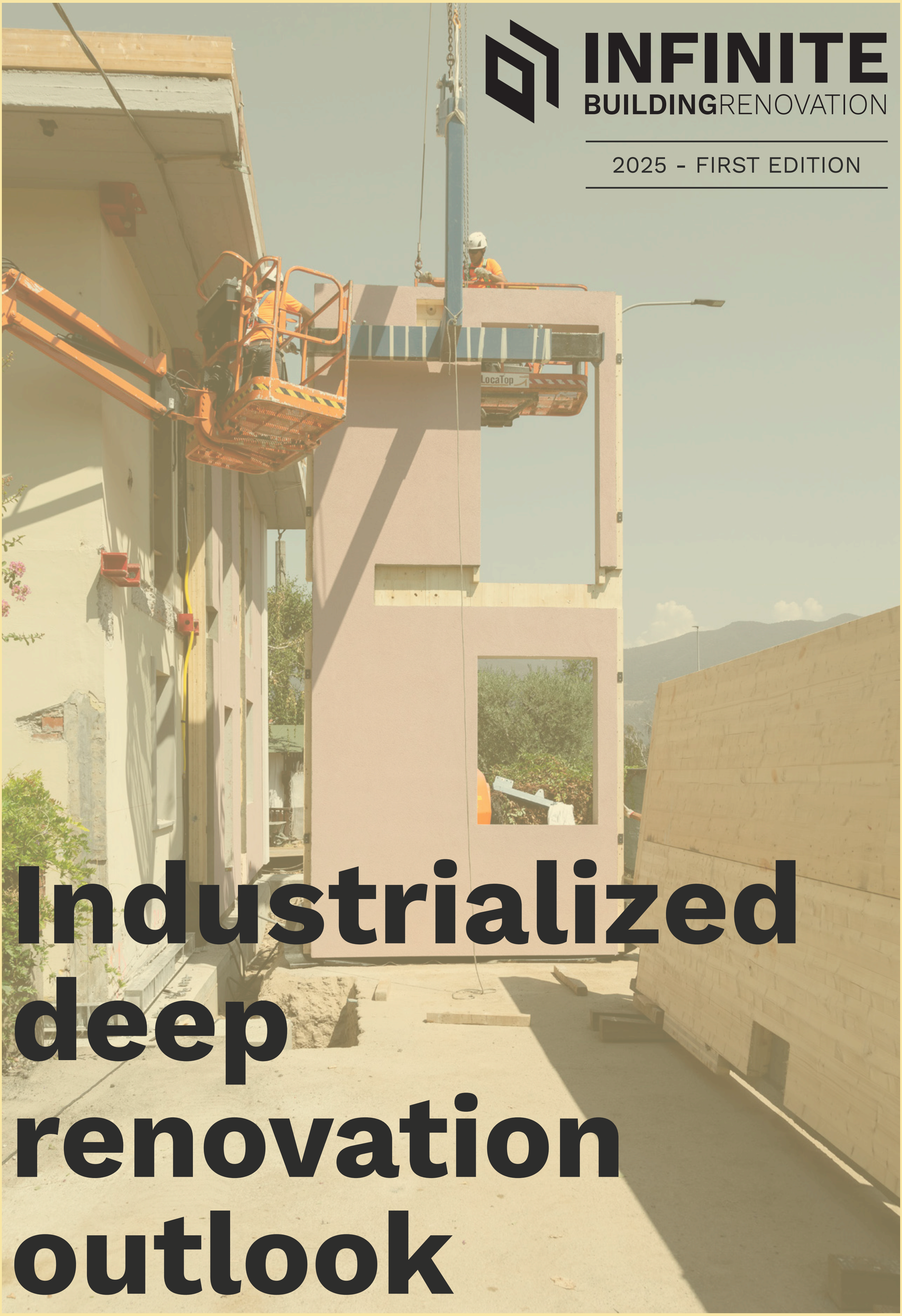

INFINITE
BUILDINGRENOVATION

2025 - FIRST EDITION

Industrialized deep renovation outlook

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Project information

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Duration: November 2020 until April 2025 (54 months)

Coordinator

Project partners

About the project

Off-site prefabrication of multifunctional envelopes has been shown to be a technically viable approach to increase rate and quality of deep renovation of residential buildings. However, several barriers are still preventing a massive adoption of prefabricated solutions.

INFINITE aims at boosting the building renovation sector through the so-called **"Renovation4.0"** approach, which leverages on both digitalisation and industrialisation to offer **tailor-made solutions** with a high level of **design freedom, decrease retrofit costs and time** thanks to the optimisation of the value-chain and **foster the adoption of eco-compatible long-lasting products and systems**.

To do so, the INFINITE Project relies on three main pillars:

1. cross-fertilisation from digitization trends in other markets (i.e. Industry4.0);
2. exploitation of industrial capabilities and coupling with LC-thinking approach;
3. experience gained from the 1st generation of multifunctional prefabricated envelopes.

INFINITE promotes a life cycle approach that allows for comprehensive design, optimisation of the O&M and depletion of end-of-life residual value.

INFINITE partners cover the whole renovation value-chain. Together, they will develop a new generation of residential building renovation products and actions centred on the all-in-one industrialised Life-Cycle-based approach. Expected outputs include:

- a set of multi-user and **multidisciplinary design tools**;
- **process-optimised all-in-one industrialised eco envelope kits**, tested on three different residential and social buildings in France, Italy and Slovenia;
- **adaptive control systems**;
- set of **demand- and industry-side matched business models** to show the Renovation4.0 market potential;
- a **structured framework of entities and knowledge** able to clearly and widely demonstrate the Renovation4.0 benefits.

INFINITE will unleash the potential of the renovation industry by increasing the market penetration of sustainable, high-quality and long-lasting building retrofitting products and methods. This will ultimately contribute to the decarbonisation of the European building stock.

Entering more into details of the **five all-in-one industrialized envelope kits**, they consist of **modular timber frames** that can be easily installed on a building's exterior to enhance energy efficiency and indoor comfort while reducing renovation time and costs. Each module **can include various technological components** contributing to meet Zero Energy Building (ZEB) targets, such as:

- Passive eco-friendly and green envelope solutions
- Energy and fresh air distribution systems
- Smart windows (smart glazing)
- Building-integrated photovoltaic (BIPV) systems
- Solar-thermal generation systems (BIST)

The design process is simplified by a **multi-user BIM platform** with plugins for LCA/LCC, energy and comfort, and O&M. This framework improves coordination among stakeholders and boosts the building's environmental and economic performance.

A **building management system (BMS)** will ensure high performance over the building's lifetime, providing performance information and serving as the central brain for the energy system, tailored to different users at both single flat and building levels.

1A 1B **PASSIVE ECO-COMPATIBLE & GREEN ENVELOPE KIT**
The INFINITE industrialized green envelope kit optimizes the manufacturing and installation of façade elements with green cladding. It includes modules for both the building façade and roof, the latter coupled with a PV system. Additional components like a grey water treatment unit and a bio-electrochemical system (BES) enhance irrigation management, reducing operational and maintenance efforts. The grey water unit recirculates rainwater, while the BES generates electricity from wastewater treatment, powering environmental sensors.

2 **ENERGY AND FRESH AIR DISTRIBUTION KIT**
This façade kit provides fresh air, heating, and cooling thanks to the integration into the façade module. It includes a new Mechanical Ventilation Unit (MVU) with heat recovery and heat exchanged, air ducts, water pipes (to be connected to a centralised heat pump), electric wires, and a sensing and control unit. The system regulates fresh air and energy distribution (air-based) automatically depending on indoor conditions and comfort target levels.

3 **SMART WINDOW KIT (SMART GLAZING)**
The smart window kit features easy-to-install adaptive glazing solutions in a smart frame, pre-installed within the wooden façade module. Options include:

- Insulated glazing with wireless sensors for dynamic sun blind control.
- Dual band electrochromic glass (plasmochromic glass) for selective solar radiation regulation.

Both options include sensors for optical, thermal, and humidity data, powered by an integrated PV module, and are controlled by a smart system for optimal energy use and comfort.

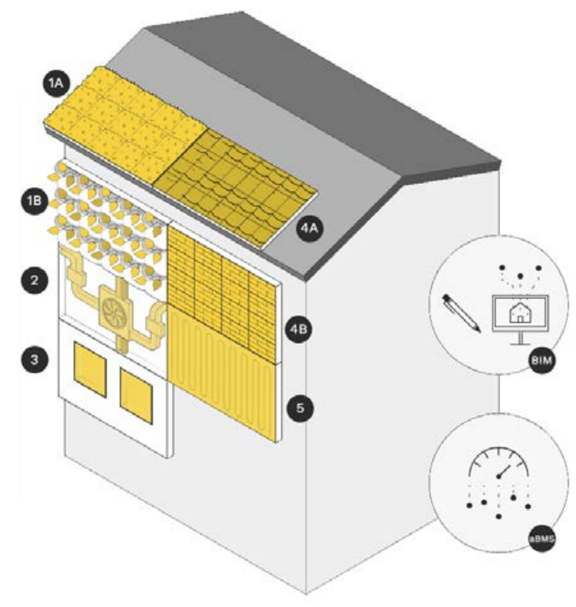
4A 4B **ENERGY GENERATION BIPV KIT**
INFINITE offers a customizable "plug & play" PV system designed to maximize energy harvesting and on-site renewable energy usage. Unlike classic solar panels, INFINITE PV panels are available in a wide range of colors and 3D textures. These panels are installed on a prefabricated wooden structure that can be placed on the façade or roof of the building. Once on-site, they only need to be fixed to the prefabricated module and plugged in, as the wooden frame already includes the supporting structure, reducing installation time and costs. The PV envelope is connected to centralized energy management hardware and software that optimize the flow between the BIPV system, energy storage, and the grid, allowing the building to meet nZEB standards.

5 **SOLAR-THERMAL GENERATION KIT (BIST)**
The INFINITE Building Integrated Solar Thermal (BIST) system consists of industrialized envelope modules containing a solar thermal collector that generates energy from solar radiation. The system is connected to a centralized heat pump and two water tanks to produce heating and domestic hot water. This solution can also act as a cooling system, where the panels are used as evaporators. The BIST system is ideal for nZEB construction projects and highly energy-efficient renovation projects. The kit includes an adaptive controller with predictive modules and mixed physics and data-based learning models to ensure optimal performance with minimal energy use.

aBMS **ADAPTABLE BMS (aBMS)**
The INFINITE renovation concept considers human-building interaction to optimize energy use and achieve near ZEB standards during operation. A distributed network of sensors integrated at dwelling and building levels, as well as in all envelope components and kits, will be connected to a Building Management System (BMS) to communicate real-time data about comfort and energy needs. This allows users to control active systems according to provided suggestions. The aBMS, with predictive modules for weather and energy usage, evaluates the best control strategies for active devices, promoting self-consumption of locally generated electricity to ensure high internal comfort with minimal energy consumption. The aBMS offers services such as customizable alerts, predictive maintenance tools, and live data visualization on comfort and energy consumption. An intelligent thermostat allows dwellers to predict their annual energy bills based on their comfort preferences. The system adapts to different user types, including facility managers, maintenance operators, and dwellers.

BIM **BIM PLATFORM (BIM)**
The INFINITE BIM platform provides a smart design environment for data exchange, essential for industrialized renovation where precise design processes are fundamental. The platform offers a decision-support tool to help users select industrialized solutions, increasing production efficiency and improving envelope and building performance. It is an adaptable and fully interoperable Common Data Environment (CDE) with dedicated interfaces and capabilities, enabling data exchange with connected tools for better coordination among users and process phases.
The INFINITE BIM platform includes the following plugins:

- LCC and LCA plugin – to optimize resources along the product life cycle, reduce negative impacts and risks, and maximize positive effects.
- Energy and comfort performance plugin – to provide designers with an optimized configuration of the all-in envelope kit, considering the interaction between energy demand, production from available renewable energy sources, and occupant comfort.
- Installation, O&M plugin – to assist installers, facility managers, and practitioners in operating correctly and timely during installation and O&M phases.



Index

THE NEED FOR A NEW APPROACH IN RENOVATION

EU GOALS AND LAWS

INTRODUCTION

Due to high levels of consumption and emissions, there are many declarations of intent that demonstrate the effort that the world, the European Union, and individual countries are putting into setting clear and increasingly stringent targets and regulations.

To lay the foundations for a global commitment, during the COP 21 held in Paris on **12 December 2015**, the first legally binding international treaty on climate change, called **The Paris Agreement** (United Nations Framework Convention on Climate Change UNFCCC, 2016), was adopted by the European Union, together with 195 other parties.

To reach its objective of keeping the global temperature increase to 1.5°C and below 2°C, the signing parties had to submit comprehensive national **climate action plans** (called National Determined Contributions - **NDCs**).

Since 2015, the number of countries mentioning actions to tackle building-related emissions in their NDC increased from 90 to 136. Also building energy codes (regulatory instruments that specify minimum energy efficiency standards for the residential and commercial stocks) raised from 60 to 80 and investments in energy efficiency continued to climb (+40%), mainly coming from

THE NEED FOR A NEW APPROACH IN RENOVATION

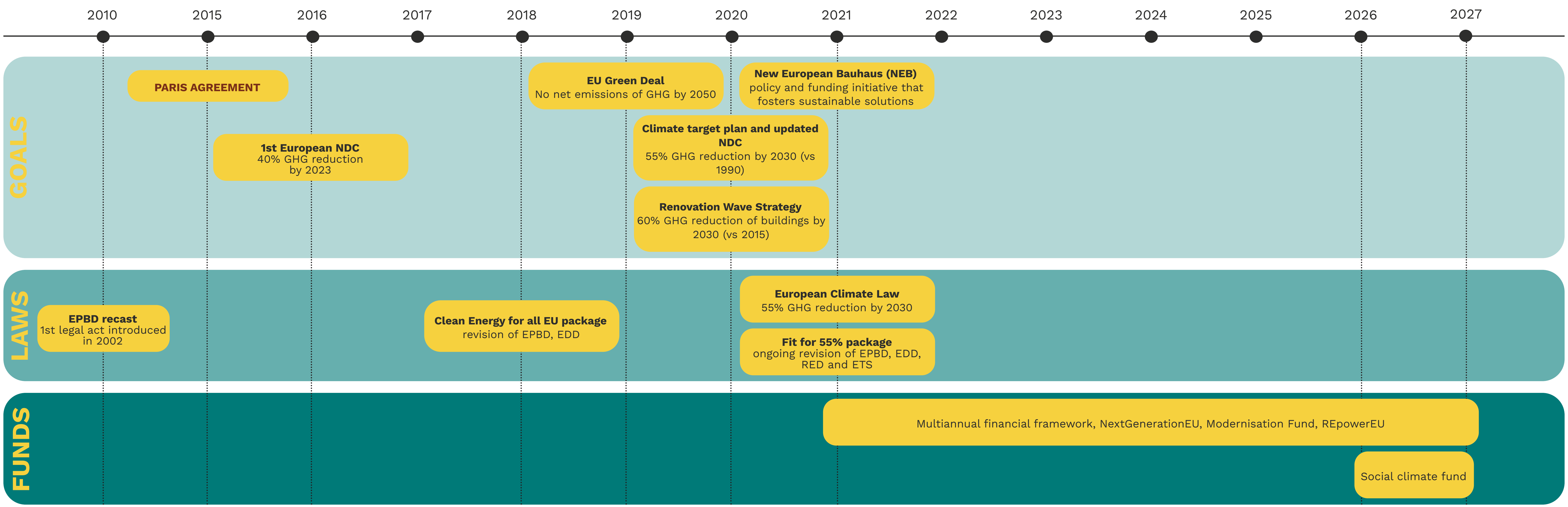
a small number of European countries.
However, the challenges are still considerable since, if the effect of the pandemic is excluded, the decarbonization level reached in 2020 is only the 40% of the reference value needed to achieve the Paris Agreement goals (United Nations Environment Programme, 2021).

A triple strategy must be adopted to drastically lower buildings emissions:

- reducing energy demand, through energy efficiency measures and behavioural changes;decarbonizing the power supply, through electrification and use of renewable sources;
- addressing embodied carbon stored in building materials, thorough the use of low-carbon solutions.

In this direction, maximizing the refurbishment of existing buildings using a sustainable and whole life-cycle approach should be a key objective of upcoming policies and incentives.

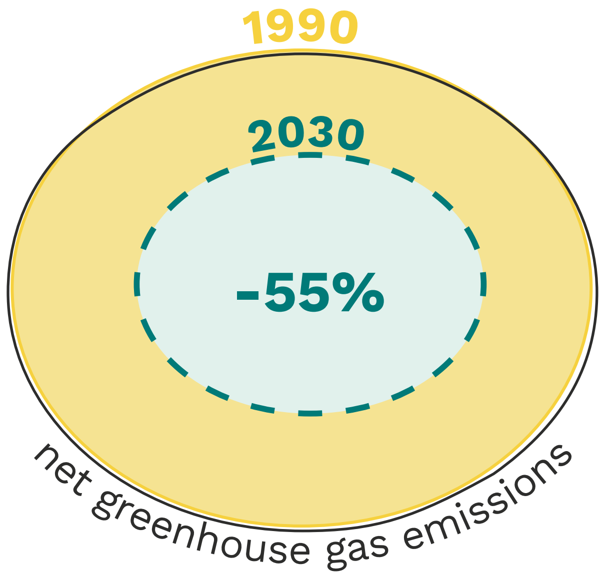
With this in mind, the European Union has enacted several measures that direct and concretize the efforts aimed at achieving the goals of the Paris Agreement. Some of these measures are described in detail on the following pages and allocated funds are dealt with in XX .



EU GOALS AND LAWS

EUROPEAN GREEN DEAL

In 2019, the European Commission unveiled a set of policy initiatives with the goal of **reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels**.



The objectives extend to many different sectors, including construction, since buildings accounted for 36% of global energy demand and 37% of energy-related CO2 emissions in 2020[1].
With regard to this sector, the Green Deal focuses attention on new construction and redevelopment interventions and specifically addresses their unsustainable methods, which involve the use of many nonrenewable resources.

Therefore, the plan promotes the use of energy-efficient construction methods such as the design of **"climate-proof" buildings**. It also provides for increased **digitalization** and the implementation of rules related to the energy performance of buildings. Another issue addressed is the renovation of **social housing** buildings: it defines interventions aimed at reducing the price of energy bills for those who have the most difficulty in meeting these costs[2].
In addition, it is intended to triple the renovation rate of all buildings in order to reduce the pollution emitted during their operational lifecycle[3].
As a consequence of the increasing environmental crisis, climate neutrality is one of the most relevant and challenging goals of the whole European Union:

reaching an **economy with net-zero[4] greenhouse gas emissions by 2050** is at the heart of the European Green Deal in line with the EU's commitment to action expressed in the Paris Agreement.

In this field, several goals, laws and funds have been issued by the European Union as chronologically summarized below.

THE FIRST CLIMATE-NEUTRAL CONTINENT
by 2050

AT LEAST 55% LESS
net greenhouse gas emissions by 2030, compared to 1990 levels

3 BILLION
additional trees to be planted in the EU by 2030

Source: official website of the European Commission

1 2021 Global Status Report for Buildings and Construcion.
2 Building and renovating, on European Commission, European Commission, December 11, 2019.
3 Frédéric Simon, The EU releases its Green Deal. Here are the key points, in Climate Home News, December 12, 2019.
4 Net-zero refers to the balance between the amount of greenhouse gas (GHG) that is produced and the amount that's removed from the atmosphere. It can be achieved through a combination of emission reduction and emission removal.

RENOVATION WAVE STRATEGY

Consistent with this aim, in **October 2020**, the Commission presented its Renovation Wave strategy[5] as part of the European Green Deal.

It contains a 2030 action plan to improve energy efficiency, boost the economy and deliver better living-standards for Europeans[6].

In more detail it sets specific goals with respect to 2015 levels, for the building sector to achieve the 55% target:

- decreasing greenhouse gas emissions by 60%,
- lowering final energy consumption by 14%
- reducing energy consumption for heating and cooling by 18%.

The strategy to be adopted follows seven key principles:
1. energy efficiency;
2. affordability;
3. decarbonisation and integration of renewables;
4. life-cycle circularity;
5. health, safety, and environmental standards;
6. green and digital transition;
7. architectural quality.

It tackles the key barriers, at every point of the value chain, proposing a list of lead actions to enable the diffusion of deep renovations on a large scale.

Overall, the need is to at least double the annual energy renovation rate of all buildings resulting in around 35 million units renovated by 2030.

What emerges is that all supply chain must be properly considered, integrated and innovated to find a feasible retrofit model and strategy.
Indeed, affordable renovations will help reducing energy bills and improving the health and wellbeing of vulnerable people, as later highlighted also in the Commission's recommendation on energy poverty, published in October 2023.

Goals and key principles of the Renovation Wave Strategy

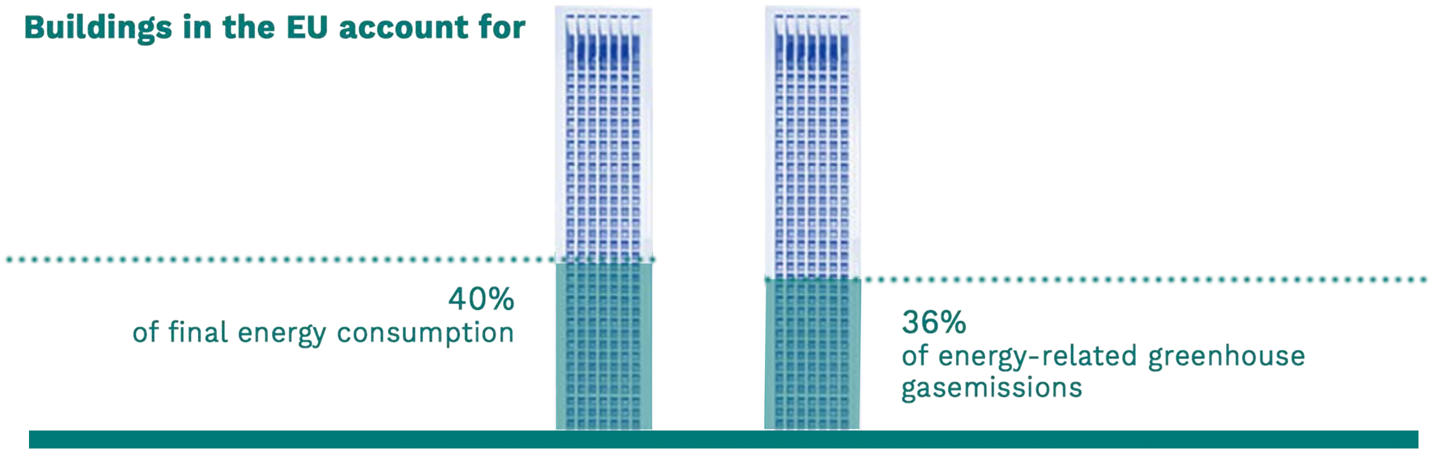
5 European Commission COM(2020) 662 final, 2020a
6 https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en, consulted on november 2024

EU GOALS AND LAWS

The "Fit for 55" package of the European Union includes significant revisions of three key directives: the Energy Performance of Buildings Directive (EPBD), the Energy Efficiency Directive (EED), and the Renewable Energy Directive (RED). These revisions are an integral part of the EU's efforts to reduce greenhouse gas emissions by 55% by 2030 compared to 1990 levels, with the goal of achieving climate neutrality by 2050. Each directive aims to improve energy efficiency, promote the use of renewable energy, and reduce energy consumption, thus contributing to the transition towards a sustainable future.

How does it contribute to the goal of climate neutrality?

Buildings in the EU account for



Huge potential for cuts

Almost 75% of existing buildings are inefficient in terms of energy and will require energy renovation on large scale

less energy used
+
more green energy
=
fewer emissions

[redacted]

EPBD

The **Energy Performance of Buildings Directive** (EPBD) was introduced in 2002 to improve energy performance in EU buildings. Revised in 2010 (Directive 2010/31/EU) and 2018 (Directive 2018/844/EU), it enhanced energy certification and promoted smart technologies and renewable energy. In 2021, the “Fit for 55” package proposed further revisions to accelerate renovations and reduce emissions. The latest revision, approved in May 2024, mandates zero-emission buildings by 2030.

The **EPBD (2002/91/EC)** is the first European legal act on energy policy in buildings, introduced in **2002.**

It laid down the foundation for the setup of **minimum energy performance standards (MEPS)** in new buildings and in existing ones undergoing major renovation and having a useful floor area over 1000 m2.
Minimum energy performance standards are the first step to limit buildings consumptions, but they do not incentivise the pursuit of high energy efficiency. For this reason, 2002 EPBD introduced the concept of **Energy Performance Certificates (EPCs)**, documents displaying the building’s energy performance through an energy class value or a continuous scale rating system.

The **2010 EPDB recast** brought in the concept of **Nearly Zero Energy Building (NZEB)** defined as “building of very high energy performance, where the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources produced on-site or nearby” (art 9).

