2022, with the highest increases coming in housing and the cost of living [16]. The rising costs of construction materials and the impact of the energy crisis are amongst the reasons why the constructors of new residential buildings faced price rises of 11.9% in 2022 compared with 2021 levels [17].

Central and Western Europe

The prefabricated renovation landscape in Western and Central Europe is dominated by successful examples of the **Energiesprong (“energy leap”)** approach. Energiesprong is an innovative renovation concept that sets its own guidelines and standards for the serial renovation of existing residential buildings. In the **Netherlands**, where the Energiesprong method originated, it has already been used successfully to refurbish several thousand terraced houses, and the approach is also spreading to the **UK, Italy, Germany, France and Italy** [18].



Figure 3. The pilot building before and after renovation. Source: K. Kuusk, P. Pihelo, and T. Kalamees, “Renovation of apartment buildings with prefabricated modular panels”, in: E3S Web of Conferences, vol. 111, p. 03023, January 2019, doi: 10.1051/e3sconf/201911103023.

A key component of Energiesprong refurbishments is the reduction of energy consumption, the greatest potential for which lies in the area of heating energy demand. Typical multi-apartment buildings built between 1950 and the 1980s across Europe lack exterior insulation and have a heating energy demand of 100–130 kWh/m² or more a year. Renovation measures such as insulating façades, basement ceilings and roofs and replacing windows reduce heat losses and thus the heat demand to a fraction of their original amounts. These measures

are also part of Energiesprong refurbishments. After implementation, the **heating demand drops to 30–40 kWh/m²** [19]. A pilot project in Germany that saw 24 residential units built in 1957 refurbished using the Energiesprong approach demonstrated that upgrading energy class from H to A corresponds to **energy savings of 89%** [20].

A number of prefabricated solutions for single-family houses have also been researched in Central and Western Europe. For example, the simulation case study of a single-family detached house constructed in 1965 in Berlin demonstrated the application of the so-called SmartWall solution. This multifunctional wall system comprises prefabricated walls and timber-based frames as well as insulation materials, a fan coil unit and windows. The simulation showed that **primary energy could be reduced by 89% and heating demand by 77%**. SmartWall can either form an exterior façade or be used inside as a space or aesthetic element. The solution can be applied in any climate and is especially effective in those where demand for cooling is higher. SmartWall can be used as a deep renovation solution, combined with photovoltaic (PV) applications and help refurbished buildings to achieve **nZEB** status [21].

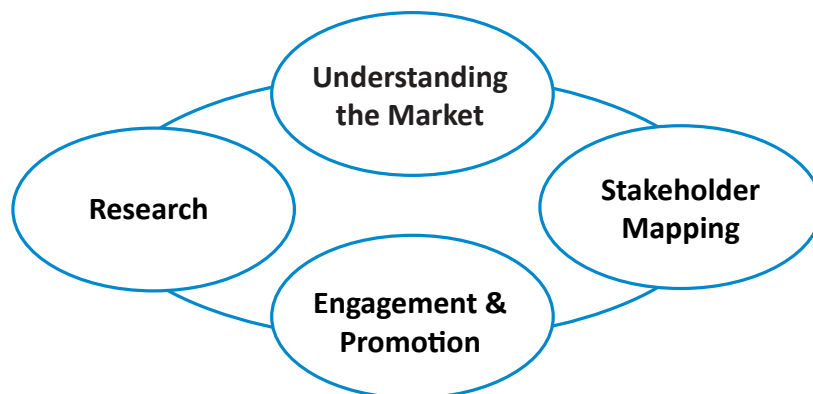
Current Barriers

Despite the manifold clear benefits that prefabricated solutions can bring, the main barrier to their wider adoption remains the aspect of cost-effectiveness, since a deep energy retrofit can be as expensive as demolition and new construction [4]. Nonetheless, it is important to bear in mind that renovation has a lower environmental impact, takes less time and makes it less likely that residents will need to move out temporarily. Some of the studies cited previously found that cost-effectiveness had not yet been achieved for deep renovations.