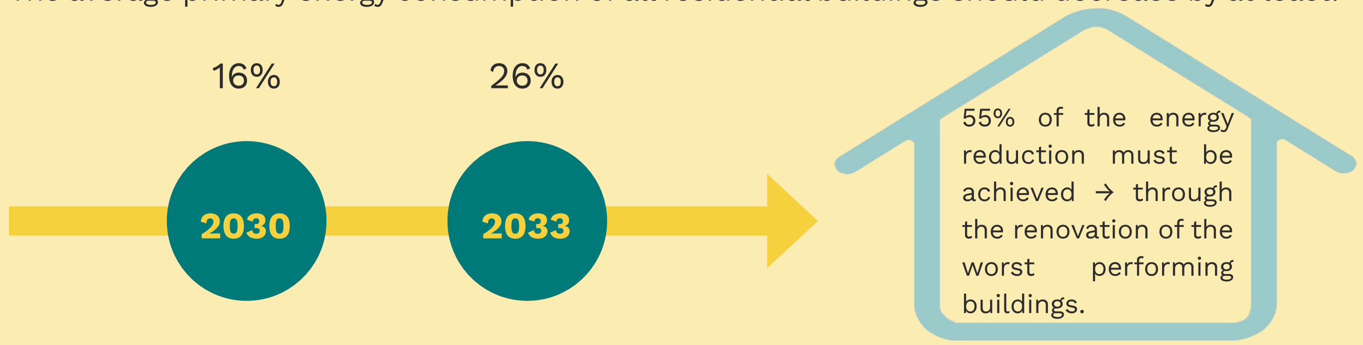
The EPDB was finally amended in **2018** to be in line with the 2030 climate goals[1]. First, it established more effective Long-term Renovation Strategies (LTRS) at national level.

The most recent LTRS starts from the NECPs 2030-roadmap to set up a long-term strategy supporting the building renovation towards a highly stock decarbonization by 2050.

In December 2021, another revision of the Energy Performance of Buildings Directive (EPBD) has started, as part of the ‘Fit for 55’ package and as needed to deliver on the Renovation Wave (European Parliament, 2022). For the first time, it mentions the concept of “(staged) deep renovation”. A new definition of “zero-emission building” is also provided (Article 2).

Member States may choose buildings to target and measures to take, providing **55 % of the energy reduction is achieved by renovating the worst performing buildings**. On minimum energy performance requirements, the law envisages that Member States renovate 16% of the worst performing non-residential buildings by 2030 and 26 % by 2033.

The average primary energy consumption of all residential buildings should decrease by at least:



1 Economidou et al., 2020

EU GOALS AND LAWS

EED

The Energy Efficiency Directive (EED) was introduced in 2012 with the goal of improving energy efficiency in the European Union.

Launched as Directive 2012/27/EU, it aimed to achieve a 20% improvement in energy efficiency by 2020, setting measures to encourage the efficient use of energy across various sectors.

The revised **Energy Efficiency Directive (EU/2023/1791)** significantly raises the EU's ambition. It establishes **"energy efficiency first" as a fundamental principle of EU energy policy**, giving it legal standing for the first time.

In practical terms, this means that energy efficiency must be considered by EU countries in all relevant policy and major investment decisions taken in the energy and non-energy sectors.

The 2023 revision of the directive follows a proposal for a recast directive on energy efficiency put forward by the Commission in July 2021, as part of the EU Green Deal package.
The 2021 proposal was further enhanced as part of the REPowerEU plan, presented by the Commission in May 2022, aiming to decrease the EU's dependency on fossil fuel imports from Russia.

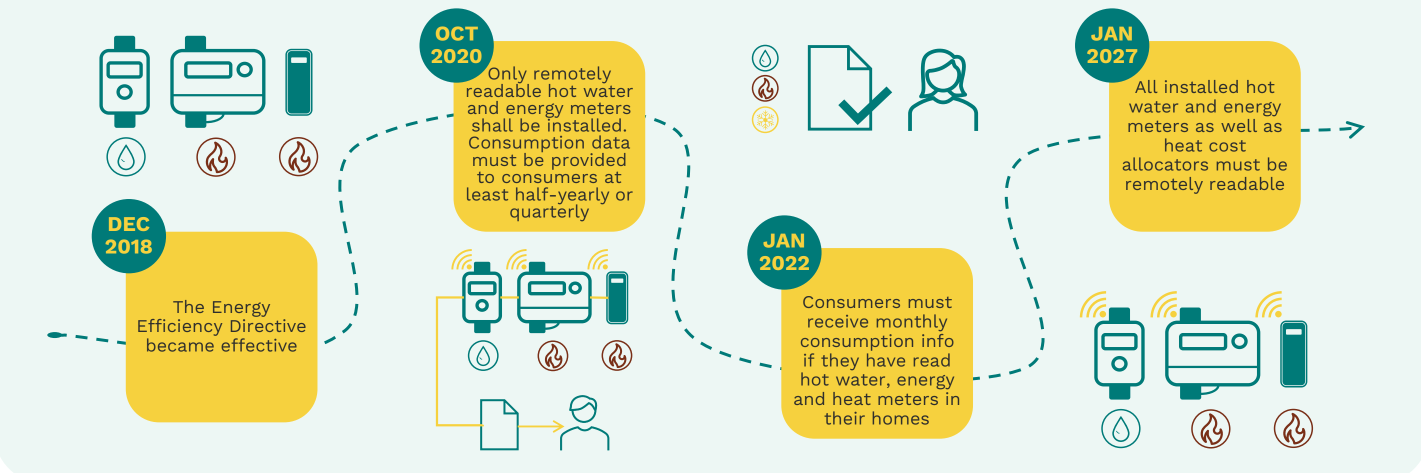
Full implementation of the Energy Efficiency Directive will be key for the EU to comply with the commitment of the Global Pledge to **double the global rate of energy efficiency improvements** from about 2% to over 4% by 2030.

The core of EED encompasses:

- the increase of EU energy efficiency target, by ensuring an additional 11.7% reduction in energy consumption by 2030, compared to the EU reference scenario 2020;
- the reduction of the total energy consumption of public bodies by 1.9% each year;
- the renovation of 3% of public buildings each year to NZEB or ZEB level

The revised directive was published in the EU Official Journal and entered into force on 10 October 2023.

ROADMAP ENERGY EFFICIENCY DIRECTIVE (EED)



RED

The **Renewable Energy Directive** (RED) constitutes the **legal framework** for the development of clean energy in all sectors of the EU economy, with the objective of fostering cooperation between EU countries to achieve this goal.
The RED establishes a binding target of at least **42.5% of energy from renewable sources by 2030**, with the aim of reaching **45%**[2]. This revision was deemed necessary to accelerate the EU's transition to clean energy, reduce greenhouse gas emissions and decrease dependence on fossil fuels, especially in light of the energy security concerns highlighted by the REPowerEU plan and the European Green Deal[3].

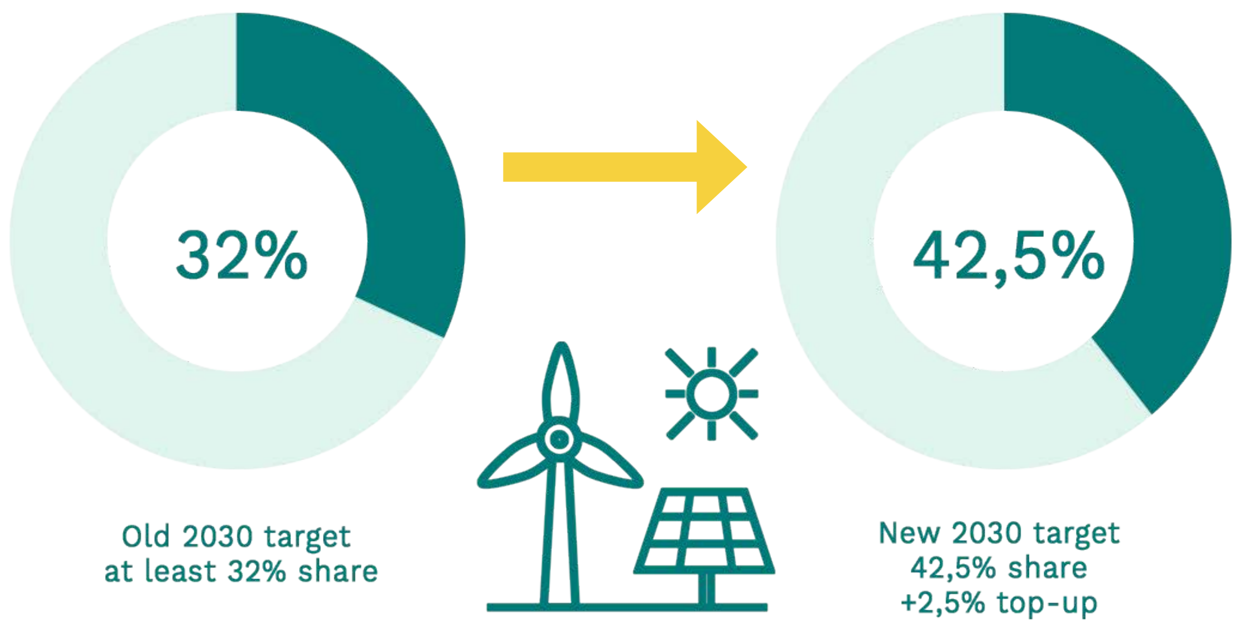
The amending Directive **EU/2023/2413** entered into force on **20 November 2023**. A **18-month period** has been designated for the transposition of the majority of the Directive's provisions into national law, with a more constrained deadline of **July 2024** for certain provisions pertaining to the authorisation of renewable energy.

The legislative structure is intended to promote the development of clean energy across the EU economy. The transposition of the **11/2023 amendment** to the RED into national law is also a requisite component of this process.

This transposition requires Member States to adopt specific measures to facilitate the authorisation and implementation of renewable energy projects, minimizing bureaucratic obstacles and accelerating approval times.

Additionally, the directive encourages cross-border cooperation among Member States, promoting joint projects and the exchange of best practices. This collaborative approach is essential to achieving the EU's ambitious renewable energy targets and ensuring a fair and sustainable energy transition for all European citizens.

A more ambitious EU target for 2030



2 https://eur-lex.europa.eu/eli/dir/2023/2413/oj/eng
3 https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en

EU GOALS AND LAWS

NEW EUROPEAN BAUHAUS

Beside the three main directives that set clear targets for national laws, the European Commission put in place also a broader initiative: the **New European Bauhaus (NEB)**.

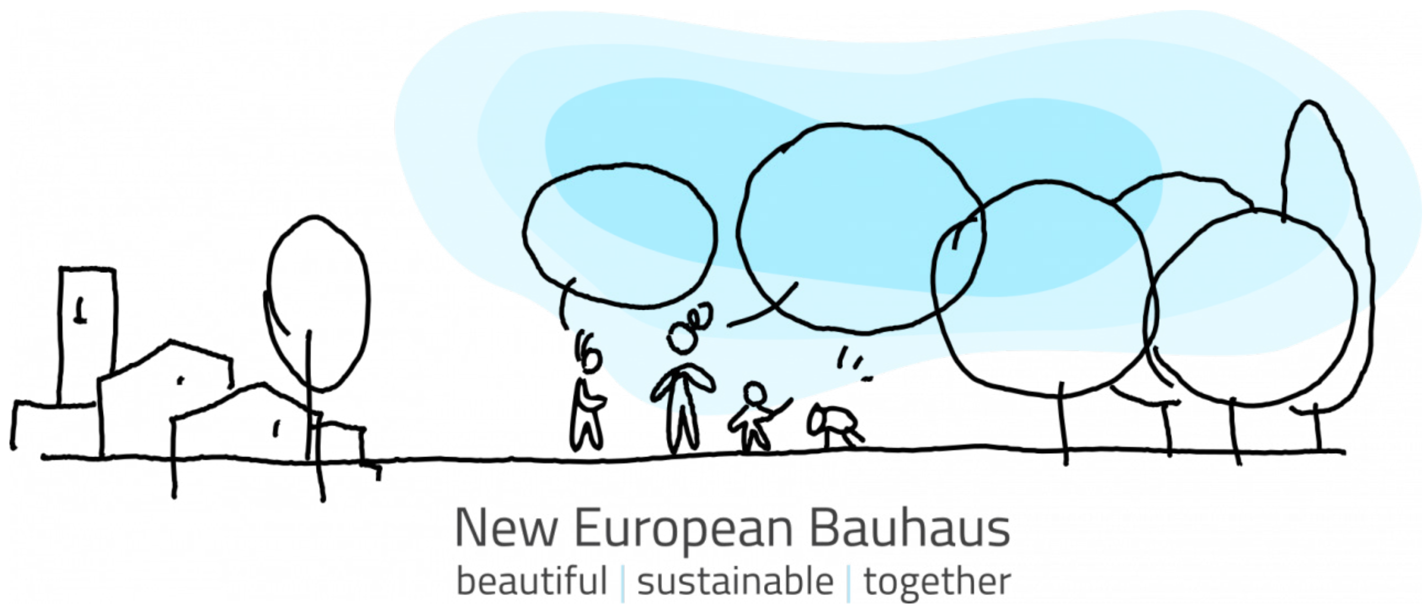
It is a creative and interdisciplinary initiative that connects the European Green Deal to our daily lives and living spaces. It calls on all Europeans to imagine and **build together a sustainable and inclusive future** that is beautiful for our eyes, minds, and souls.

The New European Bauhaus was launched in 2021 to promote sustainable, inclusive, and aesthetically pleasing solutions to transform the built environment and living patterns, aligning with the ecological transition. The goal is to create livable spaces that respect the diversity of places, traditions, and cultures in Europe and beyond.

The initiative involves people at the grassroots level, focusing on neighborhoods and providing tools and guidelines for tailored solutions to different communities. The NEB encourages the participation of citizens, experts, businesses, and institutions to imagine and build a sustainable and inclusive future that is **beautiful for the eyes, mind, and soul**.

Since 2021, the NEB has sparked a wave of creativity across the European Union, with projects aimed at improving the sustainability, inclusivity, and aesthetics of urban spaces. The European Commission has also presented investment guidelines to align projects with the NEB's transformative vision and has launched the NEB Academy to promote new skills and training in the sustainable construction sector.

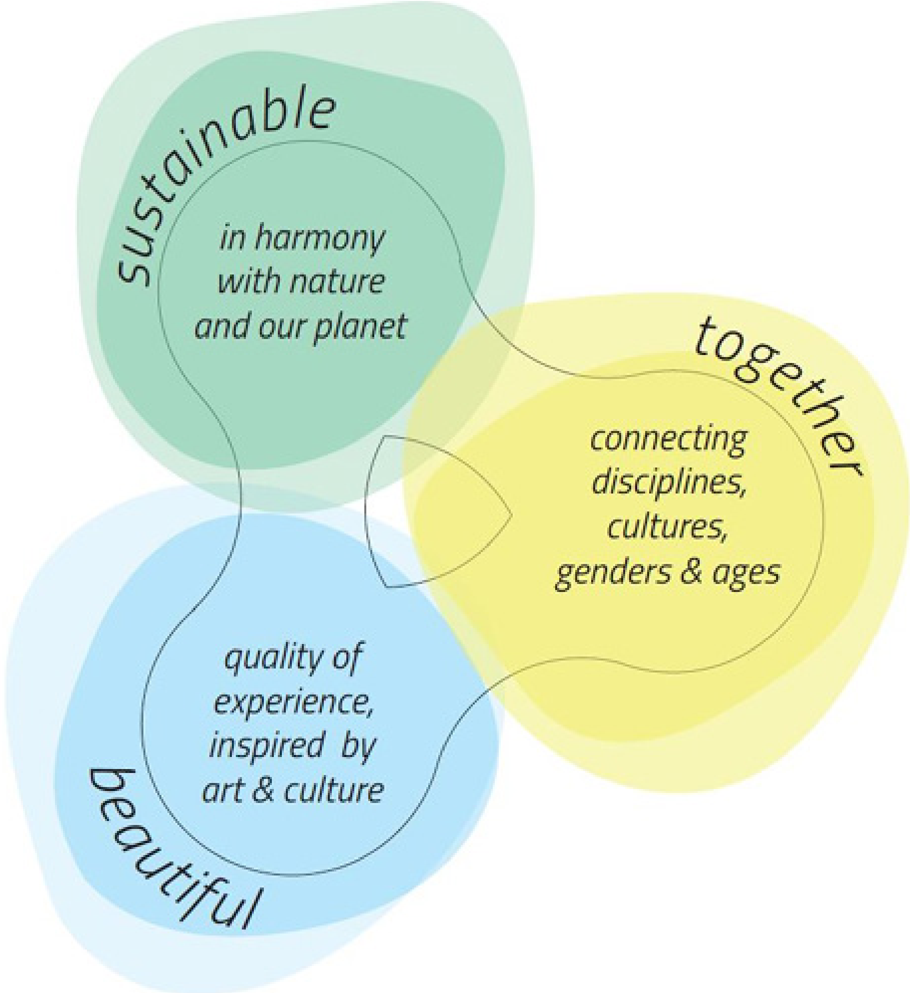
Moreover, in 2024, the European Commission introduced the **NEB Investment Guidelines** to help investors align projects with the NEB's transformative vision. The Commission also launched the **NEB Academy**, an initiative to promote new skills and training in the sustainable construction sector. The second edition of the **New European Bauhaus Festival** took place in 2024, showcasing innovative projects and recognizing outstanding contributions.



https://new-european-bauhaus.europa.eu/about/about-initiative_en

NEW EUROPEAN BAUHAUS'S KEY-TOPICS

- It is a **bridge** between the world of science and technology, art and culture.
- It is about **leveraging** our green and digital challenges to transform our lives for the better.
- It is an **invitation** to address complex societal problems together through co-creation.
- It facilitates and steer the transformation of our societies along three inseparable values:
  - **sustainability**, from climate goals to circularity, zero pollution, and biodiversity
  - **aesthetics**, quality of experience and style beyond functionality
  - **inclusion**, from valuing diversity to securing accessibility and affordability



https://new-european-bauhaus.europa.eu/about/about-initiative_en

CURRENT EU CHALLENGES

ENVIRONMENTAL CHALLENGE

Across the EU, there are **12 million non-residential buildings and 119 million residential buildings**, of which 42% are apartments, 34% detached dwellings, and 24% semi-detached dwellings, mostly located in urban centers (43%). Around **48 million buildings**, representing 40%, **were built pre-1970**, before the widespread introduction of building codes and energy efficiency measures. It is also estimated that **35% of the whole stock has an EPC rating between D and G**[1], with around 30 million building units representing the 15% worst-performing ones across all Member States.

These data suggest that residential buildings still significantly contribute to the overall energy demand.

Indeed, they account for around **28%**, being as energy-demanding **as transport and more than industry** (26%)[2].
Housing is far from reaching 210 Mtoe, which corresponds to a 14% reduction in its final consumption, as stated in the Renovation Wave.

Efforts in energy efficiency and deep renovation are needed to achieve a **decrease of 2% per year** towards the 2030 objectives.

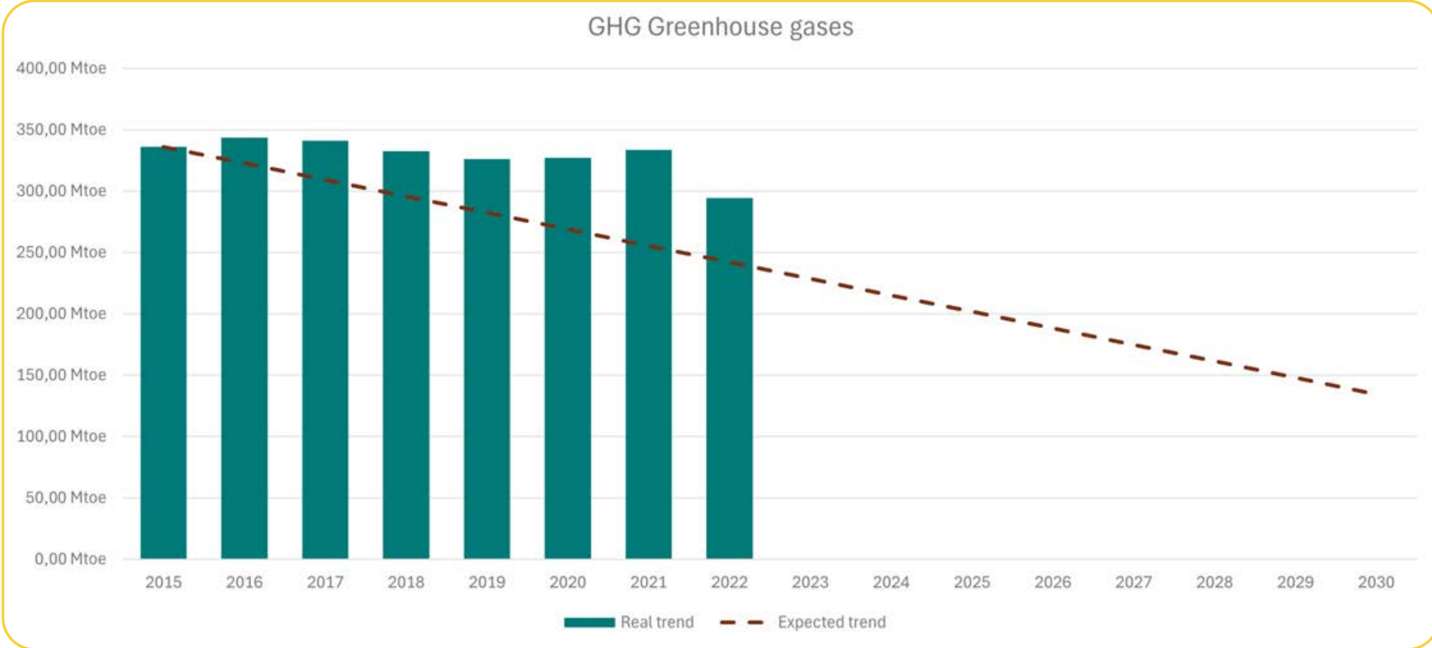
For the residential category, the above-mentioned 28% EU share, which corresponds to about 248 Mtoe of final energy consumed, employs several types of fuel for different household end-uses.

Share of fuels in the final energy consumption of the residential sector by type of end-use,EU, 2020. Adapted from: (Eurostat,2022).

Type of end-use ⇨ / Fuel type ⇩	ENERGY USE	Space Heating	Space Cooling	Water Heating	Cooking	Light and appliances	Other and uses
		62,80%	0,40%	15,10%	6,10%	14,50%	1%
Solid fossil fuels	2,8%	91,0%	0,0%	7,8%	1,1%	0,0%	0,0%
Derived heat	8,2%	77,0%	0,0%	2300,0%	0,0%	0,0%	0,0%
Oil and petroleum products	12,3%	78,2%	0,0%	14,6%	6,5%	0,0%	0,7%
Renewables and biofuels	20,3%	87,9%	0,0%	10,3%	1,2%	0,0%	0,7%
Electricity	24,7%	13,1%	1,5%	12,0%	12,5%	57,9%	3,0%
Natural gas	31,7%	74,6%	0,0%	19,3%	6,1%	0,0%	0,0%

1 Eurostat - Building Statistics
2 Eurostat - Energy Consumption

THE NEED FOR A NEW APPROACH IN RENOVATION



EU Commission, DG Energy, Unit A4

Overall, space heating is the end-use that requires the most energy (above 60%) and uses the highest share (around 75%) of natural gas, which is the most consumed non-renewable fuel.

This is why the **RED directive** set an ambitious **target of a 49% share of RES in the heating and cooling of buildings by 2030**. It is followed by both domestic hot water and lighting/appliances (15% each). On the contrary, space cooling doesn't reach 1% since it's needed only in a few countries located in the south of Europe.
The high share of renewables (20%), especially for heating systems, **shows a positive trend towards 2030 objectives**.

Indeed, in the EU, 39% of electricity generation comes from renewables and biofuels[3].
Transposing the proportion to the residential sector, the renewable share would reasonably increase by 10% (being the 39% of 24.7%), to reach 30%.
It clearly emerges the need to drastically reduce the operational energy demand of the whole building sector by improving the performance of both the envelope and the technical systems, with particular attention to heating and cooling (due to the -18% target set by the Renovation Wave).

Indeed, **to meet the Renovation Wave goal** of decreasing greenhouse gas emissions by 60% with respect to 2015 levels, housing must reduce building-level releases by around 20 Mt CO2 per year[4].

This implies a yearly rate of 6.5%, which is possible only by combining energy efficiency measures and the implementation of renewable sources to cover the remaining needs.

3 European Commission - Renewable Energy Targets
4 European Commission - Renovation Wave

CURRENT EU CHALLENGES

SOCIAL CHALLENGE

High energy consumption in buildings leads not only to unsustainable CO_2 emissions but also to unbearable energy bills, a phenomenon known as **energy poverty**. According to the European Energy Poverty Observatory (EPOV), energy poverty happens when energy bills form a significant portion of consumers' income, affecting their ability to cover other expenses. It can also occur when consumers are forced to reduce their energy consumption, impacting their physical and mental health.

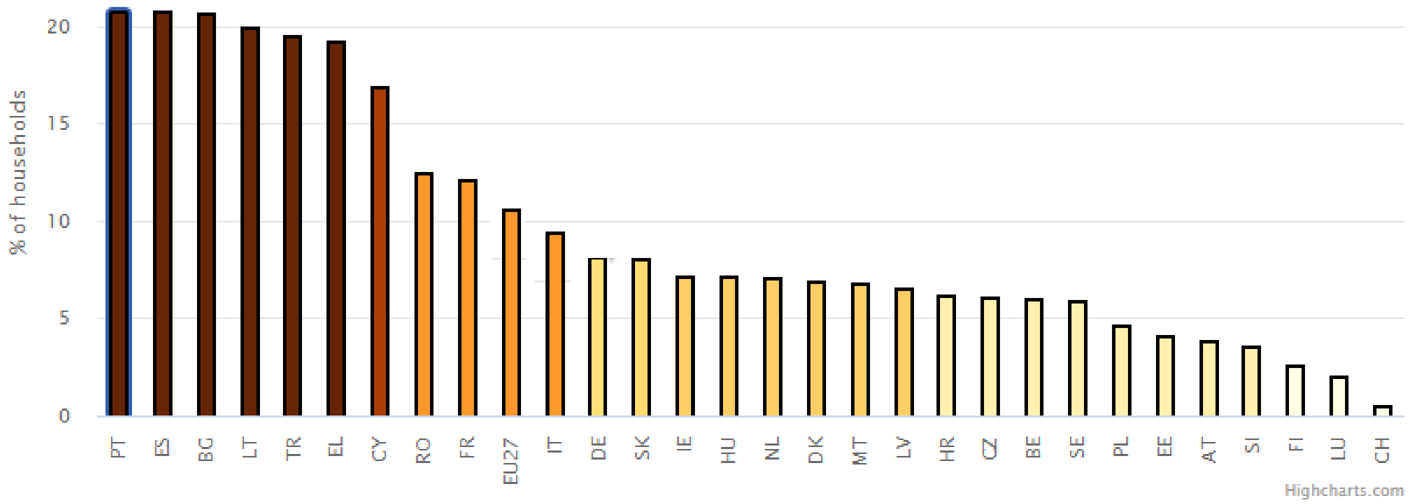
A legislative definition was introduced for the first time in the 2021 EED recast proposal, defining energy poverty as a household's lack of access to essential energy services needed for a decent standard of living and health.

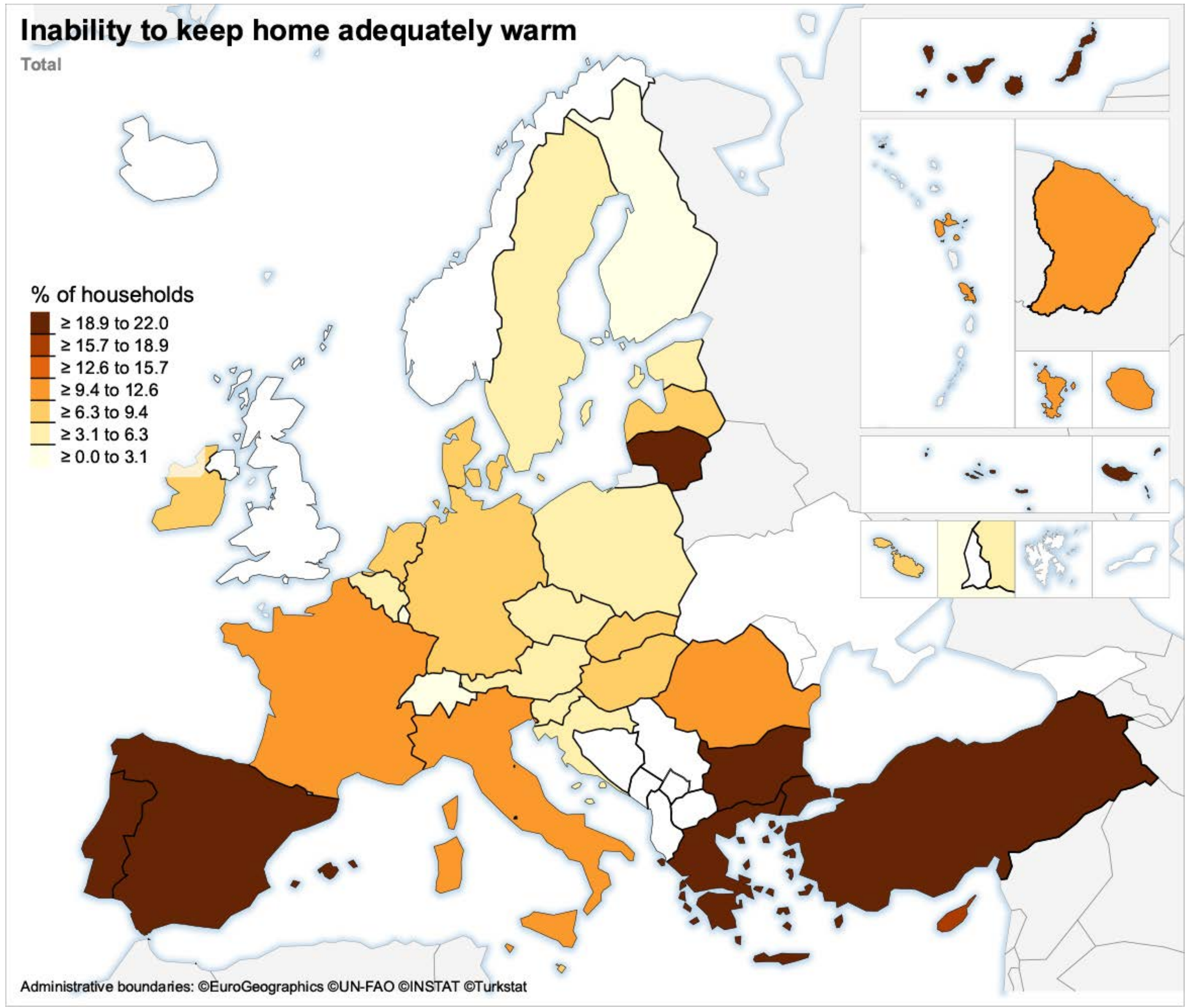
Energy poverty is a multi-dimensional issue caused by a combination of low income, high energy expenses, and poor energy efficiency in buildings. Various EU initiatives and laws address this issue within the framework of climate policies, such as the Renovation Wave, EED, EPBD, REpowerEU, and the Social Climate Fund, aiming to ensure a fair transition.
Data collection and monitoring are essential to understand the full extent of the problem and to implement effective policies. Given its complexity, energy poverty cannot be easily measured by a single indicator, necessitating the use of multiple parameters(high share of energy expenditure in income, low share of energy expenditure, inability to keep home adequately warm, and arrears on utility bills).

Eurostat data shows that In 2022, 9.3% of the EU population declared that they were not able to keep their home adequately warm. Compared with 2021, this share increased by 2.4 percentage points (pp).

The situation varied across the EU countries. The highest shares of people unable to keep their home adequately warm were registered.
Additionally, 6.5% of the EU population had arrears on their utility bills, indicating financial difficulties.

Such pheonomenon got worst with the energy crisis, exacerbated by post-pandemic economic recovery and the war in Ukraine, which led to unprecedented levels of gas and electricity bills in 2022. Energy poverty affects health, well-being, social inclusion, and quality of life. Long-term strategies and structural measures are necessary to mitigate these effects and ensure a fair transition for all.





CURRENT EU CHALLENGES

ECONOMIC CHALLENGE

In the construction sector, economic stagnation persists due to several factors: undercapitalization, horizontal and vertical fragmentation of the supply chain and low levels of profitability.

The sector is seeing declining labor market resilience and for three main reasons:

1. Aging of the workforce (soon more than 20% of the industry's workforce will be over 55 years old, while in 2030 the over-55 workforce will exceed 25%);

2. Lack of skills and training;

3. Low investment in innovation and digitalization.

The construction sector's productivity is generally lower compared to other sectors in the European economy. In 2021, the apparent labor productivity in the building construction sector in the EU was €47,500 per person employed, lower than the average for the non-financial business economy of €60,200 per person employed[1]. The labor productivity ratio adjusted for wages in the building construction sector was 138.0%, below the average for the non-financial business economy (154.4%) but above the average for the construction sector (119.9%). In 2022, productivity in the construction sector increased by 9.2%, surpassing the overall increase of 2.8%, with manufacturing productivity remaining relatively stable at 0.2%[2].

As for the 19 countries analyzed by the institutes of the Euroconstruct network (Cresme for Italy), the forecast is that nonresidential construction will stagnate until 2024 and then resume growth[3]. Residential construction, on the other hand, will lose some of its market volume until 2024 and grow at a modest pace in the following years[4]. By 2025, housing construction is expected to fall to its lowest level since 2016[5]. Of the 19 countries under review, 17 are part of the Union. They are joined by Norway and Switzerland[1].

The reasons for this 'slowdown' are known:

- strong rise in interest rates and construction prices;
- persistently high inflation;
- loss of household purchasing power;
- weaker economic growth;
- tight government budgets;
- drop in real estate prices.

In addition, current real estate investment returns are hampering growth, as is the growing uncertainty in the commercial real estate sector[6].

In 2023, non-residential construction in the EU grew by 1.5% but is expected to register very weak growth in 2024 (+0.3%)[7]. Residential construction is projected to decline by 5.7% in 2024, following a decline of 2.6% in 2023[8]. The construction sector in the EU is expected to contract by 2.3% in 2024. However, **some countries** like Greece and Lithuania **have shown significant growth in their construction sectors due to specific national recovery plans**.

1 https://ec.europa.eu/eurostat/statistics-explained/index.php?oldid=327480
2 https://www.euroconstruct.org/news/2023_06_it/
3 https://fiec-statistical-report.eu/european-union
4 https://www.fiec.eu/library/publications/statistical-report
5 https://think.ing.com/articles/eu-construction-sector-faces-year-of-decline-but-green-shoots-appear/
6 https://fiec-statistical-report.eu/
7 https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/economic-forecasts/autumn-2024-economic-forecast-gradual-rebound-adverse-environment_en
8 https://www.property-forum.eu/news/europes-construction-sector-on-recovery-path-in-2025/19282

THE NEED FOR A NEW APPROACH IN RENOVATION

INDUSTRIALIZATION FOR RENOVATION

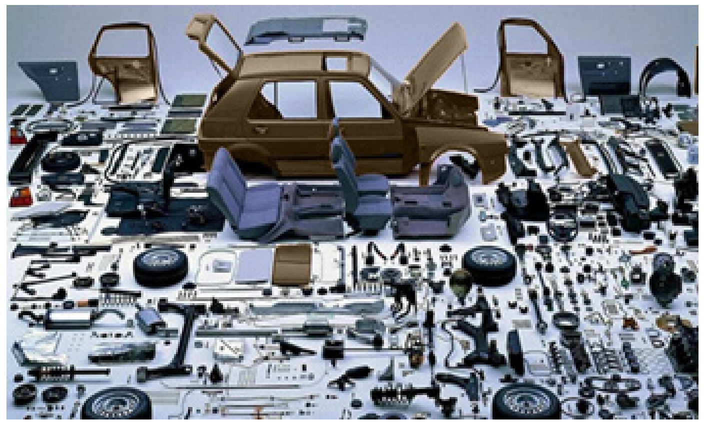
Given the numerous challenges that the construction sector is facing and the urgent climate targets imposed by EU legislation, a new paradigm is needed.
Industrialization has been an ideal but elusive goal for at least a century, doggedly pursued by generations of designers and builders. Beginning in the early twentieth century with the Modern Movement, there was an early attempt to industrialize building processes, inspired by developments in several other economic sectors. This effort continued through the Second World War, which brought a massive housing emergency and an urgent need to develop solutions as quickly as possible.

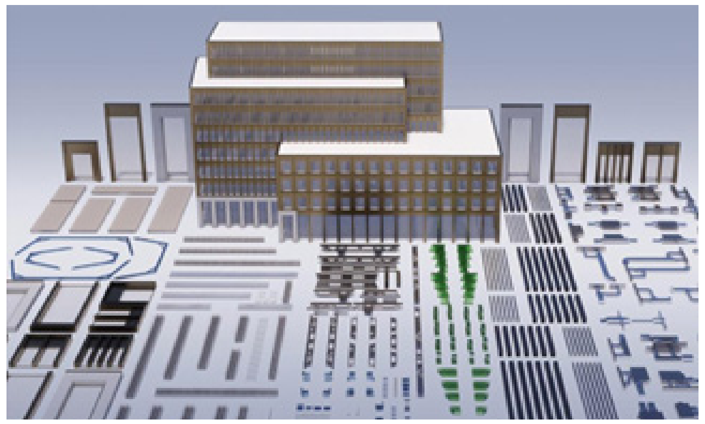
This urgency led to the implementation of prefabrication and modular building systems for the construction of large-scale complexes. These systems still make up much of the housing stock in the suburbs of Germany, France, and the Netherlands, based on heavy prefabrication of reinforced concrete load-bearing panels. While these solutions were low-cost, they offered limited architectural flexibility, leading to a lack of diversity in suburban neighborhoods.

Unfortunately, industrialized building systems failed to establish themselves even after this acceleration in the construction industry. In most cases, in-situ or so-called "wet" solutions are still used, which involve traditional on-site construction methods.

In the last two decades, industries have been trying to revive and propose "dry" prefabricated solutions, with high-performance layered systems based on lightweight technologies such as wood or metal. Moreover, thanks to the ever-increasing development of digitized technologies to control production processes and the use of increasingly customizable systems, it is now possible to offer "mass customization solutions" that are industrialized but also highly personalized. This facilitates the creation of products that are finely fabricated off-site and transportable, with a high level of product completeness, directly to the construction site for assembly. Nowadays, technology and digitization serve architecture, rather than the other way around, as was the case in the past.

This shift towards industrialized and digitized construction methods not only addresses the need for efficiency and cost-effectiveness but also aligns with the sustainability goals set by the EU. By embracing these modern techniques, the construction industry can significantly reduce its environmental impact, enhance the quality and durability of buildings, and meet the growing demand for sustainable and resilient infrastructure.





Source: Bryden Wood

WHAT IS IDR?

DEFINITION OF IDR

WHAT'S THE MEANING OF DEEP?

As emerged from the European Renovation Wave strategy and legislation, deep renovation is a policy goal of the EU and its Member States. Currently, the renovation rate for deep interventions is only around 0.2%,[1] while the annual weighted renovation rate (including light, medium, and deep ones) reaches 1.0%[2]. So far, only about 12% of the residential building stock has been renovated to meet the targets[3]. To achieve climate neutrality by 2050, the renovation rate should increase to 3%, with deep retrofits accounting for 70% of the total[4].

The **Global Buildings Performance Network (GBPN)** followed a tiered research approach to clarify and harmonize the concept of deep renovation (GBPN, 2013). According to the results of the GBPN process, the following conclusions have been drawn:

- Targets for deep renovation should be set in both relative and absolute terms. However, they require further specifications on the building type, the energy class, and the location. Indeed, relative targets depend on the initial building's condition and age, while the absolute ones should vary according to the climate zone.
- CO2 emissions reduction targets can be omitted even if they're the final objective since they are strictly linked to the decrease in the energy consumed by the building stock.
- Primary and final energy targets should be specified to encourage savings in both energy generation and building operations. Priority is given to a clear primary savings goal because it's directly linked to the total emissions.
- In the European Union, the most widely accepted and validated definition of deep renovation sets energy reductions at 75% or more compared to the status of the existing building before the retrofit[5]. Primary energy consumption after renovation should be less than 60 kWh/m^2/year[6].

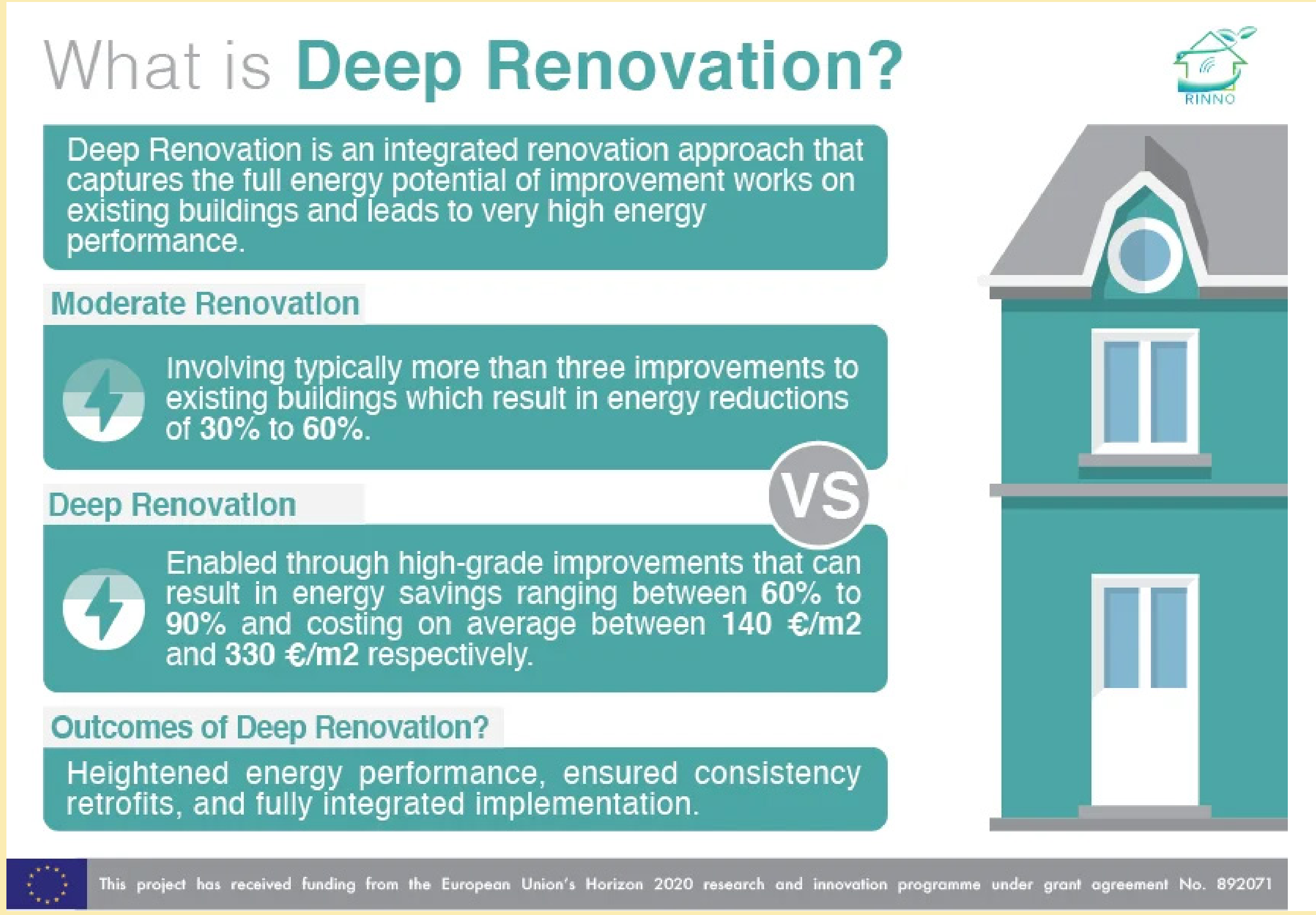
"Deep renovation" means a renovation in line with the energy efficiency first principle and efforts to reduce whole life-cycle greenhouse gas emissions generated during the renovation[7].

This approach focuses on essential building elements such as wall insulation, roof insulation, low floor insulation, replacement of external joinery, ventilation and heating systems, and treatment of thermal bridges to ensure the necessary comfort of the occupants in both summer and winter.

It is a renovation resulting in a reduction of at least 60%[7] in primary energy demand for worst-performing buildings for which it is technically and economically not feasible to achieve a zero-emission building standard, and which transforms a building or building unit:
a. before 1 January 2027, into a nearly zero-energy building;
b. from 1 January 2027, into a zero-emission building.

1 https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en
2 https://build-up.ec.europa.eu/sites/default/files/content/bpie_renovation_wave_analysis_052021_final.pdf
3 https://www.iea.org/policies/12766-european-commissions-renovation-wave-strategy
4 https://energy.ec.europa.eu/system/files/2020-10/eu_renovation_wave_strategy_0.pdf
5 https://op.europa.eu/en/publication-detail/-/publication/40299428-f65d-11eb-9037-01aa75ed71a1/language-en
6 https://publications.jrc.ec.europa.eu/repository/bitstream/JRC122347/epbd_report_12.07-rev-27-07-2.pdf
7 Art.2 of the recast EPBD (European Parliament, 2023a); https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en

WHAT IDR IS?



In the draft of the recast EPBD (European Parliament, 2023a), wanted by the 2021 Fit for 55 package, deep renovation is introduced, for the first time, among the directive's definitions, in Article 2[7].

A good alternative to the deep **retrofit made** all at once is to face it **step by step, the so called "Staged renovation"**. This means that the interventions are carried out at different moments and therefore the costs incurred are spread over time.

An important point to keep in mind when using this approach is to plan each intervention in advance, in order to keep the holistic overview of the deep retrofit and orient each intervention to the final goal.

To do this, several tools can be used to facilitate the process. For example, a good way to approach step by step retrofit is to use the **kits** developed by Infinite project (see the introductory chapter "About the project").

DEFINITION OF IDR

WHAT'S THE MEANING OF INDUSTRIALIZED?

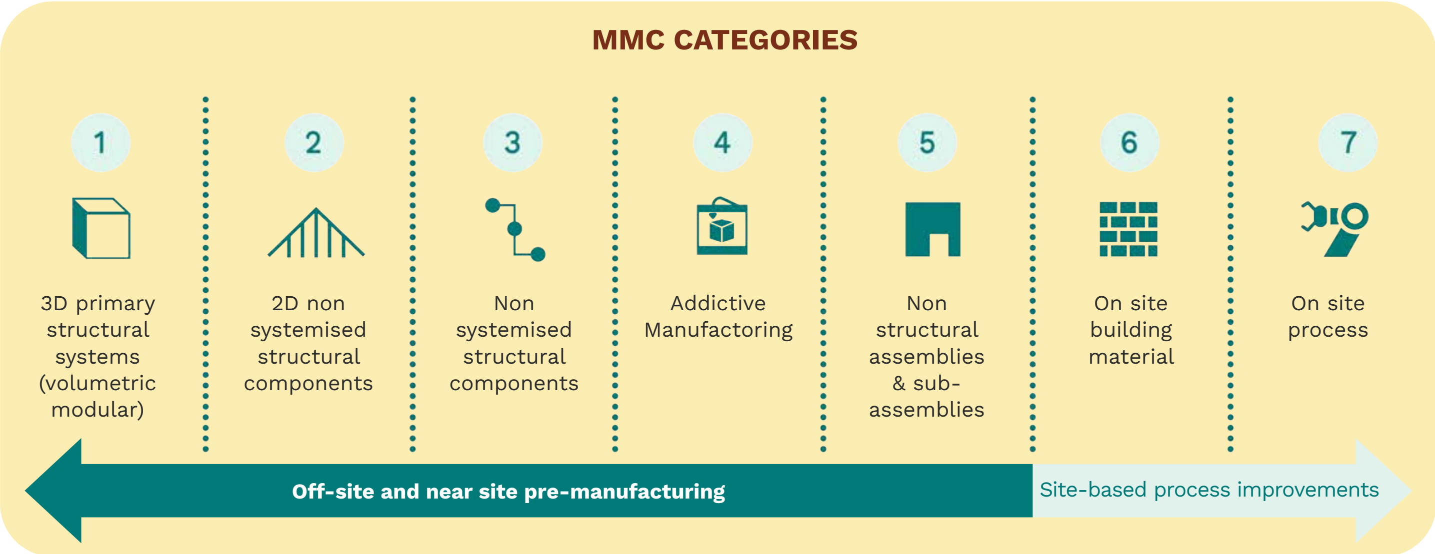
Moving from the performances and savings to be achieved within each deep retrofit to the way it should be carried out, industrialized renovation acquires significant relevance.

It refers to a new approach based on **offsite construction methods**: the production of retrofit solutions and components is moved away from the job site to a controlled factory environment, at an industrial scale[8].

In terms of definition, while "industrialized," "offsite," "prefabricated," and "modular" can be considered synonymous, "**modern methods of construction (MMC)**" refers to a slightly different and broader concept born in the United Kingdom[9]. The need to increase prefabrication in the housing sector was discussed, drawing on experiences from the manufacturing industry, to identify how to improve efficiency, reduce waste, and make the sector more responsive to changing needs[10].

More recent reports, such as "Offsite Manufacture for Construction: Building for Change"[11] and "Modern Methods of Construction: Introducing the MMC Definition Framework"[12], reinforce the same ideas[13]. The latter is particularly important since it aims at standardizing MMC terminology to enable better access to finance, insurance, and affordable housing procurement[14].

MMC is defined as "a range of approaches which spans offsite, near site, and onsite pre-manufacturing, process improvements, and technology applications".[15]

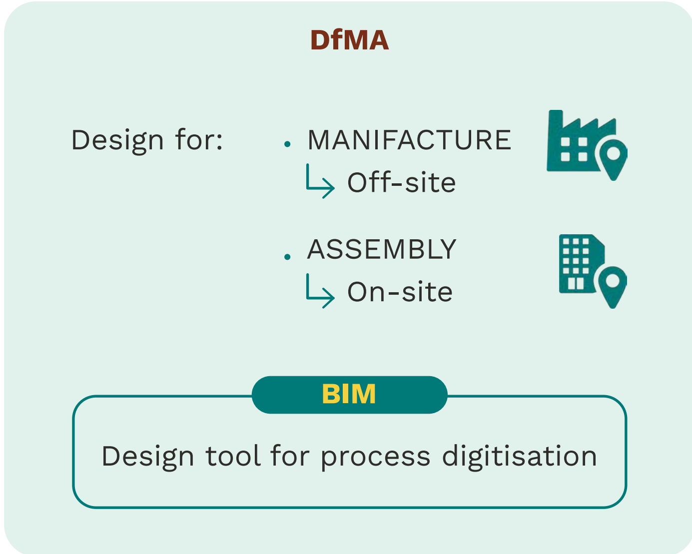


The seven categories included in the MMC definition framework. Source: MHCLG Joint Industry working group, 2019

8 European Commission: https://build-up.ec.europa.eu/sites/default/files/content/industrial_prefabrication_solutions_for_building_renovation_final-version.pdf
9 European Commission: https://build-up.ec.europa.eu/en/news-and-events/news/offsite-construction-solution-sustainable-buildings
10 European Commission: https://build-up.ec.europa.eu/sites/default/files/content/sp2021_positioning_paper_boosting_the_renovation_wave_with_modular_industrialized_renovation_kits.pdf
11 House of Lords, 2018
12 MHCLG Joint Industry Working Group, 2019
13 European Commission: https://hlmarchitects.com/mmc-standardisation-and-kit-of-parts/
14 https://www.sisealy.co.uk/our-services/modern-methods-of-construction/
15 European Commission: https://www.gov.je/SiteCollectionDocuments/Planning%20and%20building/R%20Modern%20Methods%20of%20Construction%20-%20Housing%20Delivery%20Innovation.pdf

According to this classification, offsite construction is only a subcategory of MMC that includes only the pre-manufacturing categories (items 1, 2, 3 and 5 of the image on the side), where components are realised away from the construction site.