However, the upcoming revision of the Energy Performance of Buildings (EPBD) Directive aims to set more ambitious targets regarding building energy performance redefining the “worst-performing” building stock and related actions as

well as rescaling energy performance certificates. The policy priorities expressed by the revised EPBD will require action to be taken quickly and different renovation approaches to be mobilised in order to meet renovation targets. The cost-effectiveness of deep renovation solutions can be improved by adopting them more widely; as the numbers of and demand for deep renovations using prefabricated elements increase, costs will fall as work and processes are optimised, supply chains are developed and established more effectively and projects become scalable. Depending on national contexts, however, additional barriers might be identified in the respective legal frameworks, the availability of skilled workers, overall market trends and conditions for prefabricated materials.

How to Promote Prefabricated Refurbishment



Start with Some Research

- First of all, it will be helpful to find out if there are any tangible examples of prefabricated refurbishment in your region, city or country. This will give you an overview of the current level of awareness of such solutions. Additionally, as you will know from your everyday work, it is always easier to get a message across when using examples from your local context.
- Make yourself familiar with the legal framework and the key laws governing the construction and renovation process in your country. Keep

the perspective of prefabricated approaches in mind as you review them, as this will aid an understanding of the potential adaptability of solutions of this kind in your municipality or country.

- Pay special attention to the aspects of how the renovation decision is usually put forward and taken and of who is typically in charge of renovation processes –insights like these will help you identify your target audiences and thus tailor your communication measures.

- Look at the financial and other support available for renovation, such as grants, subsidies and capital allowances, from a prefabricated renovation perspective. Do not neglect the specific technical requirements concerning the various depths of renovation or the techniques whose use is being promoted. In some countries, prefabricated renovation approaches are already supported via dedicated subsidy and grant schemes.
- Find out how developed the local market for prefabricated modules is, who the main local players are and who might become such a player in the future.
- Draw up a list of solution suppliers that are currently active on the market. If there are no or not enough options locally, it might be a good idea to look for service providers in neighbouring or partner countries.
- When preparing the content that you intend to use for your communication measures, think first about what type of content you need to create. Assess whether all the expertise needed to produce the content is available within your team and, if not, what kind of expertise you will require in order to create and communicate content effectively.