For energy efficiency purposes only, the most common MMC used for renovation is non-structural assemblies and sub-assemblies (category 5), in the form of **integrated wall and roof panels** (including photovoltaic, windows and/or other technical ducks or equipment). Where buildings have specific technical constraints or surface irregularities, site-based process (categories 6 and 7) are used to optimise the work.



Approches that enable industrialised renovation

To be effectively implemented, offsite construction requires **DfMA (Design for Manufacture and Assembly)**, which is the process of procuring and designing a project so that a significant proportion of the works can be built in the factory (customised prefabricated elements manufactured off-site[16]) and assembled on-site[17].

This approach has many advantages:

- Most of the work is carried out in the factory, under safer conditions and with better quality control[18];
- The few remaining on-site operations are faster, cleaner, and require less labour[19];
- there is less waste, given the high level of precision in the production of the prefabricated product and the performance is higher as it does not depend on manual work on site[20];
- DfMA components can be more easily dismantled at the end of their useful life and destined for reuse or recycling.

The DFMA approach uses various tools to optimize the efficiency of the manufacturing and assembly process, like:

- MTM (Methods-Time Measurement);
- Cost analysis software;
- Cost-oriented design methodologies;
- Industrial cost analysis tools;
- Standardization of components.

Building Information Modeling (BIM) is another powerful tool that can be utilized to enhance the DFMA approach in several ways. in fact, BIM integrates design, manufacturing, and assembly activities, improving efficiency and reducing costs in construction projects.

16 https://re.public.polimi.it/bitstream/11311/1144366/2/AEDM_DFMA_PREPRINT.pdf
17 https://build-up.ec.europa.eu/en/news-and-events/news/offsite-construction-solution-sustainable-buildings
18 https://www.mdpi.com/2075-5309/14/1/285
19 https://hub.hku.hk/bitstream/10722/283279/1/content.pdf
20 https://cris.brighton.ac.uk/ws/files/6751819/DfMA_in_construction_a_review_paper_with_author_.pdf

WHAT IDR IS?

BENEFITS AND CHALLENGES

BENEFITS

So far, the potential benefits (such as time, safety, cost, quality, etc.) of innovative practices have been investigated and quantified primarily for new offsite construction, even if also industrialized renovation has a broad range of advantages with respect to traditional methods. In the list below, and in the following picture are reported all the IDR benefits grouped in three categories:

1. **Direct advantages** which are strictly related to a deep industrialized retrofit and differentiate it from a light and traditional intervention. The time frame considered is just the short term, from the design stage till onsite renovation works.
2. **Indirect benefits** that are related to broader project impacts, linked to direct advantages, and leading to parameters that can be economically quantified and valorised. They take into account the whole building lifecycle and different stakeholders' categories (owner, tenants, workers, society).
3. **Economies of scale** which come into play when more than one project is involved, as long as a pipeline of similar and clustered buildings renovations is planned. These advantages can be split among solution providers, general contractors and stock owners or developers.

Direct benefits

DESIGN

- **High project performance**: optimized energy efficiency, seismic safety, and better air quality is ensured through innovative solutions;
- **Up-front planning**: comprehensive early-stage coordination implies precise implementation and enhanced process efficiency.

MANUFACTURING

- **Controlled environment**: producing components in factories guarantees higher product quality and precision;
- **Improved durability**: prefabrication results in more robust and relliable components, extending their operational lifespan;
- **Better quality**: factory-tested materials ensure fewer defects and closer adherence to specifications.

TRANSPORT

- **Logistic optimization**: centralized production enables to better plan and organize the transportation of components, lowering the number of trips to site.

CONSTRUCTION

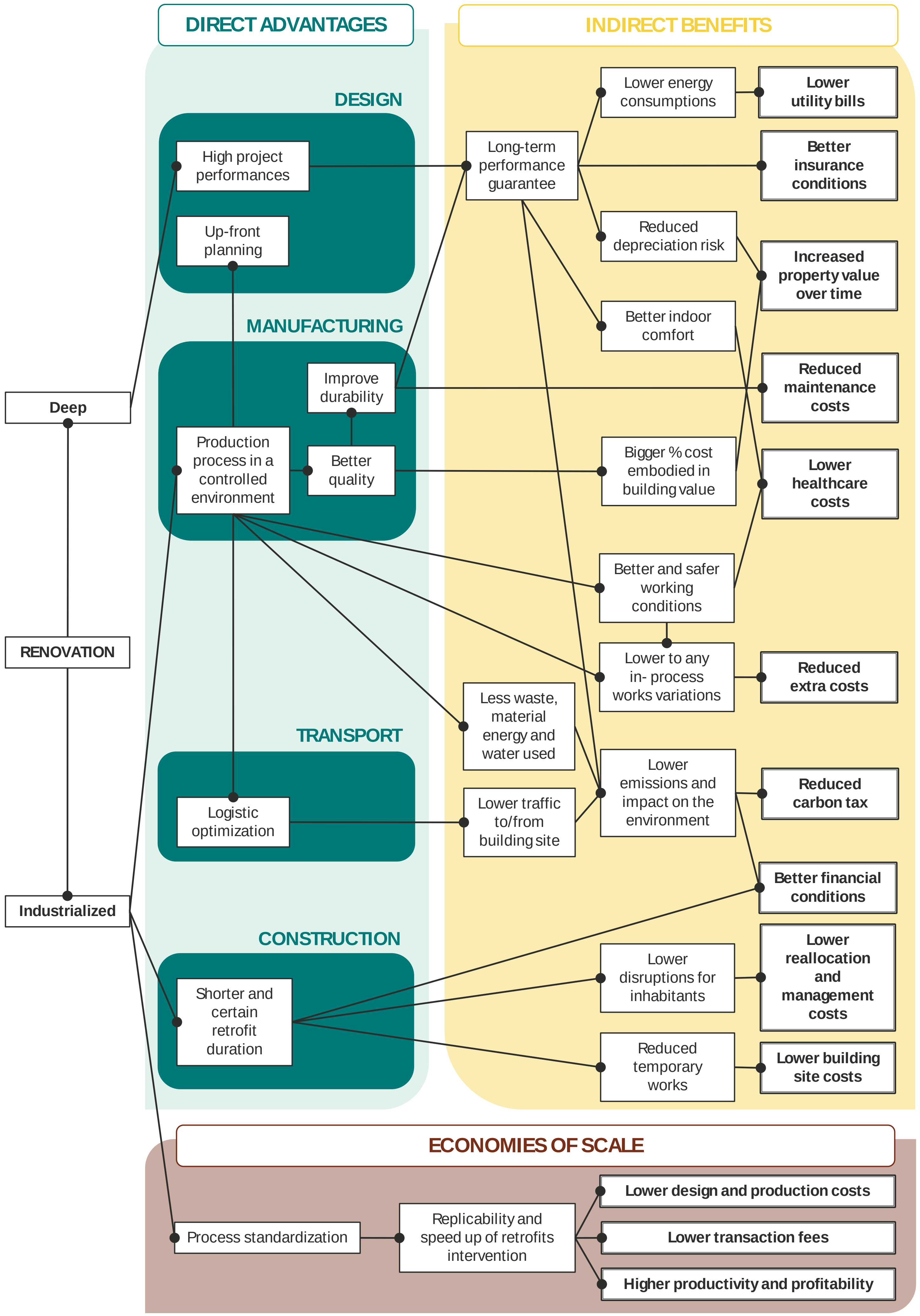
- **Shorter retrofit duration**: simultaneous offsite manufacturing and onsite preparation gives greater certainty in construction program and reduced risk of delays

Indirect benefits

- **Long-term performance guarantee**: quality-controlled manufacturing ensures that design performances are met in the long-term;
- **Lower energy consumption**: high-efficiency components reduce operational energy needs;
- **Lower utility bills**: decreased energy usage translates directly into cost savings for residents;
- **Better insurance conditions**: reduced risks associated with standardized construction methods enhance insurance terms;
- **Reduced depreciation risk**: high-quality materials and durability minimize property value depreciation;
- **Increased property value**: energy and performance upgrades enhance long-term asset market value according to its location;
- **Better indoor comfort**: improved insulation, air quality, and temperature control increase occupant satisfaction;
- **Reduced maintenance costs**: standardized, durable components reduce the frequency and cost of repairs;
- **Lower healthcare costs**: better indoor conditions improve tenants' health and reduce associated costs;
- **Safer working conditions**: factory settings minimize onsite hazards, improving worker safety;
- **Less waste**: controlled production processes reduce material waste and optimize scraps reuse;
- **Lower traffic**: fewer transport trips to sites decrease congestion and emissions;
- **Reduced emissions**: optimized logistics and energy-efficient guaranteed products lower environmental impacts;
- **Reduced carbon tax**: certifiable efficient energy use and lower emissions lead to tax benefits;
- **Better financial conditions**: guaranteed process and solutions improve access to green financing options;
- **Minimal disruptions**: reduced onsite activity leads to less noise and inconvenience for residents;
- **Lower reallocation costs**: limited construction time allows tenants to avoid relocation;
- **Reduced temporary works**: prefabrication minimizes the need for scaffolding and onsite facilities;
- **Lower site costs**: prefabrication reduces onsite time, labor and associated overhead.

Economies of scale

- **Process standardization**: prefabrication fosters repeatability and efficient resource use across projects
- **Faster retrofits**: modular and offsite techniques accelerate the renovation process and rate.
-
- **Lower costs**: industrialized production reduces individual project design and manufacturing expenses
- **Higher productivity**: centralized and efficient operations lead to better overall profitability



WHAT IDR IS?

CHALLENGES

Besides the wide range of advantages given by offsite techniques, industrialized deep renovation still faces several key challenges that hinder its widespread adoption.
Such barriers can be summarized as follow:

- From a FINANCIAL point of view, IDR implies **high upfront costs**. Initial investment for prefabricated materials and advanced processes is a significant deterrent for both private and public customers. There is, then, a strong need for **new financial models** that enable the real implementation of better financial conditions, like green loans or pay-for-performance models. In this regard, assessing the long-term performance of innovative renovations can be complex and challenging since it requires monitoring multiple parameters for which it can be difficult to establish universal thresholds due to the variability of building typologies, climates and users' behaviors. Finally, being a quite new practice, offsite renovation is linked to **uncertainty in return on investment**, which can deter investors and building owners.

- From a TECHNICAL AND OPERATIONAL perspective, industrialized approaches imply structural changes in the workflow, starting from a **higher effort in upfront planning** and design with lower design flexibility throughout the renovation phase. In addition, the **digitalization of the processes** is also essential but tools like BIM (Building Information Modeling) and digital twin technologies demand significant investment and expertise. Nowadays, **supply chains are too fragmented**. The lack of standardized processes and coordination among stakeholders slows down the scalability of industrialized renovations and constructions. **A shortage of trained installers and skilled workforce also** prevent the kick in on innovative approaches. Indeed, advanced renovation techniques require training in digital tools, sustainable materials, and efficient project and production management, which may not yet be widespread.

- Moving to the DEMAND AND BEHAVIORAL side, there is a **diffused skepticism**. Building owners, tenants, and contractors hesitate to adopt new technologies or methods due to perceived risks and resistance to modular and prefabricated solutions due to perceptions of poor quality or lack of adaptability. **Engaging tenants** (before, during and after the renovation) addressing their concerns about disruptions, cost-sharing, energy savings and rent changes is also a crucial but complex process. Actually, the actions of the inhabitants have a major impact on the performance of the building during the use phase, and they can help to make the most out of the proposed innovations if they are properly trained in the correct management of the house.

- Considering REGULATORY barriers, there is a **lack of policy support**. Insufficient incentives, subsidies, or supportive legislation hinder the adoption of innovative retrofit practices. **Inadequate building codes** may not align with deep and offsite renovation goals, creating barriers to compliance. Finally, **current procurement procedures** often favor traditional methods, making it difficult for industrialized approaches to compete due to their different cost structures and implementation requirements.

Overall, overcoming these barriers will require coordinated efforts, including financial innovation, workforce development, digital upskilling, tenant engagement strategies, and strong policy frameworks to enable industrialized deep renovation to scale effectively leading to cost reductions through wide market spread.

IDR BEST PRACTICES

THE EU IDR STAKEHOLDER MAP

The application of industrialized deep renovation has been largely investigated in the **literature**, even if offsite new construction is still much more known and examined.

Beside the ongoing academic investigations, current practice tends to deal with minor and single interventions (e.g., wall or roof insulation, window replacement, installation of new boilers or heat pumps, integration of a photovoltaic system, etc.) that are implemented without an overall coordination and organic vision of the whole building performance. The reason is linked to several barriers that involve technical, financial, and social aspects of IDR, as explained in the previous paragraph. In recent years, such obstacles have been mainly addressed by various **research projects financed by the European Union**. Indeed, they do not only focus on the development of prefabricated technology sets, but they also tackle viable financial, business and operational models.

Furthermore, throughout Europe, private initiatives of **pioneering companies developing prototyped industrialized solutions** for new buildings and deep retrofits are on the rise.

As a result, the R&D departments of different companies (manufacturers of façade panels, windows, ventilation equipment, photovoltaics, etc.) collaborate and launch new integrated elements on the market, testing them on private and small-to-medium-sized buildings.

Even if, most of the currently developed offsite manufacturing uses relatively traditional production lines, there is growing investment in automated plants from the leading players[1].

This bottom-up trend shows a growing interest in the industrialization of the building process on the part of the supply side but does not provide the sector with a strategic scaling-up of interventions towards a common, widespread approach.

Taking into account the intrinsic limitations of scattered market initiatives or single pilot projects, **Energiesprong is the most successful and diffused industrial prefabrication movement for deep renovation to date**.

This retrofit model, born in the Netherlands, has several applications worldwide as a technically and economically sustainable model that can be replicated on a large scale[2]. It quickly spread to France, Germany, the UK, and even Italy, and has been awarded several prizes: in 2018, it received the Global Green Building Entrepreneurship Award; in 2019, it was recognized as European Energy Innovation of the Year; and most recently, in 2024, it won the World Habitat Award[3].

To summarize, the map on the right allows to highlight both the Countries having already developed an active IDR market (Energiesprong in dark green) and the Countries having applied IDR technologies on pilot projects (thanks to Horizon funds, light blue). The latter are still quite relevant because they are the upcoming "candidates" to scale up IDR in Europe.

1 https://www.unido.org/news/unidos-regional-launch-industrial-development-report-2024-eastern-europe
2 https://www.unido.org/sites/default/files/unido-publications/2023-11/IDR24-OVERVIEW_1.pdf
3 https://energiesprong.org/why-the-end-is-just-the-beginning-when-retrofitting-homes/

IDR BEST PRACTICE

THE ENERGIESPRONG MOVEMENT

Energiesprong is a **deep industrialized renovation program** that uses a comprehensive supply chain approach to enable the achievement of net-zero energy and attractive retrofits by implementing offsite technologies such as prefabricated facades with windows and ventilation system integrations, insulated rooftops with solar thermal and photovoltaic panels and smart heating and cooling installations.

The refurbishment comes with rapid onsite installation and a long-year warranty on building performances. Retrofitting according to the Energiesprong model means turning a high energy house into a house that is able to generate its own energy for heating, hot water and household appliances, and to provide a higher level of indoor comfort.

The experience of the first **11.700 interventions** across Europe has shown that it is possible to reduce energy consumption by more than 50%, lower costs by 30% and decrease the carbon footprint of the building by more than 75% compared to the baseline. These results are more significant than any other retrofit approach currently used in Europe.

The Energiesprong workflow starts from the analysis of the building until the end of its useful life. The digitalization of the process allows significantly optimization of time and human resources with consequent compressions in costs expected overall costs in proportion to renovated volumes. As shown in the picture, After the **analysis** phase of the building to be retrofitted, a digital twin model is created, and the DESIGN phase can start. **Bim** is used to integrate architectural, structural and production engineering variables, as well as to carry out the necessary energy and anti-seismic simulations. The digital project is then transformed into shop drawings for the factory **production** of the offsite elements, the **logistics** optimization and the management of the onsite WORKS, assemblies and installations. The twin model, suitably revised once the tests are completed, becomes the basis for the **use and preventive maintenance** phase of the renovated building. The management of this and the **end-of-life** phases are facilitated by offsite and controlled production of the components which leads to high guaranteed performances levels with an expected increase in the residual value of the building.

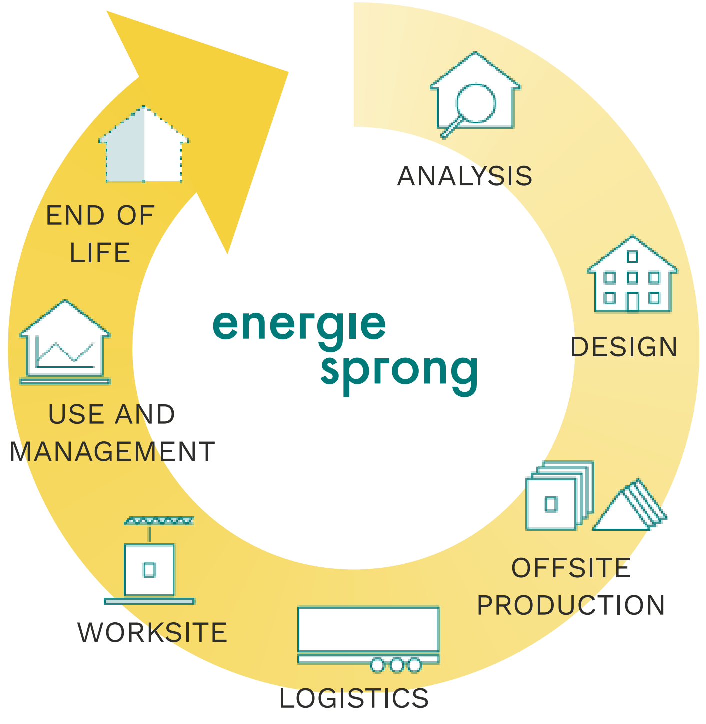
Overall Energiesprong renovation is:

DECARBONIZED
since it's a deep intervention in line with the European 2030 and 2050 targets.

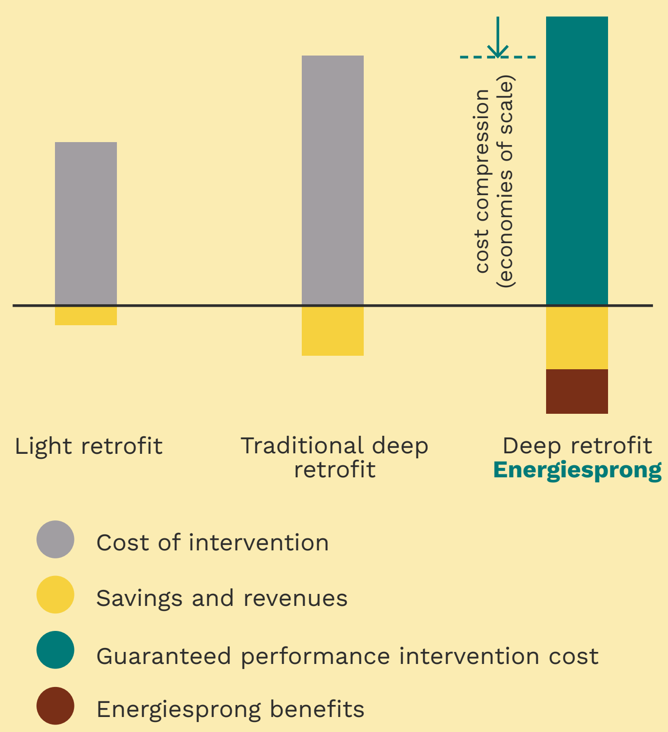
SAFE
because it aims to ensure improved energy and seismic performance, as well as greater safety on construction sites.

SCALABLE
because it aims to reduce costs and execution times by industrialising processes and guaranteeing optimal performance in the long term.

DESIDERABLE
because it reduces the time spent on site and eliminates the need for scaffolding. It also ensures improved indoor comfort and quality finishes.



Cost/benefit comparison of the Energiesprong and light and deep retrofit with a traditional approach.



From an economic perspective, in the Energiesprong model, the renovation is financed by future savings in energy costs, which are added to those of the planned maintenance over the guaranteed period of around 30 years without net additional investment expenditure to tenants, as shown in the bar chart.

This new business model is based on the concept of **Total Cost of Ownership** which makes it possible to overcome the logic of minimum initial capital expenditure and aims to evaluate the investment with a **Life Cycle Cost approach**. In this regard, the extra costs resulting from industrialized and high-quality products are offset by the economic advantages generated by the unique benefits of Energiesprong (listed in the previous chapter).

On the one hand, by replicating the interventions on a large scale, it will be possible to reduce the costs of the prefabricated elements, in proportion to the quantities produced, thanks to industrial optimizations.
On the other hand, for a correct analysis, it is necessary to consider the value generated by the monetization of the different benefits, for the different actors involved in the different phases of the renovation process.

Beside the general economic model, each Country developed the Energiesprong movement according to the availability of national funds, peculiarities of the building stock, local opportunities and strategical priorities. In the next pages, an overview of modalities and achievements in the Netherlands, France, United Kingdom, Germany and Italy is presented.

THE ENERGIESPRONG MOVEMENT

THE NETHERLANDS

Implementation date	2010-2016 2017-on going
Market development team	Platform 31, non profit network of organization Stroomversnellingn non profit association
Funding structure	50 million (government 2010-2016) 6 billion (WAW Social Bank loan) 3.6 million shared (transition Zero, H2020 2016-2019) 11.6 million shared (Mustbe0, Interreg, 2019-2020)
Achieved results	5700 retrofitted houses
Expected results	14400 planned retrofits

According to the overview made by the European Construction Sector Observatory (European Commission, 2017), Energiesprong was commissioned by the Dutch Ministry of the Interior and Kingdom Relations through € 50 million government funding[1] (distributed from 2010 till 2016) to meet the objectives of the Innovation Agenda for the Built Environment, a compilation of innovative policies focused on construction and energy transition. Energiesprong's first goal was to create the conditions for affordable net-zero energy retrofits to take hold in the mass market by 2020. It targeted to deliver solutions to 2.500 new buildings, making them energy-neutral, and 2.500 renovated ones, allowing them to reach from 45% to 80% energy savings.

The first retrofits were piloted on terraced houses, and they **achieved**:

- 150 kwh/m2 (**70%**) **of total reduction in energy consumption** from 20.000 kWh to 6.000 kWh;
- **1/3 savings** generated by the energy produced **on-site** and **2/3 savings** coming **from energy efficiency measures**;
- a cost of 130.000 € per unit.

By the end of 2013, thanks to economy of scale, 3D technologies and prefabricated materials, the cost per terraced house lowered to about 65.000 €, getting closer to the 40.000 € target. Overall, the accomplished energy savings have been:

- 45% in 800 existing houses
- 60% in 160 existing houses
- 80% in 258 existing houses

In 2013, Energiesprong also brokered the **"Stroomversnelling"** (rapids) **deal between six housing associations, four construction companies and other supporting organizations to retrofit to Net Zero Energy (NZE) 111.000 social housing dwellings (11.000 confirmed agreements with the prospect of a further 100.000)** divided into: terraced houses; four-story buildings and multi-apartments blocks, according to the scale up strategy shown in the figure below in the previous page. The three categories have a growing degree of complexity given by the rising number of floors which increase the height of the retrofit interventions and decreases the roof surface available per dwelling for the installation of renewable energy sources to supply enough electricity for heating, hot water and appliances. Therefore, while terraced houses renovation have potentially reached the mass market, the innovation of technical solutions should be mature enough to be tested on the first prototypes for multi-apartments blocks. Stroomversnelling required an investment of € 6 billion, funded by the WSW Social Bank through a 40-year government-backed loan to the involved housing associations.

In 2014, while the market development team grew from 3 to 45 people, the number of housing associations part of the deal increased from 6 to 27, resulting in 200 pilot retrofits delivered.
In 2015, together with the roll-out of 2000 more renovation interventions, Stroomversnelling evolved into a **standing market initiative** becoming a network of more than 65 members among contractors, component suppliers, housing providers, local governments, financiers, energy system managers and other parties with the aim of increasing the pace of growth of NZE retrofits. In the meanwhile, other Countries joined the Energiesprong movement, establishing their own market development teams while the Netherlands expanded the NZE retrofit approach to commercial offices, schools, and care homes.

Dutch government funding ended in 2016 but additional economic support to the whole Energiesprong network has been obtained through three EU research projects for a total of € 20,6 million among 5 Countries (€3,6 M for H2020 Transition Zero between NL, FR, UK; €5,4 M for Interreg Nort-West Europe E=0 between NL, FR, UK, LU; €11,6 M for Interreg Nort-West Europe MustBe0 between NL, FR, UK, DE).

Besides the EU subsidy programs, Stroomversnelling is funded by all its members (institutions, housing associations, solution providers) and by the European Climate Foundation, a philanthropic fundraising initiative to foster the development of a net-zero emissions society.
To date, **5.700 houses have been retrofitted and 14.400 are on the pipeline.**
In addition, being the most advanced Energiesprong country **it has already monitored several houses** on execution, delivery and usage. In particular, the monitoring of 46 homes in Heerhugowaard and 18 in Tilburg, shows that on average the actual energy performances match the design specifications, meaning that the guarantees are respected[2]. Space heating usage solar production have been a little more than expected. In some cases, among early projects there has been insufficient air tightness due to some problems with the panels' installation and also bad quality products of one specific company. Such issues are inevitable in the first interventions, but monitoring is crucial to quickly address the problem ad improved the upcoming design.
It was also helpful to spot too high consumptions among occupants who were consequently educated to avoid higher energy bills. In addition, several aspects of tenant satisfaction were measured: they were generally satisfied with the retrofit result but less happy about the overall process. These first monitored projects explicated the need to incorporate occupants wish in the intervention, clearly communicate with them and properly manage their expectations.

1 European Commission (2017) European Construction Sector Observatory - Policy fact sheet - Netherlands - Energiesprong (Energy Leap) - Thematic Objectives 1 & 3.

2 Energiesprong, 2019

THE ENERGIESPRONG MOVEMENT

FRANCE

Implementation date	2016-on going
Market development team	Greenflex, sustainability consultancy company
Funding structure	3.6 million shared (transition Zero, H2020 2016-2019) 5.4 million shared (E=0, Interreg, 2016-2019) 11.6million shared (Mustbe0, Interreg, 2019-2022) ADEME, the French Environment and Energy Efficiency Agency Caisse des Dépôts
Achieved results	4182 retrofitted houses
Expected results	2000 planned retrofits

In March 2016, Energiesprong was launched in France, together with the beginning of Transition Zero and E=0 projects which have, among others, the objective to **create early markets for net zero energy refurbishments using frontrunner social housing organizations** in France and United Kingdom. The market development team is hosted by GreenFlex, a sustainability consultancy company specialised in helping organisations to accelerate their social and environmental transition. GreenFlex has set up a market development team of 7 people to adapt and implement the Energiesprong approach with local stakeholders[1]. The first two project renovated, funded by E=0 project, are 10 houses in Hem (housing provider: Vilogia, general contractor: Rabot Dutilleul Construction, intervention: from class F to class A spending € 1.200.000) and 12 units in Longueau (housing provider: ICF Habitat, general contractor: Bouygues, intervention: from class F to class A spending € 1.500.000)[2]. These first demonstrators have inspired others, within the MustBeZero project and beyond: 64 stakeholders, among which 14 housing associations, have signed a charter engaging them to contribute to the Energiesprong dynamics in France. Financing has been obtained also from ADEME (The French Environment and Energy Efficiency Agency) and Caisse des Dépôts, which plays a major role in financing social housing, energy transition and smart city developments.

Of particular importance is the renovation of 988 apartments, spread over 9 buildings of 11 storeys each, commissioned by Est Métropole Habitat near Lyon in 2020. The panels on the east façade were installed by crane in just 8 days without the need for scaffolding, demonstrating the feasibility of industrialised interventions on multi-storey residential buildings[3].

Beside scattered project, the recently born MASH (Mutualisation d'Achat au Service de l'Habitat) initiative represents the first purchasing centre for industrialized and guaranteed zero-energy renovations and it was driven by the Social Union for Housing in Pays de la Loire. It promotes the pooling of purchases and the coordination of actors, thank to which social landlords can carry out large-scale renovations and achieve ambitious objectives in terms of energy efficiency. For the first time, 14 social landlords have come together within a central purchasing body to launch a group order for Energiesprong renovations addressing approximately 2000 homes. The units have been divided into 5 lots of a few hundred units each.
The renovation works took place in a staggered and progressive manner, allowing all companies, whether small or large, to participate to these first aggregated call for tenders[4].

To conclude, Energiesprong France has put a lot of effort in **monitoring and analysing the market development** to redact the first Observatory of Costs, Quality and Impact of Energiesprong renovations aimed at establishing trajectories based on project data[5].
Six major housing types have been identified for mass industrialized renovation, starting from 22 typologies characterized by different construction periods and different geographical locations.
There are 3 categories of detached houses and 3 of multi-family buildings, for a total of 14 million units suitable for interventions. In addition, for each of the dimension analysed has compared Energiesprong renovation with 3 other scenarios: minimum maintenance, traditional renovation, and demolition/new construction. The main fundings are summarized below in the pictures "COST", "QUALITY" and"IMPACT".
Considering an average social housing stock, the advantages of Energiesprong renovations in terms of overall cost and carbon impact over 30 years, with respect to the other scenarios are aggregated in the graph.

1 Energiesprong FR, 2023a
2 EU Interreg NWE project E=0, 2020
3 Energiesprong FR, 2023c
4 Energiesprong FR, 2023b

COST

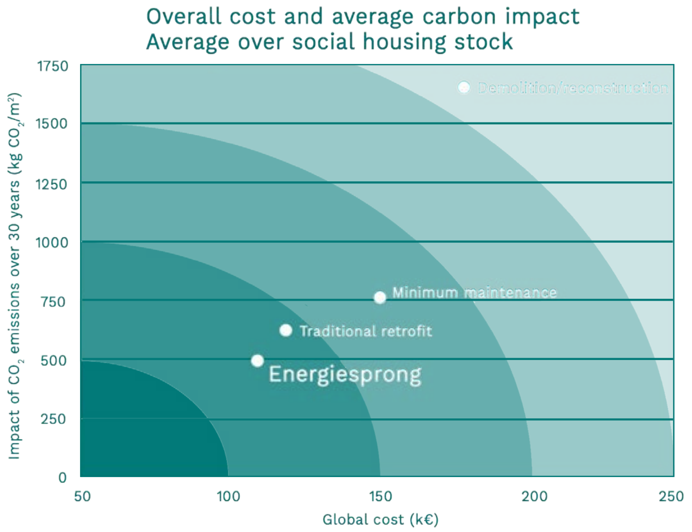
- Prices are already falling, with a -20% reduction for current projects compared to the first projects;
- Observatory data can be used to drift thr price trajectory and asses likely prices for mass markets. Single family housing retrofits will cost around €900 /m²VAT excluded (-40% compared with initialprojects), while multi family housing willbe about €700 / m²VAT excluded (-55% compared with initialprojects);
- In terms of overall cost over 30 years, Energiesprong offers the best performance/cost ratio compared with the other scenarios.

QUALITY

- The solutions implemented on the pilot projects enabled to achive and even surpass the goal of zero energy for uses (production > consumption);
- Heating requirements are reduced by 75% compared with the existing system;
- Numerous high-performance solutions are emerging. They present commonfeatures such as the use of integrated and prefabricated solutions and a growingshare of bio-sourced materials.

IMPACT

- Compared with the other scenarios the carbon impact of an Energiesprong renovation is the lowest, inboth multi-family and single-family housing;
- An Energiesprong intervention reduces the total carbon inimpact of an home over 30 years by 35% (considering all greenhouse emissions and not just those associated with energy consumption), compared with a minimum maintenance scenario;
- This reduction can reach 50% when the most carbon free constructive solutions are implemented (such as bio-sourced prefabricated facade and roofs);
- For E, F and G homes, decrease in carbon impact can get to75%, two times better then a traditional renovation.



Total cost and carbon impact over 30 years: comparison among different retrofit approaches.
Source: Energiesprong FR, 2021

5 Energiesprong FR, 2021

UNITED KINGDOM

Implementation date	2016-on going
Market development team	Energiesprong UK, network of 14 founding partners
Funding structure	3.6 million shared (transition Zero, H2020 2016-2019) 5.4 million shared (E=0, Interreg, 2016-2019) 11.6million shared (Mustbe0, Interreg, 2019-2022) Founding partners, both housing associations and solution providers
Achieved results	489 retrofitted houses
Expected results	1500 planned retrofits

Energiesprong UK is an independent market development team with 14 founding partners who are frontrunners in the field of sustainability and innovation from the social housing sector as well as construction companies that share the vision of working together to innovate the sector. In addition, it has a range of supporting partners that are relevant stakeholders in the transformation Energiesprong UK is aiming to achieve. Beside the funding received by the EU projects, it is financed by the founding partners (housing associations and solution providers)[1].

Within the framework of **E = 0 Interreg project[2],** two pilot projects have been delivered, both targeting single family houses:

- **In Maldon** a 5-house pilot was delivered by ENGIE (solution provider) and GSA (architect) with Moat being the housing provider. The goal was to reduce the level of carbon dioxide per house by 3.2 tonnes per year, starting from a D rating. The main challenge was that the local planning office required the street scene to remain unchanged so, apart from the addition of solar, original looks needed to be preserved. To do so, ENGIE opted for acrylic brick-effect external insulation panels, which were colour-matched to the brickwork they cover. Tenant engagement was also key for the success of the project. Tenants have been consulted throughout the process, including weekly progress meetings, training sessions and manuals to show how to use the new technologies installed.

- **In Nottingham** 17 homes, comprising of 10 bungalows and 7 two-bedroom, three-storey houses, have been improved. They are owned by Nottingham City Homes ALMO and have been retrofitted by Melius Home. Their predecessor was the 10-home pilot project delivered by Melius Homes, designed by Studio Partington and funded by the Horizon 2020 Transition Zero projects. It won the UK Housing Award for Innovation in recognition of Nottingham City Homes' pioneering approach to tackling energy inefficiency in older housing stock to address both climate change and fuel poverty. The positive impacts, the tenants' satisfaction and the potential to regenerate the neighbourhood led Nottingham Councillors to support the upgrading of up to 155 homes in 2019. Therefore, the ALMO has secured over £5 million through the European Regional Development Fund with its Deep Retrofit Energy Model project, to support this rollout.

Under MustBe0 Interreg project, the focus has been shifted to multi-storey buildings pilot projects, tackling in particular: 24 units in a 2-storey building in the London Borough of Ealing and a 5-storey apartment block of 38 flats in North Kensington, London[3].

Beside the demonstrators, a **MustBe0 competition was launched in 2020** by Energiesprong UK to develop new approaches for high-performance, scalable and cost-effective net zero retrofit solutions focused on apartment blocks. There were three categories to focus on: adding a layer of new dwellings on top of existing flats while ensuring whole building net zero energy, Net zero energy for low rise apartments (< 4 stories), and billing, metering and monitoring. In 2022, instead, a second design competition was launched, making £40.000 available for panel manufacturers and suppliers to propose offsite multi-storey fabric systems that are nearing market readiness. Competitions have been tested across different Energiesprong countries, as an effective way to collect and compare innovative solutions under development.

In conclusion, Energiesprong UK is also delivery partner (together with Turner and Townsend) of the £ 10 bn **The Retrofit Accelerator-Homes Innovation Partnership**, which is a new way to approach retrofit procurement, all across UK[4]. Indeed, in England several housing associations are public, so finding effective tendering procedures in key to the scalability of Energiesprong market. The Retrofit Accelerator - Homes programme is funded on a 50:50 basis by the Mayor of London and the European Regional Development Fund (ERDF). Within the partnership, seven London-based social housing providers and four UK building firms, along with a network of suppliers, are working together to stimulate a new market for whole house retrofit and reduce costs. The ultimate goal, after the three-year Innovation Partnership, is the creation of a national framework agreement for delivering retrofit projects and exploit the Social Housing Decarbonisation Fund (SHDF). In fact, paring social landlords with solution Providers (who are responsible for design, delivery, guaranteed performance, and in some cases maintenance), provides a runway to develop new net-zero components targeted to hit specific performance standards. In pilot projects it has been noted that procurement required suppliers to put a lot of design work, often in a short time frame. For this reason, to foster research and development, in the Innovation Partnership, bidders will receive £ 30.000 for the design stage to contribute towards costs. The main strength of the approach is that suppliers do not compete each other: if they create a solution that works within the gross maximum price, the potential market is so big that they can deliver prototypes, pilots and finally they get a spot on the national framework, which enables any UK housing provider to purchase their solutions.

1 Energiesprong UK, 2023
2 EU Interreg NWE project E=0, 2020
3 EU Interreg NWE project MustBe0, 2023

4 Energiesprong UK, 2022

IDR BEST PRACTICE

THE ENERGIESPRONG MOVEMENT

GERMANY

Implementation date	2017-on going
Market development team	DENA, German Energy Agency
Funding structure	11.6 million shared (Mustbe0, Interreg, 2019-2022) Ministry of Energy in Germany (BMWI)
Achieved results	868 retrofitted houses
Expected results	10 000 planned retrofits

April 2017 marked the launch of the Energiesprong initiative in Germany.
Based on results in the Netherlands, the Ministry of Energy in Germany (BMWI) has allocated a budget to fund a market development team for the coming three years. The high level of government engagement is also demonstrated by the fact that the MDT is hosted by the **German energy agency** DENA, which is centre of expertise for energy efficiency, renewable energy sources and intelligent energy systems[1].

The first phase of market development is underway. The focus is currently on the development and scaling of solutions for smaller apartment buildings from the 1950s, 1960s and 1970s with a simple shape and high energy consumption of more than 130 kWh per square meter per year. It's estimated that there are 500,000 of these buildings in Germany a relatively large stock of similar buildings that belong to only a few housing associations. More than 80 housing companies, 16 construction companies and numerous component manufacturers are already involved in bundling demand and developing a modular system for serial renovation solutions.

Initial projects have been implemented for multi-family buildings in **Hameln, Bochum, Herford, Cologne and Mönchengladbach-Lürrip,** achieving energy savings of up to 90%. These and other ongoing projects (such as the one in **Mönchengladbach**) have been and are supported by the **EU Interreg NWE Mustbe0 program and/or KFW grants**, through the BEG program, according to the energy efficiency standard met[2].

So far 68 houses have been retrofitted and more than 500 are about to start representing an estimated construction volume of €300 million in various phases from planning to preparation. Furthermore, more than 100 construction companies are already active, and four new companies for serial refurbishment in Germany have been specifically founded. The first new factories to produce prefabricated elements are in concrete planning, and the first one will start operations shortly[3].

Such numbers, together with the significant 2021 and 2023 funding programs dedicated to serial renovation, show the commitment of the German government and construction industry in shifting towards offsite manufacturing. Indeed, the first completed pilot projects demonstrate a high quality of solutions both from a technical and architectural point of view, being, so far, some of the most valuable examples of Energiesprong intervention and regeneration potential.

1 Energiesprong DE, 2023b
2 Energiesprong DE, 2023a
3 DENA, 2023

The project that is most worth mentioning is the one in **Mönchengladbach** where LEG, the second-largest German housing group, has launched the first Energiesprong real-world laboratory to test on a small scale what should work on a large scale. The intervention encompasses 6,000 m² of living space and 111 apartments to develop a serial renovation concept that will make it possible to renovate around 3% of the 166,000 apartments. LEG has chosen 5 solution providers (B&O, ecoworks, Fischbach, Saint-Gobain pre.formance, and Renowate) to work on 19 identical apartment buildings from the 1950s to bring them up to the climate-neutral NetZero standard using 5 different serial renovation approaches. The renovation was completed at the end of 2023 and the buildings achieved a huge energy leap from energy efficiency class H to A (primary energy requirements were reduced by 90%, and CO_2 emissions were reduced by 570 tons per year). The fact that the buildings were identical enabled an objective comparison of the various Energiesprong approaches. The exchange between the 5 construction companies in the project was expressly desired as a central aspect of the real-world laboratory. Indeed, the knowledge gained is helping to find scalable solutions more quickly.

Finally, another strong indicator of the interest of the German market in industrialization was the foundation of the company Renowate GmbH in April 2022. It is a joint venture between the housing company LEG and the Austrian construction group Rhomberg. The start-up is a total solutions provider that offers complete energy renovation from the initial diagnosis to turnkey installation. As a cross-industry joint venture, Renowate combines housing expertise with construction experience to develop a scalable renovation solution that makes it possible to decarbonize large housing stocks quickly and cost-effectively. A special feature characterizing Renowate projects is the use of the self-developed tenant communication IT platform. The aim is to provide tenants with all relevant and transparent information before, during, and after the intervention, allowing the property owner to save personnel capacity previously used for time-consuming tenant communication and complaints handling.

THE ENERGIESPRONG MOVEMENT

ITALY

Implementation date	2021-on going
Market development team	EDERA, social enterprise for the renovation and decarbonisation of the built environment
Funding structure	Fondazione Cariplo The solution providers involved in the different supply chains
Achieved results	455 retrofitted houses
Expected results	400 planned retrofits

Energiesprong Italy was established in March 2021 following an initial activation phase led by Habitech and REbuild. **EDERA Srl** Impresa Sociale was founded by REDO SGR S.p.A., Benefit Corporation, FHS – Fondazione Housing Sociale, ANCE – National Association of Builders, and Thomas Miorin. It is an innovation centre focused on decarbonising and retrofitting buildings.

EDERA set up a team of 12 to adapt the Energiesprong approach to Italy. The team's role is to encourage collaboration and innovation in the supply chain. EDERA also works with a **network of experts** to address emerging barriers (e.g. market potential, business models, procurement processes, stock clustering, tenant engagement). The market development team has received financial support from **Fondazione Cariplo**, a prominent philanthropic institution. Moreover, the solution providers who join the network are required to pay an annual fee since they recognize the value of the open innovation program.
To date, Energiesprong Italy counts:

- **30 large and small supply companies** within the construction industry are involved in the movement and have innovated production. Multiple supply chains have been established to undertake pilot projects. These are Italy's first examples of deep industrial retrofits using different technologies and structural materials (wood, steel, concrete and hybrid couplings).
- **15 social housing organisations**, divided between local public bodies, FEDERCASA members and private cooperatives, which own or manage over 150,000 homes. Meetings and workshops have been organised to understand their needs and how the supply can provide appropriate solutions.
- **5 pilot buildings** for a total of 455 apartments retrofitted with offsite integrated components.

More in detail, in July 2022 the first pilot project was launched in **Corte Franca** (Lombardy region). Differently from other Energiesprong countries, it was a private building realized by Woodbeton, a major panel manufacturer and general contractor, part of the Italian Energiesprong network. This choice has been forced by boundary conditions: 110% incentives have doped the renovation market, creating a surplus of private renovation demand which made public and social stock less urgent and less appealing.

A second private pilot project occurred in 2024 in **Pieve Emanuele** (Lombardy) and it used around 2000 light offsite façade panels, produced by Isopan, for energy and seismic retrofitting of 6 big condominiums in 3 months.
With the end of the 110% incentive and the forthcoming PNRR action line encouraging public intervention, the private sector became less attractive. For this reason, a pipeline of buildings from the public and cooperative housing sector was selected. These buildings are in urgent need of energy efficiency and energy poverty reduction. This is the case of **Via Russoli**, a set of 4 public residential towers in Milan, for a total of 187 dwellings. Achievements include the use of innovative offsite facades for energy retrofitting made with rice hulk biobased insulation, and the application of photovoltaic panels to meet energy needs and reduced energy poverty. Furthermore, a very interesting tenant engagement process was activated with the inhabitants, and it led to shared roof gardens.
Public organizations are increasingly aware of

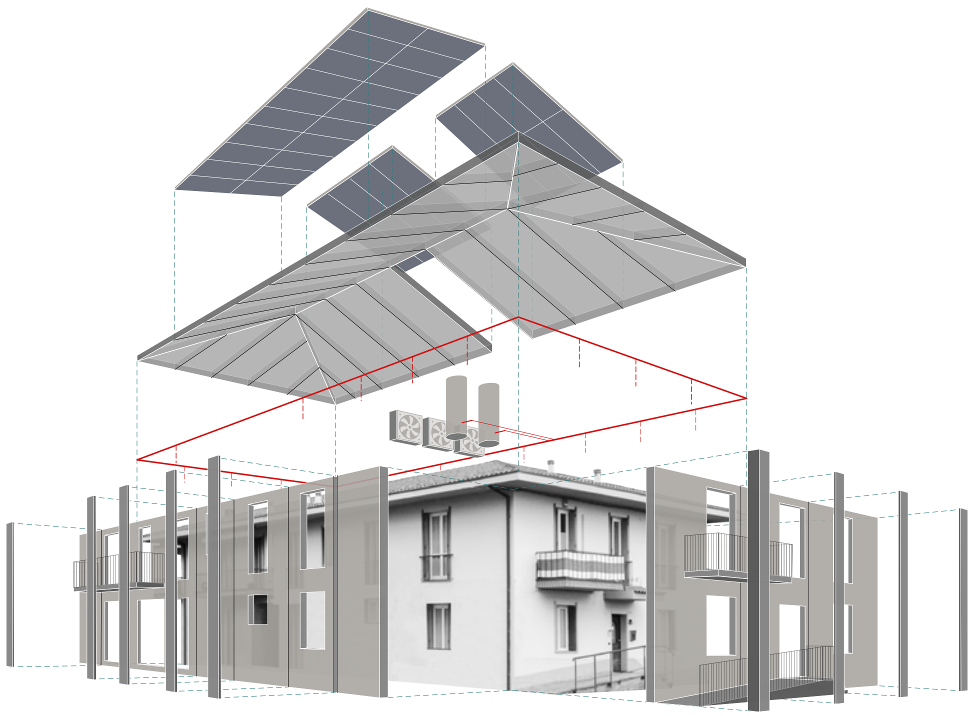
the need for alternative and innovative models to efficiently manage their stock due to limited financial capacity. Indeed, in Via Russoli a Public Private Partnership was implemented for the first time: Woodbeton, Ricehouse and a2a joined forces to candidate to the bid proposing an **EPC+ (Energy Performance Contract including energy supply and the maintenance of both technical and envelope systems)**.

Overall, strengths that characterize Energiesprong in Italy include the introduction of **anti-seismic improvement elements**, which require special attention at the design and structural level, and the **integration of plant systems** for summer cooling, given that insulation alone is insufficient in southern Europe. These elements make the model suitable for the Italian context and enrich the catalogue of technological solutions available internationally.
Indeed, in 2024 in the context of e-SAFE H2020 project, the first intervention in public social housing in south Italy was carried out in **Catania,** Sicily, a region characterized by high summer temperatures. The high levels of efficiency achieved have demonstrated the adaptability and versatility of these instruments in different climatic areas.

All the projects demonstrate the feasibility of key Energiesprong requirements:

- Achieved NZEB energy performance, reducing non-renewable energy consumption;
- Improved anti-seismic performance, increasing the vulnerability index;
- Minimized inconvenience to residents by installing façade panels without scaffolding;
- Enabled fully electric buildings with integrated with PV systems and heat pumps for DHW production;
- Significantly reduced environmental impact with respect to traditional interventions.

Finally, another challenge that Energiesprong Italy intends to tackle in the near future is to ensure high standards of quality to retrofit and preserve the nation's **architectural heritage** ensuring a high variety of finishings, materials and elements typologies adaptable to the broad Italian building stock.



Refurbished building in Corte Franca (Lombardy)

EU FUNDED RESEARCH PROJECTS

To meet the European Union's energy transition targets, especially after the ongoing revision of the EPBD, EED, and RED directives, the building environment is expected to change significantly over the next few decades[1]. However, energy renovations are expensive, and owners or building managers often lack the means to finance them. To fill the large financial gaps, several funding streams are available at the EU level to ensure that the necessary investments are made on the required scale. In fact, as stated in the Renovation Wave, "the EU's reconstruction instrument, NextGenerationEU, together with the EU's multiannual financial framework, will provide an unprecedented volume of resources that can also be used to kick-start renovation for reconstruction, resilience, and greater social inclusion".

The infographic below provides an overview of the EU funding schemes (from Renovate Europe), under three main headings:

- Supporting **direct investment** in quality construction and energy efficiency;
- **Leveraging private investment** on a larger scale and funding technical support services;
- Stimulating **research and innovation** and removing market barriers to building renovation.

Direct investment projects are primarily supported by the **European Regional Development Fund (ERDF),** the **Cohesion Fund (CF)** and the **Recovery and Resilience Facility (RRF)**. These funds aim to strengthen economic, social, and territorial cohesion by correcting imbalances between regions. Projects include investments in regional and urban development, infrastructure improvements, and initiatives to enhance energy efficiency in buildings[2].

Interreg is a program that promotes European territorial cooperation. Funded by the European Regional Development Fund (ERDF), Interreg supports cross-border, transnational, and interregional projects that aim to solve common problems among European regions and countries. These projects can cover various sectors, including the environment, innovation, sustainable mobility, and urban development. Interreg facilitates the sharing of knowledge and best practices, contributing to strengthening the economic, social, and territorial cohesion of the EU.