Understand the Market and Technology Adaptation Lifecycle

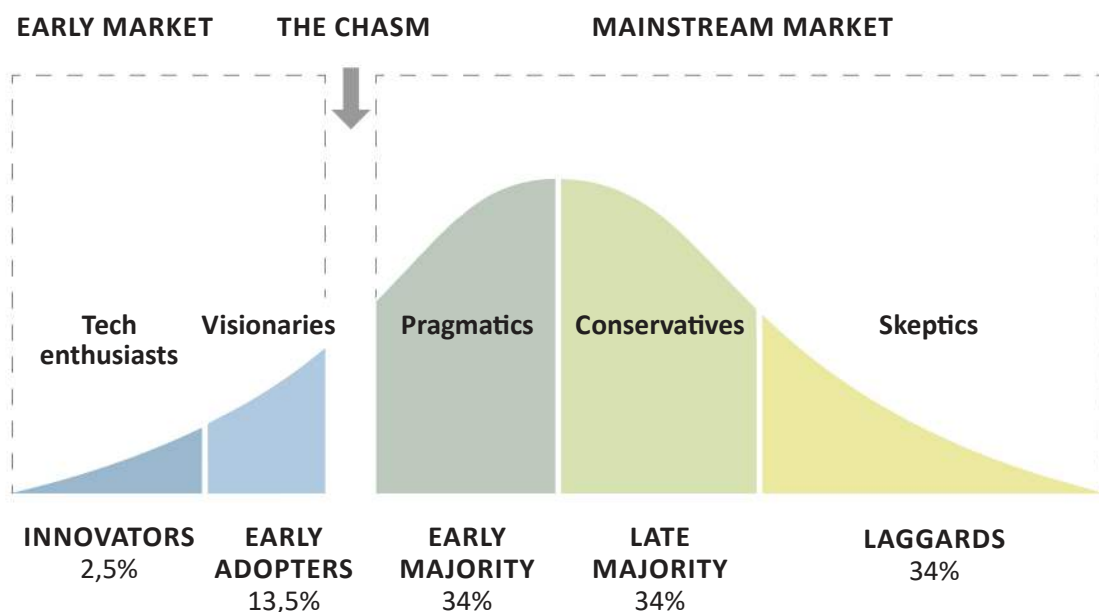


Figure 4. Technology Adaptation Lifecycle. Source: Rogers, E.M. (1962), *Diffusion of Innovations*. Free Press, New York. Image source: <https://www.business-to-you.com/crossing-the-chasm-technology-adoption-life-cycle/>

You will undoubtedly be aware that any new technology or development will not necessarily be readily taken up and adopted by the majority of the population. The technology adoption cycle [22] is one attempt to explain why innovations are not usually embraced immediately by broader customer segments.

The illustration above will help you to evaluate and identify the extent to which your country or municipality has already adopted prefabricated refurbishment. It is highly likely that any ongoing projects in your country or municipality would represent the stage of either **innovators or early adopters**, indicating that there will be individuals

willing to try the new technology at an early stage of its introduction. Once an **early majority has been achieved**, it will typically take some time for the technology to move from the early market to the mainstream market. A late majority is achieved after the technology is adopted on a wider scale and familiar to most of society. Sceptics tend to rely heavily on the opinions of friends and neighbours and are more reluctant to embrace new technologies. The chasm represents the significant gap between the early and mainstream market stages. Crossing the chasm is not easy as there is a large discrepancy between the demands of your

early adopters and the needs of the early majority; the former are willing to trial a new technology to establish the trend, while the latter need tangible results and thus confirmation that they will benefit from the new technology.

When organising communication measures relating to prefabricated refurbishment, try to make it as evidence-based as possible, building and elaborating on examples from this guide and on experience gained locally in order to tailor the communication to your different customer segments.

Do Stakeholder Mapping

Once you start communicating about prefabricated refurbishment, the key questions will be: what the possible stakeholder groups are; which services and options currently exist on the market; and, if the market is not developed yet, who might be interested in developing the networks required to scale up prefabricated refurbishment in your region

and country. For your stakeholder mapping, use the available matrices that will help you group the stakeholders. One of these is the power/influence matrix [23] shown here, in which stakeholders are placed on the chart according to the power and influence they exert on a particular issue.

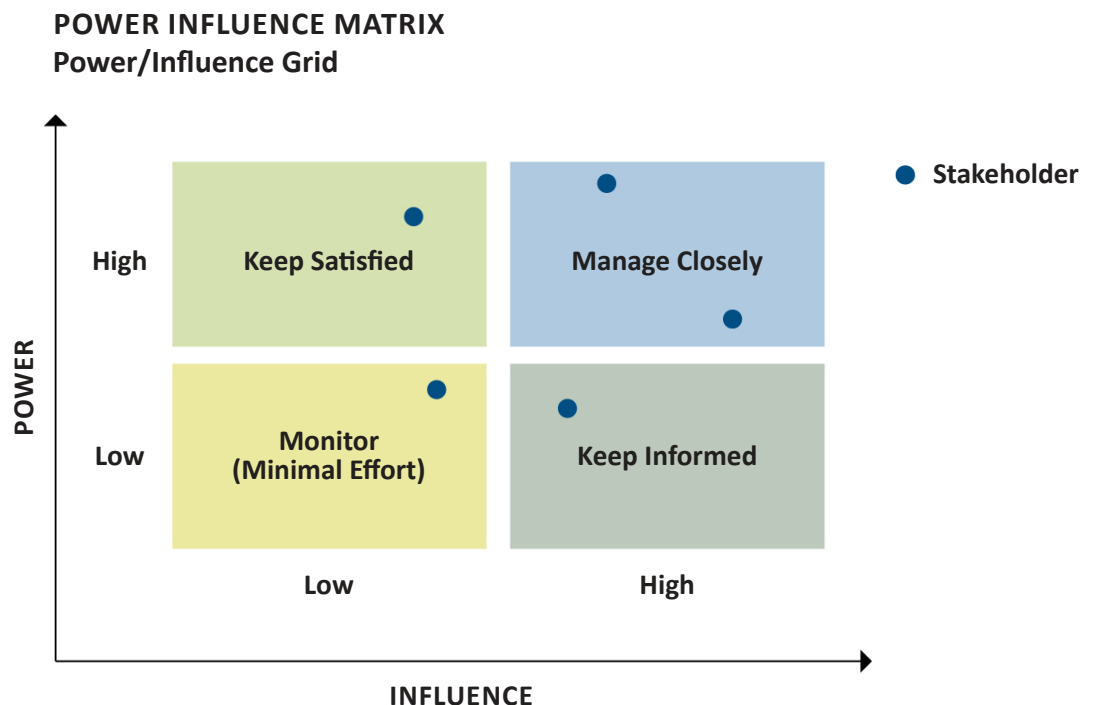


Figure 5. The power/influence matrix. Source: Mendelow, A. L. (1991), "Environmental Scanning: The Impact of the Stakeholder Concept", proceedings from the Second International Conference on Information Systems, pp. 407–418. Cambridge, MA. Image source: <https://www.sketchbubble.com/en/presentation-power-influence-matrix.html>

Another example matrix can help you classify stakeholders based on their level of support for the particular issue at stake and their influence [24].

These are only two examples of the many matrices available. Chose the one that you consider most suitable and helpful for understanding your stakeholder groups and their relationship to the issue of prefabricated refurbishment.

Finally, once you have mapped your stakeholders, you should define what their interests and requirements are with respect to prefabricated refurbishment approaches in order to help you decide on the next steps for promoting the topic. One effective way to proceed here is to create separate personas or profiles for each different kind of stakeholder [25].

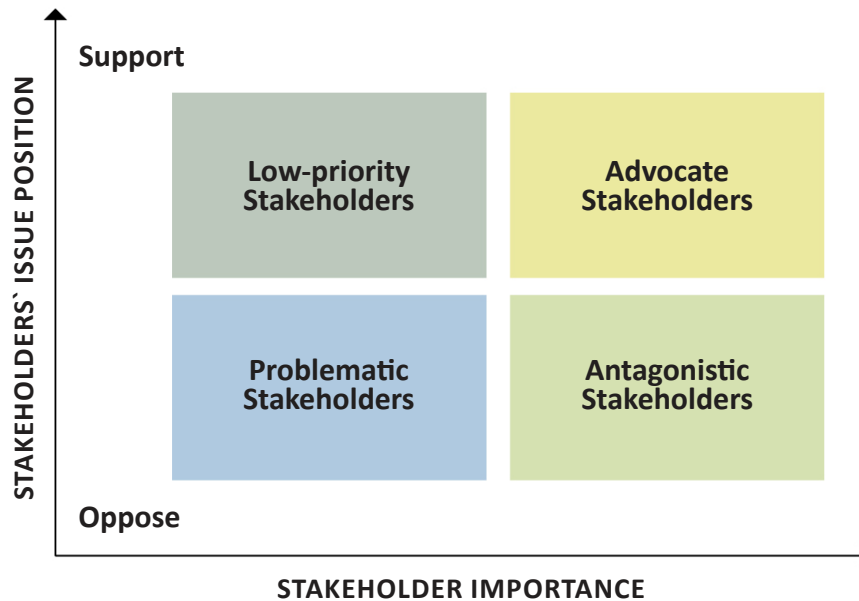


Figure 6. The stakeholder matrix. Source: Paul C. Nutt (2002), *Why Decisions Fail: Avoiding the Blunders and Traps That Lead to Debacles*, Berrett-Koehler, pp. 113 – 114, 2002.