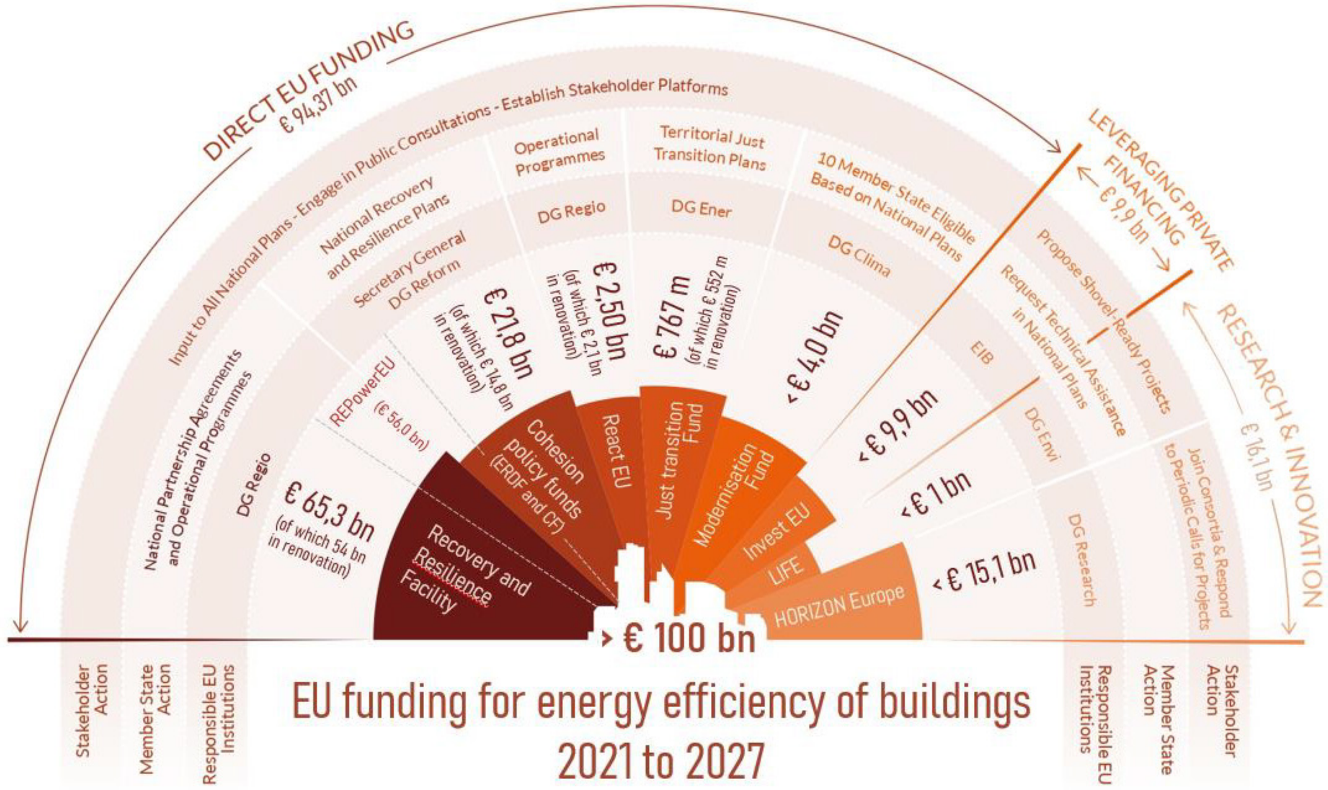
The **InvestEU Programme** is a key initiative for **leveraging private investment**. With an EU budget guarantee of €26.2 billion, the InvestEU Fund aims to mobilize more than €372 billion in additional investment by backing the investments of financial partners such as the European Investment Bank (EIB) Group. This program supports projects in areas like green and digital transitions, innovation, and social investments, thereby crowding in private investors to achieve significant economic and environmental impacts[3 4].

Finally, the third point on research and innovation the third point includes Horizon and LIFE projects, which provide around €17 billion for energy efficiency-related research. In total, more than €100 billion will be made available, which is around 20% of the EU budget that the European Green Deal Investment Plan has earmarked for achieving the 2030 climate-related targets[5].

The **Horizon** program is one of the main initiatives of the European Union to fund research and innovation. Horizon 2020 (2014-2020) and Horizon Europe (2021-2027) were designed to address global challenges, promote industrial competitiveness, and improve the quality of life for European citizens. Horizon funds are allocated to projects ranging from basic research to technological innovation, with a strong focus on environmental sustainability and climate neutrality. These projects include the development of advanced technologies for building renovation, the use of renewable energy sources, and the implementation of digital tools such as Building Information Modeling (BIM)[6].

The **LIFE** program is dedicated to the environment and climate action. Funded by the European Commission, LIFE supports projects that contribute to the transition towards a sustainable, circular, resource-efficient, and low-carbon economy. The LIFE Clean Energy Transition program (2021-2027) is a specific subsection aimed at facilitating the clean energy transition by funding projects that promote energy efficiency, the use of renewable energy, and the reduction of greenhouse gas emissions[7]. Research and innovation funded by these programs have led to the development of advanced technologies for industrialized building renovation, such as integrated timber façade panels, advanced HVAC components, and technologies for harvesting renewable energy. These projects address sustainable financial and operational models to facilitate the market adoption of such innovations.

In summary, the European Commission's 2021 to 2027 active funds through the Horizon, LIFE, and Interreg initiatives play a crucial role in promoting research, innovation, and sustainability, contributing to achieving climate neutrality and the intermediate targets for 2030.



Summary of funding allocated by the EU for energy efficiency of buildings between 2021 and 2027

1 https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en
2 https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes_en
3 https://investeu.europa.eu/investeu-programme_en
4 https://investeu.europa.eu/investeu-programme/investeu-fund/frequently-asked-questions-about-investeu-fund_en
5 https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en

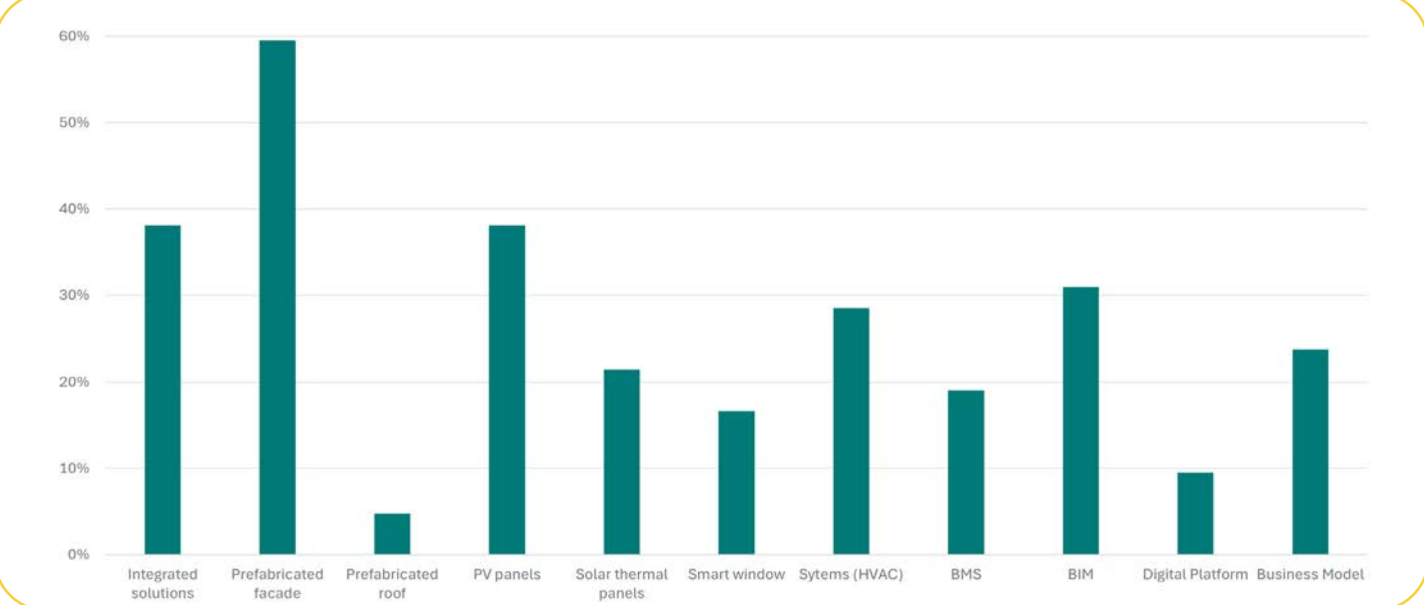
6 https://ec.europa.eu/newsroom/growth/items/690437/en
7 https://energy.ec.europa.eu/system/files/2020-10/eu_renovation_wave_strategy_0.pdf

HORIZON PROJECTS

Of the **Interreg, LIFE and Horizon programmes** mentioned above, the analysis in this Outlook focuses on the latter, which funds a wide range of activities, including scientific research, technological development, industrial innovation and business take-up.
The main **H2020** and **Horizon Europe** projects on industrialised deep renovation have been evaluated in order to highlight those that implement innovation in real **pilot buildings** (one of the most recurrent requirements in the Horizon call for proposals), which is the first step towards market activation of IDR (the countries falling into this category are shown in yellow on the map on page 39).

The analysis of these projects shows that they favour the use of **industrially prefabricated panels** (60%) as an energy efficiency solution, especially the most recent programmes. These panels significantly reduce the energy consumption of buildings, while using durable and quick to install solutions and offer a high level of comfort. These panels also enable integrated solutions such as **photovoltaic** (38%) or **solar thermal** (21%) systems, ensuring the use of renewable energy to power high-efficiency machines for heating/cooling, mechanical ventilation or domestic hot water (**HVAC**, 29%). These technologies can ensure even better performance when implemented with **BEM** and **BMS** systems (29%). Finally, the design phase can be optimised and more efficient through the use of **BIM** methods (31%), which are also useful during the intervention phase and throughout the building life cycle.
It is also essential to identify **business models** (24%) that ensure the creation of a stable market aimed at increasing the profitability and sustainability of this type of intervention from an economic and a social point of view.

In conclusion, many initiatives spread across Europe address industrialised deep renovation from different perspectives, using and focusing on different innovations. Most of them have been initiated and developed thanks to EU and national funding, while Energiesprong is the first autonomous movement. Even if cost compression and scalability are still open challenges, the forthcoming library of case studies shows the variability, architectural quality and high performance that IDR solutions can bring to the built environment.

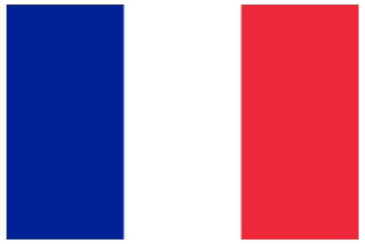


	Program	Start	End	Project coordinator	Integrated solutions	Prefabricated facade	Prefabricated roof	PV panels	Solar thermal panels	Smart window	Sytems (HVAC)	BMS	BIM	Digital Platform	Business Model	PILOTS 1	PILOTS 2	PILOTS 3	PILOTS 4	PILOTS 5
4Rin EU	Horizon 2020	2016	2021	IT		x					x				x	SP	NL	NO	IT	
ABRACADABRA	Horizon 2020	2016	2019	IT		x	x	x		x	x				x					
BERTIM	Horizon 2020	2015	2019	SP		x				x	x		x			SP	FR	SE		
BRESAER	Horizon 2020	2015	2019	SP	x	x		x	x	x					x	SP				
BE-SMART	Horizon 2020	2018	2022	CH				x												
BuiltHEAT	Horizon 2020	2015	2020	IT		x					x									
Drive 0	Horizon 2020	2019	2023	NL									x			IT	EE	LT		
E2VENT	Horizon 2020	2015	2018	FR	x						x	x				SP	FR	PO		
ENSNARE	Horizon 2020	2021	2025	SP	x			x	x	x		x	x	x		EE	BG	IT		
IMPRESS	Horizon 2020	2015	2018	NO		x							x		x	RO				
INCUBE	Horizon Europe	2022	2026	EL	x			x	x				x		x	SP	NL	IT		
INFINITE	Horizon 2020	2020	2026	IT	x	x					x	x	x	x	x	FR	SI	IT		
INSITER	Horizon 2020	2014	2018	NL									x							
INSUPanel	Horizon 2020	2017	2020	SP		x														
MORE CONNECT	Horizon 2020	2014	2019	NL	x	x	x						x			EE	PT	LV		
OptEEmal	Horizon 2020	2015	2019	SP										x						
OutPHit	Horizon 2020	2020	2024	DE		x									x	AT	DE	EL		
P2Endure	Horizon 2020	2016	2021	NL		x							x			PO	NL	NO		
PLUG-N-HARVEST	Horizon 2020	2017	2022	GR		x										SP	DE	EL		
PLURAL	Horizon 2020	2020	2024	GR	x	x		x	x		x	x	x		x	CZ	SP	EL		
POWERSKINPLUS	Horizon 2020	2019	2024	PO	x	x		x								PT	DE	CZ		
REHOUSE	Horizon 2022	2022	2026	SP	x	x		x		x						FR	IT	HU	EL	
PRO-GET-ONE	Horizon 2020	2017	2022	IT	x						x					NL	IT	RO		
RE4	Horizon 2020	2016	2020	IT											x	UK	SP	IT		
REMODULES	Horizon 2020	2020	2024	NL											x					
RE-SKIN	Horizon 2020	2017	2022	SP	x	x						x				FR	IT	BG		
REZBUILD	Horizon 2020	2017	2020	IT									x		x	NO	SP	IT		
StepUP	Horizon 2020	2019	2024	UK	x	x										HU	SP			
TransitionZero	Horizon 2020	2016	2018	UK		x														
e-SAFE	Horizon 2020	2020	2025	IT	x	x		x	x			x								
Envision	Horizon 2020	2017	2022	NL	x	x		x	x	x						NL				
Excess	Horizon 2020	2019	2024	AT				x	x							AT	BE	FI	SP	
Fortesie	Horizon Europe	2022	2025	LU	x	x	x	x		x	x					EL	PT	PO	LV	
Green instruct	Horizon 2020	2016	2020	UK	x	x														
Heart	Horizon 2020	2017	2022	IT		x		x				x				IT	FR			
Heart4cool	Horizon 2020	2016	2021	IT				x	x		x									
InnoWEE	Horizon 2020	2016	2020	IT		x														
Inperso	Horizon Europe	2022	2026	SP		x					x		x			SP	NL	EL		
Reco2st	Horizon 2020	2018	2021	DK				x		x	x	x								
RenoZEB	Horizon 2020	2017	2022	SP		x														
Rinno	Horizon 2020	2020	2025	IT		x		x			x		x	x	x	FR	EL	PO	DK	
Surefit	Horizon 2020	2020	2025	PT				x	x		x					PT	UK	EL	SP	FI
Total					**38%**	**60%**	**5%**	**38%**	**21%**	**17%**	**29%**	**19%**	**31%**	**10%**	**24%**					

CASE STUDIES

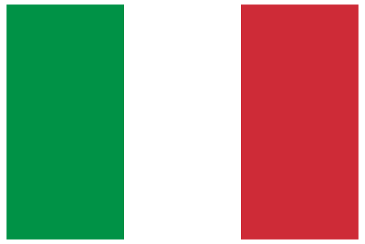
INDEX

AUSTRIA



FRANCE

GERMANY



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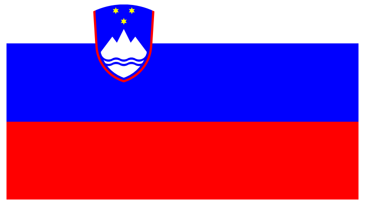


SLOVENIA

SPAIN

THE NETHERLANDS

THE UNITED KINGDOM

Kapfenberg

Find out more

The lead project pursues the goal of highly efficient refurbishment of existing buildings and housing estates in urban areas. The main focus is on buildings constructed between 1950 and 1980. The project is divided into 5 sub-projects, which cover all aspects of the high-quality refurbishment of residential buildings, from basic research to final monitoring.

The objectives of the implementation project (Kapfenberg) were to reduce the heating requirement and achieve the plus-energy standard by converting the energy supply to district heating, solar thermal energy, heat pumps and photovoltaics. The façade was renovated using prefabricated vertical timber elements that are used as a new insulation level and as building services shafts. For research purposes, 16 residential units were equipped with ventilation with heat recovery and the other 16 with an exhaust air system and exhaust air/water heat pump solution.

GENERAL DATA	
Address	Johann-Böhm-Straße 34, 8605 Bruck an der Mur
Year of renovation	2012-2014 (Planning 2011)
Housing owner	Residential building group ENNSTAL
General contractor	Nussmüller Architekten ZT GmbH
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1960s
Number of buildings	1
Number of floors (ground floor included)	4
Number of dwellings	reduced from 48 to 32
Balconies?	Yes
Total living area (m2)	2270m²
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Solid structure
Energy generation pre-renovation (type/fuel + centralized or autonomous)	-
Energy consumption pre-renovation (kwh/m2)	165 kWh/m²a

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	No
Inhabited during renovation?	Yes, inhabited for the total works duration
Tenant engagement process?	No
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	Yes, demolished and discharged to the ground
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Wooden support frame, 30cm,
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Hanged to the existing facade and the main load is transferred via a console
Circular/ biobased materials? If yes what type	District heating network
Photovoltaic panels?	Yes, integrated in the roof/facade
Solar thermal panels?	Yes, integrated in the roof/facade
Systems (ex. pipes/cables/mechanical ventilation) integrated in the panel? If yes, what type	Yes (building service shafts)
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	Yes, exhaust air heat pump
Monitoring system?	Yes
Total renovation cost (€)	4.2 Mio.
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	15 kWh/m²a
% consumption covered by renewables (PV/ ST panels)	plus energy attempt; 120,000 kilowatt hours annually
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	-
Lessons learnt (optional)	Facade integration of renewable energies is costly, Costs quickly escalate with prefabrication, Ventilation and heat pumps in combination with storage AND district heating are difficult to manage.


AEE INTEC


AEE INTEC

Angers

Find out more

This project is taking place in Angers. More precisely, it is taking place at 1 to 52 Rue d'Auvergne and 3 to 13 Rue Maurice Suard 49 100 Angers. The operation of the lessor Podeliha is a demonstrator project, in advance of phase, of the collective MASH approach. It involves the EnergieSprong renovation of 32 semi-detached houses in R+1. These houses have an average surface area of 86m². They include the following typologies: 9T4, 18T5 and 5T6.

This operation is a demonstrator project of the collective MASH approach. This approach brings together 14 lessors from the Pays de la Loire and Brittany region for the renovation of more than 2000 homes.

GENERAL DATA	
Address	Rue d'Auvergne
Year of renovation	2021
Housing owner	Podeliha
General contractor	Bouygues Construction
Panel manufacturer	Bouygues Construction

BUILDING INFORMATION	
Year of construction	1969
Number of buildings	32
Number of floors (ground floor included)	2
Number of dwellings	32
Balconies	No
Total living area (m2)	2,750 m²
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Classic concrete structure
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Individual gas
Energy consumption pre-renovation (kwh/m2)	183

RETROFIT INFORMATION	
Internal renovation	1969
Volume increase	32
Scaffoldings	2
Inhabited during renovation	32
Tenant engagement process	No
Total onsite works duration (days)	2,750 m²
% facade renovated offsite	-
% roof renovated offsite	
New balconies	Classic concrete structure
Facade installation time (m2/day)	Individual gaz
Panel structure (material + dimension + other info)	183
Panel weight handling	Hanged to existing facades
Circular/ biobased materials? If yes what type	Wood only for structure
Photovoltaic panels	No
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	No need to change windows
Heat pump? If yes, where has it been installed	No
Monitoring system	No
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	120
% consumption covered by renewables (PV/ ST panels)	0%
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	No
Lessons learnt (optional)	-

Halluin

Find out more

The Bouvier residence, located in Halluin, in Hauts-de-France, is currently being renovated using the EnergieSprong method. This 80-unit residence will be transformed into two residences of 40 and 30 residences. The project began in March 2022 and is scheduled for delivery in 2023.

The project involves the renovation of 40 MustBe0 and 30 Massiréno homes. The project began in March 2022 and is scheduled for delivery in 2023.

The residence was no longer adapted to current standards and needed a complete renovation. The EnergieSprong method proved to be the solution of choice for undertaking this comprehensive work. Indeed, the objective is to improve the energy performance of the building, but also to improve its comfort. Building extensions, green spaces and energy comfort are just three examples.

GENERAL DATA	
Address	Résidence Bouvier
Year of renovation	2022-2023
Housing owner	Notre Logis
General contractor	Tommasini
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1966
Number of buildings	1
Number of floors (ground floor included)	-
Number of dwellings	40
Balconies	Loggias
Total living area (m2)	2,000 m²
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Classic concrete structure
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	Individual gas
Energy consumption pre-renovation (kwh/m2)	385

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	Yes
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation	No, dwellings were empty when renovation occurred
Tenant engagement process	-
Total onsite works duration (days)	-
% facade renovated offsite	0%
% roof renovated offsite	0%
New balconies	Yes, demolished and hanged to new facade
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Traditionnal ext insulation
Panel weight handling	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels	Yes
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	No
Monitoring system	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	60
% consumption covered by renewables (PV/ ST panels)	All : E=0
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	30 years
Lessons learnt (optional)	-

Hem, Lille

Find out more

Located in the north of France and constructed in 1950, this twin home features two attached residences with a total heated floor area of approximately 84 square meters. With a combined overall façade area of 111 square meters (including windows and doors) and 88 square meters without, the building offers a compact yet versatile space for renovation experimentation. The two-storey building has a garden space in front and at the back, and the two residences have a common wall and a pitched roof. Bricks masonry perimeter walls surround the building.
Situated within a neighbourhood of 207 dwellings undergoing an Energiesprong renovation program, this building is part of a larger initiative to enhance energy efficiency and sustainability in the community by 2025.

As part of H2020 Infinite project, the all-industrialised BIPV kit will be installed on the façades. The possibility of installing PV for the roof has also been studied.
Building façade will receive exterior insulation, replacement of window and French door systems, and replacing the roofing (except the structure). The heat pumps and the electrical connections will also be upgraded and updated.

GENERAL DATA	
Address	Hem, Lille
Year of renovation	2025
Housing owner	Vilogia
General contractor	BYCN
Panel manufacturer	Sunage

BUILDING INFORMATION	
Year of construction	1950
Number of buildings	1
Number of floors (ground floor included)	2
Number of dwellings	2
Balconies?	no
Total living area (m2)	168 or 162 m²
Facade surface (m2)	88 m²
Roof surface (m2)	50 m²
Type of structure	Brick

Energy generation pre-renovation (type/fuel + centralized or autonomous)	Gas boiler
Energy consumption pre-renovation (kwh/m2)	273 kWh/ m²

RETROFIT INFORMATION	
Internal renovation	-
Volume increase	no
Scaffoldings	no
Inhabited during renovation?	Yes, inhabited for the total works duration
Tenant engagement process?	-
Total onsite works duration (days)	-
% facade renovated offsite	65%
% roof renovated offsite	-
New balconies?	no
Facade installation time (m2/ day)	-
Panel structure (material + dimension + other info)	Wooden facade panels
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	-
Circular/ biobased materials? If yes what type	Grass wool Isolant “Gramitherm”
Photovoltaic panels?	Yes, integrated in the roof/ facade
Solar thermal panels?	no
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	-
Windows integrated in the panel?	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	YES, on the ground floor
Monitoring system?	yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	target of 86 kWh/m²
% consumption covered by renewables (PV/ ST panels)	all E= 0
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-

MASH Lot 1

[Find out more](#)

In three municipalities of Maine et Loire (49), 4 mass renovation operations were carried out on a complex of 50 housing units.

The operations are as follows:
- Change of ventilation and heating system: Installation of a Nilan tower (Heating, DHW and double-flow ventilation);
- Renovation of the envelope with exterior insulation: prefabricated panels in the factory by Sogea (wood wool, FOB) and traditional ITE;
- Insulation of the attic;
- Installation of photovoltaic panels.

Energy efficiency is guaranteed for 30 years thanks to the installations installed in the buildings.

GENERAL DATA	
Address	Many cities in Pays de la Loire
Year of renovation	2023
Housing owner	Maine & Loire Habitat
General contractor	Sogea Atlantique (Vinci)
Panel manufacturer	Sogea Atlantique (Vinci)

BUILDING INFORMATION	
Year of construction	1960-80
Number of buildings	342
Number of floors (ground floor included)	2
Number of dwellings	342
Balconies?	No
Total living area (m2)	23,600 m²
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Classic concrete structure
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	Electric heating
Energy consumption pre-renovation (kwh/m2)	154

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	None
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process	-
Total onsite works duration (days)	-
% facade renovated offsite	50-60%
% roof renovated offsite	0%
New balconies?	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Metal - Large panels - With glazing
Panel weight handling	Hanged to existing facades
Circular/ biobased materials? If yes what type	Insulation in wood
Photovoltaic panels	Yes
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	Yes
Heat pump? If yes, where has it been installed	Yes - Internal module
Monitoring system	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	60
% consumption covered by renewables (PV/ ST panels)	All : E=0
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	30 years
Lessons learnt (optional)	-

MASH Lot 5

Find out more

This project is part of the MASH initiative (Mutualisation d’Achat au Service de l’Habitat), an EnergieSprong renovation purchasing center, aimed at massifying high-performance energy renovations through group orders.

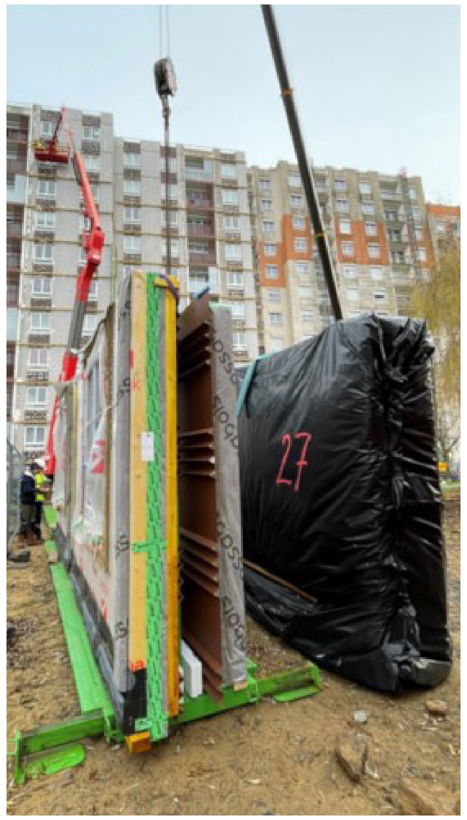
This lot stands out from previous EnergieSprong contracts due to the typology of buildings it involves: Sarthe Habitat chose this approach to renovate an 11-storey tower comprising 251 housing units, located in the heart of Le Mans. This tower represents a particular challenge due to its size and location. The renovation work on this emblematic project was launched on Monday, May 22, 2023.

This initiative demonstrates Sarthe Habitat’s commitment to improving the energy efficiency of housing, even in complex buildings such as residential towers. Using the EnergieSprong approach, Sarthe Habitat aims to transform this tower into a zero-energy building, thus offering better comfort to residents, sustainable protection against rising energy prices (energy shield) while radically reducing its environmental impact. This pilot project will contribute to the learning and dissemination of good practices in high-performance energy renovation, while serving as a model for future similar projects.