Work on Engagement and Promotion

- Come up with a clear definition for your team and institution of what the purpose of your action is and why you are trying to reach your individual stakeholder groups. Your message will not be the same for apartment owners and policymakers; you need to be able to explain why you are addressing them and how you might best reach out to each of the groups.
- Outline the specific challenge and problem. Taking the interests of the various stakeholders into account is crucial here too. Try to frame the message in a way that shows how prefabricated renovation may solve the problem or address the

interest that the respective stakeholder group is concerned with; for example, the aspect of improved thermal comfort may be key to owner-occupiers, whilst policymakers will be concerned with finding ways to meet the targets required under the EPBD more quickly.

- Chose appropriate communication channels. This can also form part and be a result of the exercise of mapping stakeholders and creating representative personas. In any case, defining and feeding the channels that will reach your stakeholders effectively is crucial for the targeted delivery and spread of your message.

- Consider providing stakeholders with access to external sources of knowledge and thus offering them external expertise regarding the solutions that you are trying to promote. This will also help to build credibility and trust in the options that you are proposing as well as expanding networks and business connections [25].

Good Example: First prefabricated refurbishment of a panel building in Germany

Panel Building in Ludwigsfelde

Address:

Albert-Schweitzer-Straße 2-14, Ludwigsfelde

Owner:

Municipal housing company Märkische Heimat

Specifications:

- 5-storey panel building (WBS 70),
- balconies on one side, urgent need of replacement
- 85 housing units
- Average rent: 5,40€/m²
- Heating costs before refurbishment 1,12€/m², 0,77€/m² without warm water

Steps until the refurbishment started:

- **Get to know the approach:**
 - Study tour of to Estonia with board members and employees
- **Consider pros and cons for the project to make the decision**
 - Balconies need to be replaced
 - Facade needs to be refurbished
 - Change of windows not necessary but makes sense
 - No elevators needed
 - No other refurbishment measures needed
 - Economic viability only given if energy costs remain high
- **Inform the residents**
 - Big promotion event with all residents of the house
 - Constantly good information flow during the whole refurbishment process



Figure 7: Construction works at the panel building in Ludwigsfelde, Copyrights: Seeria Renova



Figure 8: Before and after an installation of a prefabricated element. Source: Seeria Renova

Refurbishment in 2024/2025

Volume: 7.637.000 Euro

Funding programme: KfW 55 Efficiency House for Renewable Energies

Interest rate: 1,66% p.a. until 2033

Repayment subsidy: 2.659.300 Euro (20% from Programme Efficiency House +15% Subsidy for prefabricated refurbishment)

Timeframe: 6 months construction time for this project as a pilot project for panel buildings in Germany

Benefits for the residents during the refurbishment process compared to traditional refurbishment approaches:

- Residents do not have to move out and are bothered in their single flats only for one or two days to customise the windows and window ledges;
- Short refurbishment time (6 months)
- Less noise on the construction site
- Smaller and cleaner construction site

The housing company states that all residents in the building itself and in the neighbouring buildings were satisfied around the whole refurbishment process. No official complaints were risen during the refurbishment process.

After refurbishment

- the heating costs decreased by up to 40 Cent/m²,
- the rent rise was cut by 2€/m² (max. 7,40€/m²)
- residents are more satisfied with the look of and the living-comfort in the building

Video about the Prefabricated Refurbishment in Ludwigsfelde



After the refurbishment project ends

This exemplary refurbishment project for a panel building of type WBS70 as a pilot project can now be repeated easily for this building type taking into account all the lessons learned during this project. This leads to a shorter preparation and planning phase, a shorter manufacturing phase of the elements and a quicker start of the works for the on-site installation.

For the refurbishment works themselves only few workers were needed on the construction site. This counters a current problem of skilled labour shortage on the one hand and enhances the scalability of this approach.

Conclusion

This guide provides an overview of the various areas of potential and benefits of prefabricated refurbishment approaches to building renovation. Examples from various national and structural contexts conditions are provided in order to demonstrate the feasibility and advantages of applying relevant methods.

The recommendations provided in the guide are intended for and designed to help municipalities, one-stop shops and other interested entities to promote prefabricated refurbishment. They include conducting initial research into the potential market readiness for and/or uptake of the new approach, identifying support options and remaining barriers, understanding and/or considering the technology adaptation lifecycle, using available matrices for stakeholder mapping, and optimising communication and promotion of the solution.

This guide can help and support your daily work and serve as a tool to complement your knowledge and expertise – with a particular focus, of course, on the issue that it is primarily concerned with: promoting and disseminating the prefabricated renovation approach for the benefit of climate action, people's quality of life and housing, and sustainable economic growth across Europe and beyond.

Bibliography

- [1] European Commission, “In focus: Energy efficiency in buildings”.
- [2] L. T., P. F., H. V. and Per Anker Jensen, “Sustainable building renovation—strategies and processes”, in: *Construction Management and Economics*, vol. 40, no. 3, pp. 157–160, Taylor & Francis, 2022.
- [3] European Commission, “Modular and industrialised solutions for building renovation”.
- [4] BPIE, *Prefabricated systems for deep energy retrofit of residential buildings*, 2016.
- [5] BPIE, *Industrial Prefabricated Solutions for Building Renovation*, 2022.
- [6] P. Pihelo, T. Kalamees and K. Kuusk, “nZEB Renovation with Prefabricated Modular Panels”, in: *Energy Procedia*, vol. 132, pp. 1006–1011, 2017, doi: <https://doi.org/10.1016/j.egypro.2017.09.708>.
- [7] G. Evola, V. Costanzo, A. Urso, C. Tardo and G. Margani, “Energy performance of a prefabricated timber-based retrofit solution applied to a pilot building in Southern Europe”, in: *Build Environ*, vol. 222, p. 109442, 2022, doi: <https://doi.org/10.1016/j.buildenv.2022.109442>.
- [8] G. Margani, C. Tardo, E. Michele and E. M. Marino, “Energy, Seismic, and Architectural Renovation of RC Framed Buildings with Prefabricated Timber Panels”, in: *Sustainability*, vol. 12, no. 12, 2020.
- [9] F. Pittau, L. E. Malighetti, G. Iannaccone and G. Masera, “Prefabrication as Large-scale Efficient Strategy for the Energy Retrofit of the Housing Stock: An Italian Case Study”, in: *Procedia Eng*, vol. 180, pp. 1160–1169, 2017, doi: <https://doi.org/10.1016/j.proeng.2017.04.276>.
- [10] J. Zanni et al., “Application of CLT prefabricated exoskeleton for an integrated renovation of existing buildings and continuous structural monitoring”, in: *Procedia Structural Integrity*, vol. 44, pp. 1164–1171, 2023, doi: <https://doi.org/10.1016/j.prostr.2023.01.150>.
- [11] M. Flegar, “Performance-based optimization potential of a widely used prefabricated building type: a case study of Zagreb”, in: *repositUM*, 2018, doi: <https://doi.org/10.34726/hss.2018.43565>.
- [12] M. Almeida, R. Barbosa and R. Malheiro, “Effect of Embodied Energy on Cost-Effectiveness of a Prefabricated Modular Solution on Renovation Scenarios in Social Housing in Porto, Portugal”, in: *Sustainability*, vol. 12, no. 4, 2020, doi: [10.3390/su12041631](https://doi.org/10.3390/su12041631).
- [13] P. Pihelo, T. Kalamees and K. Kuusk, “nZEB Renovation with Prefabricated Modular Panels”, in: *Energy Procedia*, vol. 132, pp. 1006–1011, 2017, doi: <https://doi.org/10.1016/j.egypro.2017.09.708>.
- [14] L. Pérez-Lombard, J. Ortiz and C. Pout, “A review on buildings energy consumption information”, in: *Energy Build*, vol. 40, no. 3, pp. 394–398, 2008, doi: <https://doi.org/10.1016/j.enbuild.2007.03.007>.
- [15] K. Kuusk, P. Pihelo and T. Kalamees, “Renovation of apartment buildings with prefabricated modular panels”, in: *E3S Web Conf.*, vol. 111, p. 03023, 2019, doi: [10.1051/e3sconf/201911103023](https://doi.org/10.1051/e3sconf/201911103023).