GENERAL DATA	
Address	Résidence George Gauthier
Year of renovation	2024
Housing owner	Sarthe Habitat
General contractor	Groupe Altyn
Panel manufacturer	LCA/Ossabois

BUILDING INFORMATION	
Year of construction	1975
Number of buildings	1
Number of floors (ground floor included)	12
Number of dwellings	251
Balconies	No
Total living area (m2)	14,500
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Classic concrete structure
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	Collective gas
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	Yes, just for a small part of the facade
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process?	
Total onsite works duration (days)	
% facade renovated offsite	100%
% roof renovated offsite	0%
New balconies	No, building has no balconies
Facade installation time (m2/day)	
Panel structure (material + dimension + other info)	Wood - Large panels - With glazing
Panel weight handling	Hanged to existing facades
Circular/ biobased materials? If yes what type	Wood for facades
Photovoltaic panels	Yes, installed after the panels
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	Yes
Heat pump? If yes, where has it been installed	No
Monitoring system	Yes
Total renovation cost (€)	
Facade cost, supply + installation (€/m2)	
Energy consumption post-renovation (kwh/m2)	90
% consumption covered by renewables (PV/ ST panels)	All : E=0
LCA, if any (tCO2eq/m2 or other KPIs)	
Antiseismic improvement	No
Performance guarantee duration	30 years
Lessons learnt (optional)	



Raismes

Find out more

The Anne Godeau elementary school welcomes 171 students. It is located in Raismes, in Hauts-de-France. It was built in 1967. The City of Raismes now wants to rehabilitate it. The building is composed of classrooms, a catering satellite and a gymnasium.

The renovation project is part of a municipal approach in order to then replicate it on the scale of the agglomeration.

The objective is to achieve E=0 over 20 years via the EnergieSprong approach. The project began in December 2022 and was delivered in September 2023.

GENERAL DATA	
Address	Ecole Anne Godeau
Year of renovation	2023
Housing owner	City of Raismes
General contractor	HDF Construction
Panel manufacturer	HDF Construction

BUILDING INFORMATION	
Year of construction	1967
Number of buildings	1
Number of floors (ground floor included)	3
Number of dwellings	-
Balconies	No
Total living area (m2)	1,962 m²
Facade surface (m2)	-
Roof surface (m2)	654 m²
Type of structure	Classic concrete structure from the 70s
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Gas boiler centralized
Energy consumption pre-renovation (kwh/m2)	223

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation	No, move out for the total works duration
Tenant engagement process	Yes
Total onsite works duration (days)	730
% facade renovated offsite	100%
% roof renovated offsite	0%
New balconies	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure	Traditionnal ext insulation
Panel weight handling	-
Circular/ biobased materials? If yes what type	Biobased
Photovoltaic panels	Yes, installed after the panels
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	Yes, technical local
Monitoring system	Yes
Total renovation cost (€)	4501377
Facade cost, supply + installation (€/m2)	747
Energy consumption post-renovation (kwh/m2)	22
% consumption covered by renewables (PV/ ST panels)	All : E = 0
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	20 years
Lessons learnt (optional)	

Roubaix

Find out more

The first EnergieSprong renovation project on a collective housing
Vilogia is applying the EnergieSprong approach for the first time to collective housing. The residence targeted by the project is the Philippe Le Hardi residence. It is located in Roubaix. It consists of 32 housing units that were built in the 1950s. This project, which began in October 2021, is partly financed by the European fund Interreg North West Europe (NWE).
The EnergieSprong approach and its E=0 renovation objectives, lower cost and speed, thanks to the use of prefabricated was selected. The objective of the project is to renovate energy-intensive housing into E=0 housing. Indeed, the aim is to enable them to produce as much energy as they consume for 25 years. In addition, the approach aims to improve the thermal and acoustic comfort of tenants as well as their living environment. Finally, these renovations will result in a significant reduction in energy bills for residents.

GENERAL DATA	
Address	Rue d'Oran
Year of renovation	2022
Housing owner	Vilogia
General contractor	-
Panel manufacturer	BuildUp Offsite

BUILDING INFORMATION	
Year of construction	1950
Number of buildings	1
Number of floors (ground floor included)	4
Number of dwellings	32
Balconies	No
Total living area (m2)	1,450 m²
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Classic concrete structure
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Individual gas
Energy consumption pre-renovation (kwh/m2)	336

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	Yes, just for a small part of the facade
Inhabited during renovation	No, dwellings were empty when renovation occurred
Tenant engagement process	-
Total onsite works duration (days)	-
% facade renovated offsite	100%
% roof renovated offsite	100%
New balconies	No, building has no balconies
Facade installation time (m2/ day)	-
Panel structure (material + dimension + other info)	Metal - Large panels - With glazing
Panel weight handling	Hanged to existing facades
Circular/ biobased materials? If yes what type	No
Photovoltaic panels	Yes, installed after the panels
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	Yes
Heat pump? If yes, where has it been installed	Yes - Collective ext modules
Monitoring system	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	60
% consumption covered by renewables (PV/ ST panels)	All : E=0
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	25 years
Lessons learnt (optional)	-

Saint-Jean-de-Vedas

Find out more

Saint-Jean de Védas is located in the Montpellier metropolitan area, in the South of France. The building of the Escholiers elementary school was renovated there according to the EnergieSprong approach. It is a public school with 243 students. Following these renovations, the school changed its name and is now called the Georges Rascol school.

The project was carried out as part of a program to maintain, modernize and improve the comfort of the school heritage of the city of Saint-Jean-de-Védas.

On the one hand, these renovations result in E=0 over 20 years. This guarantees better living conditions for students. In addition, this zero energy level contributes to the challenges of France's National Low Carbon Strategy. On the other hand, all the work was carried out during the summer of 2022. Indeed, the project began in May 2022 and was inaugurated in November 2022. It was these requirements for results, both in terms of energy and speed on site, which were the decisive elements for the city in their choice to carry out this first EnergieSprong school renovation project in France.

GENERAL DATA	
Address	Les Escholiers
Year of renovation	2022
Housing owner	City of SJDV
General contractor	Sogea (Vinci)
Panel manufacturer	Sogea (Vinci)

BUILDING INFORMATION	
Year of construction	1970
Number of buildings	1
Number of floors (ground floor included)	2
Number of dwellings	-
Balconies	No
Total living area (m2)	1,500 m²
Facade surface (m2)	
Roof surface (m2)	750 m²
Type of structure	Classic concrete structure from the 70s

RETROFIT INFORMATION	
Internal renovation?	Yes
Volume increase?	No
Scaffoldings?	Yes, just for a small part of the facade
Inhabited during renovation?	No, move out for the total works duration
Tenant engagement process?	Yes
Total onsite works duration (days)	150
% facade renovated offsite	75%
% roof renovated offsite	0%
New balconies?	No, building has no balconies
Facade installation time (m2/day)	
Panel structure (material + dimension + other info)	Metal - Large panels - With glazing
Panel weight handling	-
Circular/ biobased materials? If yes what type	Biobased
Photovoltaic panels	Yes
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel?	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	No
Monitoring system	Yes
Total renovation cost (€)	1,191,200
Facade cost, supply + installation (€/m2)	337
Energy consumption post-renovation (kwh/m2)	30
% consumption covered by renewables (PV/ ST panels)	All : E = 0
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	20 years
Lessons learnt (optional)	-

Vaulx-en-velin

Find out more

The Noirettes and Grand Bois residences are located in Vaulx-en-Velin, in the Auvergne-Rhône-Alpes region. Est Métropole Habitat has rehabilitated 988 homes there, spread across 9 buildings. These were built in the 1970s. This is the first project in France of such a scale inspired by the EnergieSprong approach.

The renovation, with 42% prefabricated facade, made it possible to renovate almost 1,000 homes and to reduce the duration of the construction site to 19 months. Thanks to this technique, the buildings were able to be rehabilitated quickly and efficiently. In addition, this process of industrialized facade rehabilitation made it possible to thermally insulate the homes, optimize deadlines and minimize nuisances for tenants. Finally, bio-sourced materials from the circular economy were used.

GENERAL DATA	
Address	Noirettes et Grand Bois (Mas du Taureau)
Year of renovation	2021
Housing owner	Est Metropole Habitat
General contractor	Vinci Construction
Panel manufacturer	Arbonis

BUILDING INFORMATION	
Year of construction	1972
Number of buildings	9
Number of floors (ground floor included)	9
Number of dwellings	988
Balconies	No
Total living area (m2)	66000
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Classic concrete structure
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Collective gas
Energy consumption pre-renovation (kwh/m2)	182

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	Yes, just for a small part of the facade
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process	-
Total onsite works duration (days)	-
% facade renovated offsite	42%
% roof renovated offsite	0%
New balconies	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Wood - Large panels - Without glazing
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Hanged to existing facades
Circular/ biobased materials? If yes what type	Wood only for structure
Photovoltaic panels	No
Solar thermal panels	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	No
Windows integrated in the panel	No need to change windows
Heat pump? If yes, where has it been installed	No
Monitoring system	No
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	120
% consumption covered by renewables (PV/ ST panels)	0%
LCA, if any (tCO2eq/m2 or other KPIs)	
Antiseismic improvement	No
Performance guarantee duration	No
Lessons learnt (optional)	-

Wattrelos

Find out more

Wattrelos is located in the European Metropolis of Lille. There are 160 social housing units there. These were targeted by an energy renovation project, because the district, dating from the 1960s, was then aging.
The project thus concerns the rehabilitation of this residential district. This project concerns 400 inhabitants. Vilogia intended to transform this housing estate made up of energy-intensive houses into E=0 housing in record time. To do this, they applied the EnergieSprong approach which consists of an “off-site” energy renovation, thanks to the use of prefabricated buildings. This is the first renovation project on this scale in France and Europe – outside the Netherlands! Previously, EnergieSprong operations only applied to a single building.
The idea behind the project is on the one hand to transform these homes into buildings that meet the European ecological objectives of 2050 and on the other hand to carry out the renovations, while respecting the inhabitants. It is also about providing a better quality of life for tenants by ensuring greater comfort. Indeed, the quality of the air and its renewal as well as the management of the temperature of the buildings are included in the project. In addition, the project has contributed to the development of the region's economic activity thanks to the increased skills of local construction players in off-site activity. Finally, the speed of the actions was a great asset. The project began in 2020 and was delivered in 2022.

GENERAL DATA	
Address	Quartier de Beaulieu
Year of renovation	2021
Housing owner	Vilogia
General contractor	Rabot Dutilleul Construction
Panel manufacturer	BuildUp Offiste

BUILDING INFORMATION	
Year of construction	1960
Number of buildings	154
Number of floors (ground floor included)	2
Number of dwellings	154
Balconies	No
Total living area (m2)	13,900 m²

Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Classic concrete structure
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Individual gas
Energy consumption pre-renovation (kwh/m2)	313

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	Yes, for small part of the facade
Inhabited during renovation	Yes, inhabited for total duration
Tenant engagement process	-
Total onsite works duration (days)	-
% facade renovated offsite	50%
% roof renovated offsite	100%
New balconies	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Metal - Large panels - With glazing
Panel weight handling	New ground foundations
Circular/ biobased materials? If yes what type	Wood for facades
Photovoltaic panels	Yes, installed after the panels
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	Yes
Heat pump? If yes, where has it been installed	Yes - Internal module
Monitoring system	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	60
% consumption covered by renewables (PV/ ST panels)	All : E=0
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	25 years
Lessons learnt (optional)	-






Bochum, Katharinastrasse

Find out more

The project concerns the serial and in-depth redevelopment of three residential buildings from the 1950s with 24 apartments.
The use of prefabricated facade modules made it possible to reduce the activities on the construction site and therefore the disturbance for the residents. In particular, the facade insulation involved the use of prefabricated and pre-finished elements with a wooden structure while the roof was redone and the attic floor, which is occupied by some of the systems, was insulated.
The roof houses a photovoltaic system for the production of electricity which powers a water-water heat pump in combination with geothermal probes for heating and the production of domestic hot water.
The new heat generator allows you to generate 4.5 kWh of heat for every 1 kWh of electricity: it is a system particularly suitable for existing buildings but requires a properly insulated casing.
Thanks to the reduction in heating and maintenance costs, a return on investment is expected in 10 years.

GENERAL DATA	
Address	Katharinastrass, Bochum
Year of renovation	2022
Housing owner	Vonovia SE
General contractor	Fischbach Gruppe GmbH
Panel manufacturer	Fischbach Gruppe GmbH

BUILDING INFORMATION	
Year of construction	1955
Number of buildings	1
Number of floors (ground floor included)	4
Number of dwellings	24
Balconies	Yes
Total living area (m2)	1164
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	-
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	-
Energy consumption pre-renovation (kwh/m2)	158

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	Yes
Inhabited during renovation?	-
Tenant engagement process?	-
Total onsite works duration (days)	150
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	Yes
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Timber structure, 1 floor height, windows integrated
Panel weight handling	Hanged to existing facade
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes, on the roof
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	-
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	Yes
Monitoring system?	-
Total renovation cost (€)	2,5 million
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	20,13
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	-
Lessons learnt (optional)	-

Bochum, Mörikestrasse

Find out more

The intervention involved a residential building built in 1968 with 32 apartments.
The Net Zero standard was achieved by installing 105 highly insulated prefabricated façade modules with a wooden structure and external finish and a new flat roof with photovoltaic modules.
The apartments received new units for heating, domestic hot water production and controlled mechanical ventilation, with the extraction of air from the bathroom and kitchen and the introduction of air at a controlled temperature by heat pumps.
Furthermore, the apartments have been enlarged and made brighter with the transformation of the existing loggias and the installation of generous 8m2 balconies.
The common outdoor spaces were also redeveloped to resolve accessibility problems, as well as the stairwells and the doors were replaced with new aluminum elements with insulating glass.
A halving of heating costs and a reduction in the costs of electricity supplied by the photovoltaic system are expected.

GENERAL DATA	
Address	Mörikestrasse, Bochum
Year of renovation	2021
Housing owner	VBW Bauen and Wohnen Gmbh
General contractor	B&O Group
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1968
Number of buildings	1
Number of floors (ground floor included)	4
Number of dwellings	32
Balconies?	Yes
Total living area (m2)	2368
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	-
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	-
Energy consumption pre-renovation (kwh/m2)	142

RETROFIT INFORMATION	
Internal renovation	-
Volume increase	No
Scaffoldings	Yes
Inhabited during renovation?	-
Tenant engagement process?	-
Total onsite works duration (days)	180
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	Yes
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Timber strubture, 1 floor height
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Hanged to existing facade
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	-
Windows integrated in the panel?	-
Heat pump? If yes, where has it been installed	-
Monitoring system?	-
Total renovation cost (€)	4,5 million
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	30
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-

Cologne

Find out more

The project was born with the aim of quickly and cost-effectively redeveloping the four-storey condominium built in 1962, improving its energy performance from low efficiency to a Net Zero standard and guaranteeing continuity of living for the inhabitants during the entire construction period.
Once the intervention is completed, the building generates renewable energy to cover the residents' needs for heating, domestic hot water and electricity.
In particular, the envelope was redeveloped using prefabricated facade panels with integrated windows and doors and prefabricated roofing elements.
At the plant level, the existing heat generator was replaced by a centralized heat pump with new terminals, a photovoltaic system was installed on the roof, a ventilation system with heat recovery was integrated into the facade and intelligent control systems were installed. energy management.
Furthermore, the architectural quality of the building was improved thanks to the installation of a high-quality facade finish and new larger and more transparent balconies.

GENERAL DATA	
Address	Schwalbacher Straße, Cologne
Year of renovation	2023
Housing owner	Wohnungsgenossenschaft am Vorgebirgspark eG
General contractor	Zeller Kölmel Architekten GmbH Korona Holz & Haus GmbH Energiebüro vom Stein GmbH
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1962
Number of buildings	1
Number of floors (ground floor included)	4
Number of dwellings	16
Balconies?	Yes
Total living area (m2)	992
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	-
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	-
Energy consumption pre-renovation (kwh/m2)	201

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	-
Inhabited during renovation?	-
Tenant engagement process?	-
Total onsite works duration (days)	390
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	Yes
Facade installation time (m2/ day)	-
Panel structure (material + dimension + other info)	Timber structure insulated with pre-assembled windows
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes, photovoltaic system on the roof for CO2-neutral electricity generation
Solar thermal panels?	-
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	Facade-integrated ventilation system with heat recovery
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	Heat pump for central heating, including storage
Monitoring system?	Smart sensors and thermostat valves
Total renovation cost (€)	1,9 million
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-10
% consumption covered by renewables (PV/ ST panels)	100%
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-

Mönchengladbach

Find out more

The project is part of a complex of buildings redeveloped by five partners, including Saint-Gobain, which applied the PreFormance solution in this project.
The buildings, constructed in 1956, were selected for their geometric simplicity and potential for replicability.

The deep retrofit involved the use of prefabricated envelope elements, the replacement of the heat generation system with an air-water heat pump, storage systems for domestic hot water, ventilation systems and photovoltaic panels.

GENERAL DATA	
Address	Mönchengladbach
Year of renovation	2023
Housing owner	LEG Immobilien SE
General contractor	Ecoworks GmbH
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1956
Number of buildings	5
Number of floors (ground floor included)	2
Number of dwellings	20
Balconies?	No
Total living area (m2)	1000
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	-
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	-
Energy consumption pre-renovation (kwh/m2)	205

RETROFIT INFORMATION	
Internal renovation	-
Volume increase	-
Scaffoldings	Yes
Inhabited during renovation?	-
Tenant engagement process?	-
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	No
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Prefabricated facade elements including insulation, windows and doors
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes, photovoltaic systems as roof-mounted
Solar thermal panels?	-
Systems (ex. pipes/cables/mechanical ventilation) integrated in the panel? If yes, what type	Building services module integrated into the facade, which houses the heating and hot water pipes
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	-
Monitoring system?	-
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	50
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-

Catania

The case study consists of a multi-storey residential building in the city of Catania, owned by the Istituto Autonomo Case Popolari (IACP). The construction system is a reinforced concrete frame.
The intervention involves the application of an integrated retrofit technology, a new building envelope made up of a combination of prefabricated wood-based panels that act as both thermal insulation and structural reinforcement. Specifically, the seismic performance is provided by cross-laminated timber (X-Lam or e-CLT) panels fixed to the building's reinforced concrete beams using innovative friction-based seismic dampers.
The X-Lam panels are combined with timber frame panels (e-PANEL) for thermal insulation, to be installed on the building's windowed walls, together with new high-efficiency energy windows to replace the existing ones.
Finally, the intervention includes the creation of a new mechanical system (e-THERM) for the production and distribution of hot water, which includes high-efficiency air-to-water heat pumps powered by on-site photovoltaic energy production, a central storage tank for thermal energy storage and decentralised storage tanks for distribution to individual residential units.

GENERAL DATA	
Address	Via Acquicella Porto, Catania
Year of renovation	2024 - 2025
Housing owner	Istituto Autonomo Case Popolari (IACP)
General contractor	-
Panel manufacturer	E-Safe - Wedest

BUILDING INFORMATION	
Year of construction	1964
Number of buildings	1
Number of floors (ground floor included)	5
Number of dwellings	10
Balconies?	Yes
Total living area (m2)	-
Facade surface (m2)	1230
Roof surface (m2)	-
Type of structure	Reinforced concrete frame and walls made of lightweight concrete blocks
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Gas boilers
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	Yes
Inhabited during renovation?	-
Tenant engagement process?	-
Total onsite works duration (days)	-
% facade renovated offsite	50 %
% roof renovated offsite	N/A
New balconies?	No
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Timber XLAM structure, 18 cm thick, 60 to 100 km/m²
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Localized anchoring on friction-based seismic damper
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	No
Windows integrated in the panel?	No, installed separately
Heat pump? If yes, where has it been installed	Yes
Monitoring system?	-
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	300
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	Yes
Performance guarantee duration	-
Lessons learnt (optional)	-

Corte Franca, Brescia

The first Energiesprong intervention in Southern Europe took place in the municipality of Corte Franca (BS). For the first time in Italy, a building was retrofitted to NZEB standards using offsite technologies, with prefabricated panels installed in less than a week and without disturbing the occupants. The removal of gas, on-site energy production and improved insulation will reduce cumulative emissions by over 75% by 2050 compared to the pre-intervention state.

The NZEB energy efficiency and seismic retrofit intervention was carried out through new facades and roofs made of prefabricated wood panels, with a new external perimeter foundation, while the deteriorated balconies were demolished and rebuilt off-site.

The chosen energy system solution is fully electric, with a heat pump, a photovoltaic system with storage and a solar thermal system. The new systems are located in the attic, and heat and hot water are distributed through vertical shafts in the thickness of the new facades, accessible from the outside for maintenance.

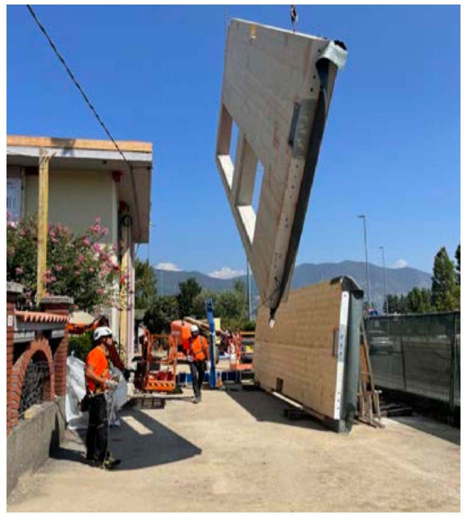
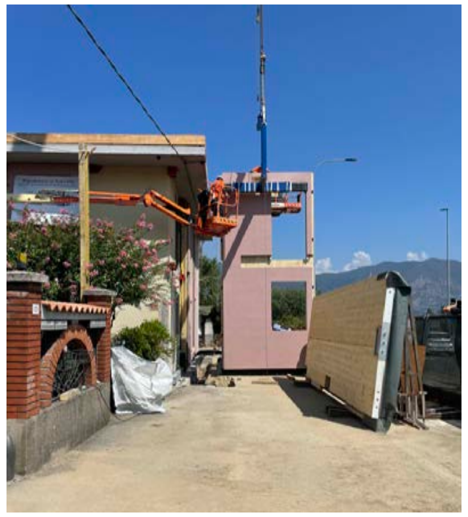
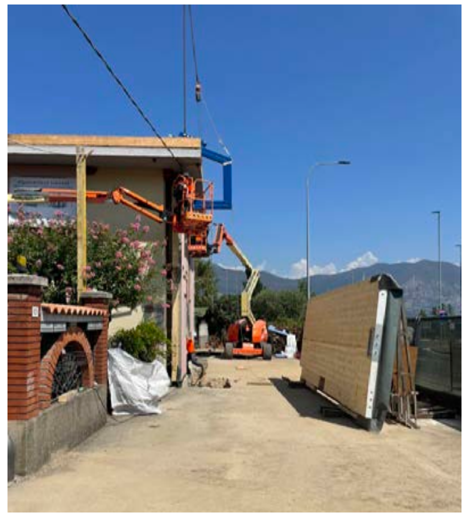
The project integrates seismic safety and energy performance with off-site solutions in record time. The 18 prefabricated panels covering the building's facades were installed at a rate of one per hour, with the entire installation taking less than a week to complete.

GENERAL DATA	
Address	Via Roma 103 Colombaro di Corte Franca
Year of renovation	2021
Housing owner	Private
General contractor	Woodbeton
Panel manufacturer	Woodbeton

BUILDING INFORMATION	
Year of construction	1973
Number of buildings	1
Number of floors (ground floor included)	2
Number of dwellings	5
Balconies?	Yes
Total living area (m2)	551
Facade surface (m2)	378
Roof surface (m2)	-

Type of structure	Concrete frame
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	Autonomous gas heat generator
Energy consumption pre-renovation (kwh/m2)	213

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	No
Inhabited during renovation?	Yes
Tenant engagement process?	No
Total onsite works duration (days)	160
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	Yes
Facade installation time (m2/day)	140
Panel structure (material + dimension + other info)	Timber structure, vertical orientation
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Supported by new perimeter curb and facade anchoring
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes
Solar thermal panels?	Yes
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	New vertical distribution in facade thickness accessible from exterior
Windows integrated in the panel?	No
Heat pump? If yes, where has it been installed	Yes, under the roof
Monitoring system?	-
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	475
Energy consumption post-renovation (kwh/m2)	41
% consumption covered by renewables (PV/ ST panels)	64
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	Yes
Performance guarantee duration	-
Lessons learnt (optional)	-


Greve in Chianti, Florence

Find out more

The Italian demonstration building of the INFINITE project, located in Greve in Chianti (FI) and part of the public housing heritage, consists of one of two identical buildings with a ground floor pilotis entrance, composed of four apartments.
The project involves the demolition of the existing roof and the deteriorated balconies, which will be replaced by prefabricated covering modules and balconies with integrated ventilation units in the parapet, with air ducts in the prefabricated facades; new foundations will be created for the supporting pillars of the balconies. The four facades will be covered with prefabricated modules made of a timber frame structure that will house the various technologies such as: air ducts, BIPV, BIST and smart windows.
The BIPV system will be installed on both the roof and the east and west facades, in an oxidised red colour to match the colour of the passive cladding. The south-facing panels will incorporate BIST technology to support the production of domestic hot water (ACS).
The windows will have a louvered shading system integrated into the double glazing, and a Building Management System (BMS) will control the building's systems.