- [16] Eurostat, “Annual inflation more than tripled in the EU in 2022”.
- [17] Eurostat, “Construction producer price and construction cost indices overview”.
- [18] Energiesprong.de, “Das Energiesprong-Prinzip”. Accessed: 20 November 2023. [Online]. Available: 20/11/2023<https://www.energiesprong.de/was-ist-energiesprong/das-energiesprong-prinzip/>
- [19] M. Beckmann, “Energiesprong Betrachtung des ganzheitlichen Konzepts für serielles Sanieren unter den Rahmenbedingungen von Mehrfamilienhäusern”, 2020. Accessed: 20 November 2023. [Online]. Available: https://epb.bibl.th-koeln.de/frontdoor/deliver/index/docId/1551/file/Beckmann_Energiesprong_200527.pdf
- [20] Energiesprong.de, “90 Prozent weniger Energie: Pilotprojekt Herford macht enormen Energiespar sprung”. Accessed: 20 November 2023. [Online]. Available: <https://www.energiesprong.de/newsroom/meldungen/2022/meldungen/90-prozent-weniger-energie-pilotprojekt-herford/>
- [21] E. Katsigiannis et al., “Energy assessment of a residential building renovated with a novel prefabricated envelope integrating HVAC components”, in: IOP Conf Ser Earth Environ Sci, vol. 1078, no. 1, p. 012130, 2022, doi: 10.1088/1755-1315/1078/1/012130.
- [22] Everett M. Rogers, Diffusion of Innovations. 1962.
- [23] A. L. Mendelow, “Environmental Scanning-The Impact of the Stakeholder Concept”, in: International Conference on Interaction Sciences, 1981. [Online]. Available: <https://api.semanticscholar.org/CorpusID:8475799>
- [24] P. Nutt, “Why Decisions Fail: Avoiding the Blunders and Traps That Lead to Debacles”, in: Academy of Management Executive, vol. 17, pp. 130–132, Feb. 2003, doi: 10.5465/AME.2003.9474995.
- [25] European Commission Joint Research Centre, F. Williquet, S. Szkola, C. Catana and I. Debremaeker, The communities of practice playbook – A playbook to collectively run and develop communities of practice. Publications Office, 2021. doi: doi/10.2760/443810.

“One-Stop-Shop extended model to increase the multi-apartment building stock renovation in the Baltic Sea Region”

The project entitled “One-Stop-Shop extended model to increase the multi-apartment building stock renovation in the BSR” (RenoWave) is being implemented with support from the EU’s “Interreg Baltic Sea Region 2021–2027” funding programme. The project is developing an extended one-stop-shop model specifically designed for multi-apartment buildings in Baltic Sea Region countries. Partner countries: Sweden, Finland, Poland, Germany, Lithuania and Estonia.

For more information: www.interreg-baltic.eu/project/RenoWave