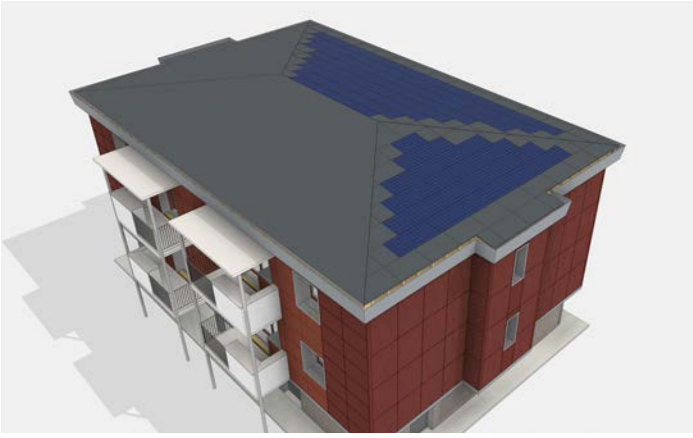
GENERAL DATA	
Address	Via di Colognole, Greve in Chianti
Year of renovation	2024 - 2025
Housing owner	Municipality, managed by Casa Spa
General contractor	-
Panel manufacturer	Fanti Legnami

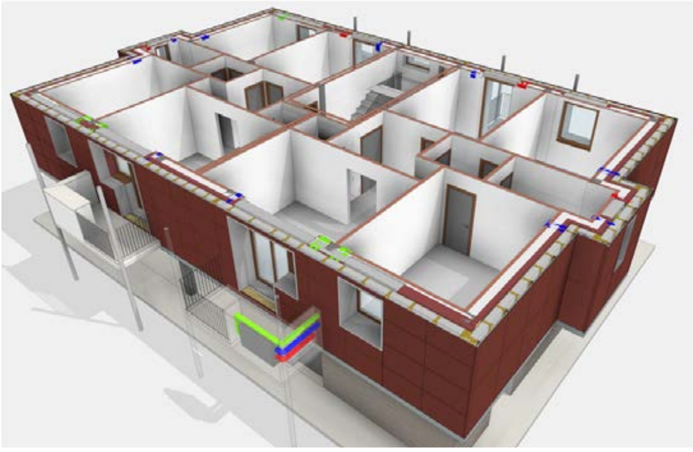
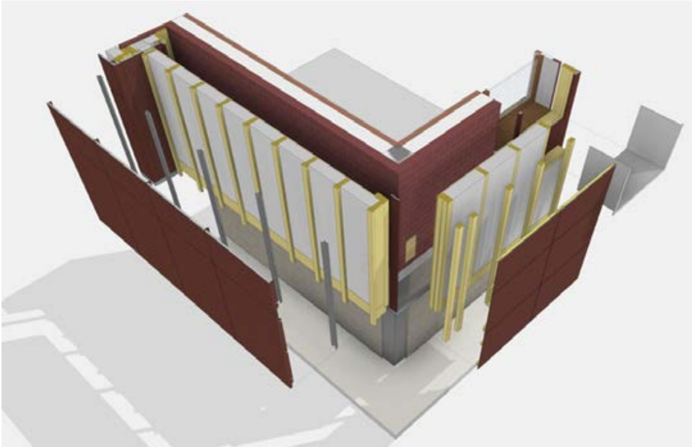
BUILDING INFORMATION	
Year of construction	1979
Number of buildings	2
Number of floors (ground floor included)	3
Number of dwellings	8
Balconies?	Yes
Total living area (m2)	-
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Concrete frame
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Autonomous heating system and domestic hot water produced with individual gas boilers
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	-
Volume increase	-
Scaffoldings	No
Inhabited during renovation?	-
Tenant engagement process?	-
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	Yes
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Wooden facade panels
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes, BIPV (building integrated photovoltaic), 48% self-consumption target
Solar thermal panels?	Yes, BIST (building integrated solar thermal) for DHW (domestic hot water)
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	Pipes integrated in the facade
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	-
Monitoring system?	Pre monitoring data collection has begun
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-







Passeggiata dei Castani, Bolzano

The project features two social housing buildings with 72 residential units, situated at Via Passeggiata dei Castani 33 in Bolzano, Italy. The renovation action development aimed to provide affordable housing while meeting strict sustainability and energy efficiency requirements. The construction site was strategically organized to enhance installation and finishing workflows, cutting production and construction time by 60%, particularly through rapid façade installation reaching 225 m² daily.

A distinctive feature of the project is its innovative prefabricated timber façades. These multifunctional elements combine architectural appeal with practical benefits, incorporating premium windows and external shading systems (movable external venetian blinds) that maximize energy efficiency and resident comfort. Given that this was the first Italian experience of this kind, the design team and customer decided to pass through a mockup and preliminary testing phase (performed by Eurac Research) to check the feasibility and the expected performances of such complex prefabricated façade system.

The engineering design included a centralized heating system delivering both domestic hot water and space heating. The renovation also included a dual efficiency heat pump coupled to 16 geothermal probes , each extending 150 meters underground. This system delivers 73% of the required space heating, minimizing fossil fuel usage. Building first block has a roof-mounted photovoltaic system, sized to power the central heating system's heat pumps and supporting common area energy needs for one building. Building second block's rooftop featured advanced solar thermal collectors, designed to supply 59% of the total hot water needs.

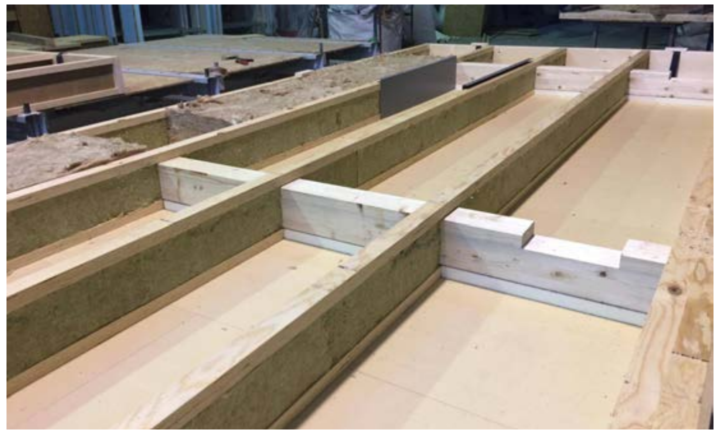
Both buildings employ decentralized mechanical ventilation systems to maintain optimal indoor air quality while reducing heat loss. Additionally, twenty-seven units are equipped with monitoring systems tracking window usage and energy consumption patterns. This monitoring enables detailed analysis of resident behavior, supporting targeted improvements in energy efficiency and user engagement.

GENERAL DATA	
Address	Via Passeggiata dei Castani 33, Bolzano (BZ)
Year of renovation	2017 - 2019
Housing owner	Municipality Bolzano
General contractor	Carron Bau Srl
Panel manufacturer	Aster Holzbau, San Genesio
Design	Smaprogetti (TO)*

BUILDING INFORMATION	
Year of construction	1989
Number of buildings	2
Number of floors (ground floor included)	6
Number of dwellings	72
Balconies?	Yes
Total living area (m2)	7.364 mq
Facade surface (m2)	6.019 mq
Roof surface (m2)	1.866 mq
Type of structure	Concrete frame
Energy generation pre-renovation	Autonomous heating system and domestic hot water produced with individual gas boilers
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	yes (97 mq)
Scaffoldings	yes
Inhabited during renovation?	Yes
Tenant engagement process?	Yes
Total onsite works duration	540 days
% facade renovated offsite	64%
% roof renovated offsite	none
New balconies?	No
Facade installation time	225 mq/day
Panel structure	Wooden façade panels (2,9x6 m) with glasswool, wood fiber HD and alluminium as external cladding
Panel weight handling	hanged on concrete frame
Circular/ biobased materials?	Wood as load bearing structure
Photovoltaic panels?	Yes on the roof for 52 KWp (not integrated)
Solar thermal panels?	Yes on the roof (not integrated)
Systems integrated in the panel?	Yes, shading system (venetian blinds), ventilation pipes
Windows integrated in the panel?	No
Heat pump?	Yes, in the technical room
Monitoring system?	Pre monitoring data collection has begun
Total renovation cost (€)	5.394.130 €
Facade cost, supply and installation (€/m2)	-
Energy consumption post-renovation	22,5 kWh/mq*y (12 kW/mq*y envelope efficiency)
% consumption covered by renewables	81% PV, 59% ST
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	2 years
Lessons learnt	Construction times reduced by 60%, quality control off site ed on site

* Designed by: ing. Giorgio Sandrone, ing.Paolo Sobrino, Arch. Elisabetta Marocco, arch. Alberto Sasso, arch. Manuel Benedikter, arch. Alberto Olivotto, Arch. Dipl. Ing. Gerhard Kopeinig, ing. Giuseppe Glionna, Ing. Andrea Cagni, ing. Massimo Vettori, P.I. Sandro Vettori

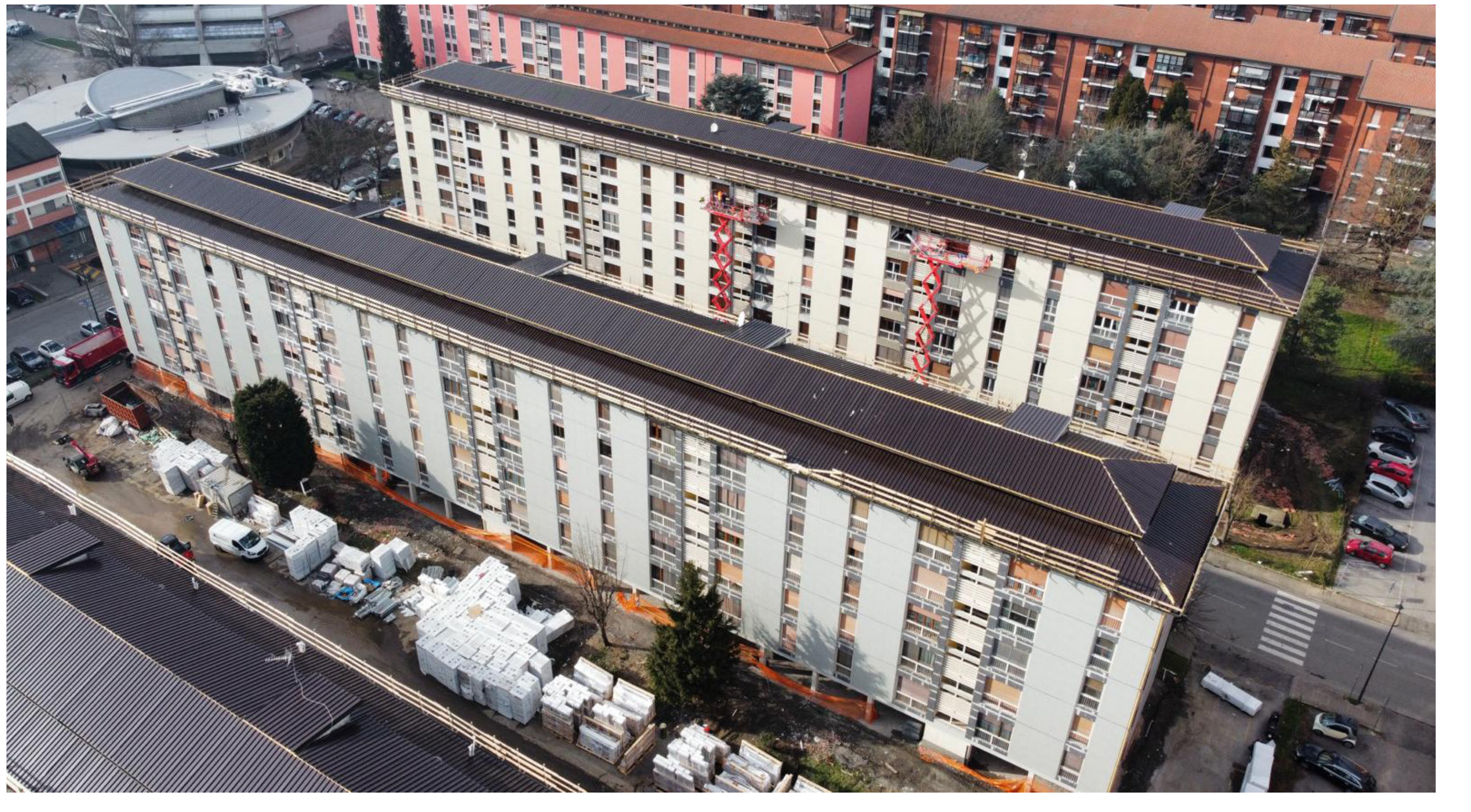
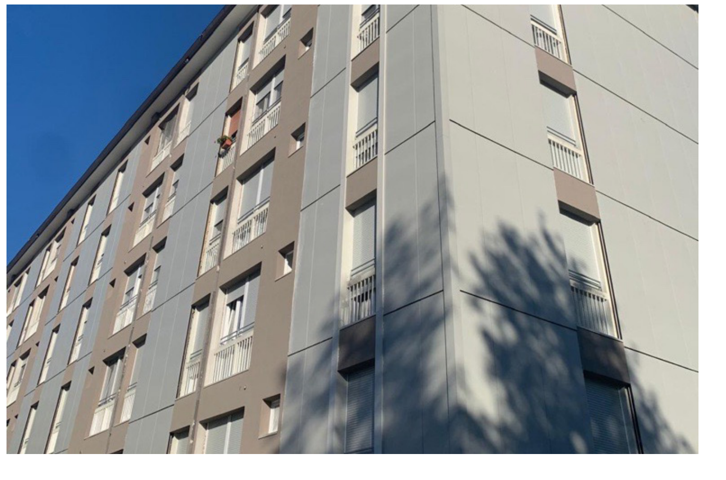
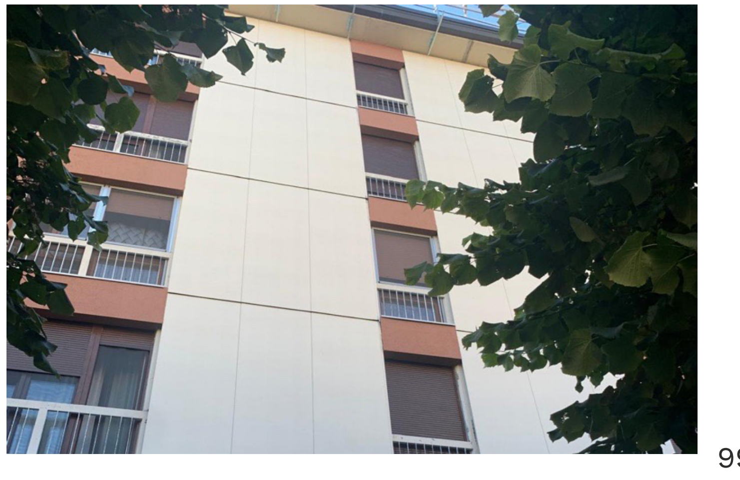


Pieve Emanuele

The project involves the energy and seismic renovation of 5 buildings in the former INCIS residential area in Pieve Emanuele.
The current condition of the buildings highlighted poor maintenance, with specific issues with the stability of the façade cladding and insulation.
The selected solution dry system was applied to about half of the total surface area of the façades; the energy and seismic renovation intervention was carried out using prefabricated insulating panels (ISOPAN ADDVision) with a vertical metal finish and a metal substructure anchored at the floor levels, ensuring the anti-tipping stability of the perimeter walls.
The other half adopted traditional EPS insulation. The junction between the two different façade materials (ISOPAN panels and insulation) was resolved with the application of pre-painted aluminum flashing. Similarly, the new flashing elements replaced items such as gutters, downspouts, and window reveals.
The project allowed for a global energy performance improvement of four classes. During the works, continuity of residence for the tenants was ensured, and the functionality of the common spaces was almost fully preserved. The use of pantograph platforms instead of traditional scaffolding maintained the visual accessibility of the buildings and the comfort inside the apartments.

GENERAL DATA	
Address	Via Donizetti, via Mascagni, via Zandonai, via Zandonai, Pieve Emanuele, Milano
Year of renovation	2024
Housing owner	Private
General contractor	PT System
Panel manufacturer	Isopan
BUILDING INFORMATION	
Year of construction	1969-1770
Number of buildings	5 (4 long and 1 short)
Number of floors (ground floor included)	5
Number of dwellings	238 (52 for the long, 30 the short)
Balconies?	No
Total living area (m2)	5 580
Facade surface (m2)	12 000
Roof surface (m2)	-
Type of structure	Reinforced concrete frame with beams and columns
Energy generation pre-renovation (type/fuel + centralized or autonomous)	-
Energy consumption pre-renovation (kwh/m2)	-
RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	No
Inhabited during renovation?	Yes
Tenant engagement process?	Yes
Total onsite works duration (days)	-
% facade renovated offsite	50%
% roof renovated offsite	N/A
New balconies?	No
Facade installation time (m2/day)	130
Panel structure (material + dimension + other info)	Steel frame and sandwich panel with polyisocyanurate insulation, vertical 350x100 cm
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Steel wall bracket
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	No
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	No systems integrated into the panels
Windows integrated in the panel?	No
Heat pump? If yes, where has it been installed	No
Monitoring system?	No
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	160 €/m² for supply + installation
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	Yes, anti-tipping stability of the perimeter walls
Performance guarantee duration	1 year
Lessons learnt (optional)	-



Povo, Trento

The intervention is located in Povo, Trento, and was carried out as part of the European ARV project, funded by the European Union under the Horizon 2020 program, in which Fanti participates as a third party of Habitech-Trentino Technological District.
It aims to demonstrate and validate attractive, resilient, and economically accessible solutions that significantly accelerate energy renovations in various climatic zones.
In the context of the general renovation of the building, consisting of 9 residential units, the project includes the installation of an insulating cladding, the installation of a shared photovoltaic system, and the replacement of windows and individual boilers. On two façades, the Renew-Wall modular system, with a wooden-based structure, was installed for the energy and architectural renovation of existing buildings.
The Renew-Wall system focuses on architectural aspects of absolute distinction, which will allow it to create a characteristic segment of interest in the renovation process,also due to an ETA, patents for the connections and seals to ensure durability, and the ability to finish the panel externally in the factory with efficient and cost-effective solutions.
The finish used in Povo is a plaster finish, the same as the one used on the rest of the building, but manufactured and finished in the factory.

GENERAL DATA	
Address	Povo, Trento
Year of renovation	2023
Housing owner	Private
General contractor	Fanti Group
Panel manufacturer	Fanti Group

BUILDING INFORMATION	
Year of construction	1952
Number of buildings	1
Number of floors (ground floor included)	3
Number of dwellings	9
Balconies?	Yes, on the side not interested by the prfabricated elements
Total living area (m2)	-
Facade surface (m2)	800
Roof surface (m2)	-
Type of structure	Load-bearing stone masonry
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Autonomous gas boilers
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	No
Inhabited during renovation?	Yes
Tenant engagement process?	-
Total onsite works duration (days)	-
% facade renovated offsite	16 %
% roof renovated offsite	N/A
New balconies?	No
Facade installation time (m2/day)	50 to 80
Panel structure (material + dimension + other info)	Timber structure and insulation between OSB and DWD panels, insulation against exhisting, ventilated facade with plaster finishing. Max dim 350x800 cm.
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Linear or localized anchoring
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	Not in this case but possible
Windows integrated in the panel?	No
Heat pump? If yes, where has it been installed	No
Monitoring system?	No
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	250 to 300
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	-
Lessons learnt (optional)	-






Russoli, Milan

The project for the residential complex consisting of four towers on Via Russoli, Milan, is developed on parallel levels: environment, city, people, and sustainability.

From an environmental perspective, the energy refurbishment of the complex involved the use of prefabricated façades made from bio-based materials, with the aim of achieving a real and conscious optimization of resources and a rational use of energy from the city's district heating network. The vertical envelope was thermally insulated by replacing windows and shutters, and the roofs were insulated with green solutions. Additionally, from the plant perspective, a photovoltaic system with storage was installed, the heating plant was renovated, and systems for temperature regulation and metering were added. The surrounding area was also revitalized through deeply regenerative actions on the common spaces. Special attention was given to the tenants, including the creation of garden spaces and green areas on the previously underutilized flat roofs, with the ultimate goal of fostering social interaction. The interventions allowed the complex to achieve an energy class of A4. The new building envelope and heating system significantly reduce the energy consumed for heating, provided by the centralized system and district heating, helping to reduce energy poverty.

GENERAL DATA	
Address	Via Russoli, Milano
Year of renovation	2022 - 2023
Housing owner	Aler (Lombard Agency for Residential Buildings)
General contractor	A2a calore e servizi
Panel manufacturer	Woodbeton, design Tiziana Monterisi Architetto

BUILDING INFORMATION	
Year of construction	1978
Number of buildings	4
Number of floors (ground floor included)	9
Number of dwellings	187
Balconies?	Yes
Total living area (m2)	10900
Facade surface (m2)	12000
Roof surface (m2)	2900

Type of structure	-
Energy generation pre-renovation (type/fuel + centralized or autonomous)	-
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	Partially, for corner balconies
Inhabited during renovation?	-
Tenant engagement process?	Yes
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	No
Facade installation time (m2/day)	140
Panel structure (material + dimension + other info)	Timber structure, horizontal direction, 1 floor height
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Hanged to the existing facade
Circular/ biobased materials? If yes what type	Bio-based RiceHouse insulation materials made from rice waste
Photovoltaic panels?	Yes
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	-
Windows integrated in the panel?	No
Heat pump? If yes, where has it been installed	-
Monitoring system?	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	Yes
Performance guarantee duration	-
Lessons learnt (optional)	-


Beatrice Arenella


Beatrice Arenella


Beatrice Arenella


Beatrice Arenella


Beatrice Arenella


Beatrice Arenella

Drive 0, case 6

Find out more

Three representative single family buildings with poor existing energy efficiency in different locations were identified and deeply renovated and implementing circular principles, focusing around material circularity using recyclable mineral wool thermal, acoustic and fire safe insulation with innovative bio-based binder for whole building envelope, newly tested ventilated façade system, 2D prefabricated façade insulated panels, new thermally efficient windows, efficient and renewable-energy powered installations and more. All demo buildings constitute of masonry walls and reinforced concrete slabs with wooden rafter pitched roofs with owners possessing certain levels of DIY construction skills, so homeowner's centric approach to renovation and circularity was also an important study parameter.

GENERAL DATA	
Address	Kandrše del, Slovenia
Year of renovation	2022
Housing owner	private person
General contractor	none, individual
Panel manufacturer	Rihter

BUILDING INFORMATION	
Year of construction	1988
Number of buildings	1
Number of floors (ground floor included)	3
Number of dwellings	1 https://ipi.eprostor.gov.si/jv/?eid=10020000022443792 7%26100300000296460202
Balconies?	Yes
Total living area (m2)	~160
Facade surface (m2)	?
Roof surface (m2)	55 (area under building)
Type of structure	Reinforced concrete
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Grid electricity Wood stowes
Energy consumption pre-renovation (kwh/m2)	109 https://www.drive0.eu/wp-content/uploads/2024/01/Drive-0_-D6.5.pdf

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	Yes
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation?	No, dwellings were empty when renovation occured
Tenant engagement process?	Yes
Total onsite works duration (days)	~200
% facade renovated offsite	~10
% roof renovated offsite	0%
New balconies?	Yes, demolished and hanged to new facade
Facade installation time (m2/day)	~10
Panel structure (material + dimension + other info)	Wood, minor part as test
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Hanged to existing, few 100 kg
Circular/ biobased materials? If yes what type	Wood, recycled mineral wool
Photovoltaic panels?	No
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	No
Windows integrated in the panel?	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	Yes, in the boiler room
Monitoring system?	No
Total renovation cost (€)	160k
Facade cost, supply + installation (€/m2)	Not available
Energy consumption post-renovation (kwh/m2)	35 according to building phizics
% consumption covered by renewables (PV/ ST panels)	Not available jet
LCA, if any (tCO2eq/m2 or other KPIs)	Not available jet
Antiseismic improvement	No
Performance guarantee duration	Not known
Lessons learnt (optional)	Very satisfied customer

CASE STUDIES SLOVENIA

Ravne na Koroškem

Find out more

INFINITE is a project funded by the European Union's Horizon 2020 research and innovation programme.
The Slovenian demo case is a medium size, multi-use building owned by multiple owners. Built during the 1970-1980, it is composed by offices on the ground floor, plus 40 single residential units divided among four floors and an attic area. Although the building is connected to a district heating system, the overall energy performance is poor because of badly insulated envelope and windows. The structure consist of steel-reinforced concrete frame with brick masonry.
INFINITE's all-industrialised BIPV kit will be installed on the façade on the south side of the building. On the other façade, the thermal insulation will be enhanced thanks to the passive kit. The distribution kit will be mounted where needed to provide heating and cooling to the apartments. The balconies on the northern façade will be transformed into loggias. For the roof, both BIPV and the green kit are being evaluated. Three different kinds of smart windows will be tested in selected pilot dwellings.

GENERAL DATA	
Address	Ob suhi, Ravne na koroškem, Slovenia
Year of renovation	2024
Housing owner	STAN
General contractor	Exit
Panel manufacturer	Lesoteka for renovation, Žiher for new floor

BUILDING INFORMATION	
Year of construction	1982
Number of buildings	1
Number of floors (ground floor included)	5
Number of dwellings	71
Balconies?	Yes
Total living area (m2)	2.654 (gross) 2527 conditioned
Facade surface (m2)	-
Roof surface (m2)	543 (area under building)
Type of structure	Reinforced concrete
Energy generation pre-renovation (type/fuel + centralized or autonomous)	"Grid electricity District heating system District heating and centralized electrical heating tank"
Energy consumption pre-renovation (kwh/m2)	166 (primary energy), heating 51, needed for operation 95 according to EPC

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	Yes
Scaffoldings	Yes, just for a small part of the facade
Inhabited during renovation?	Yes, inhabited for the total works duration
Tenant engagement process?	Yes
Total onsite works duration (days)	Not available jet, still in proces
% facade renovated offsite	~1/4
% roof renovated offsite	100%
New balconies?	No, traditional renovation of existing balconies
Facade installation time (m2/day)	~70
Panel structure (material + dimension + other info)	Wood, ~6x2
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Hanged to existing, few 100 kg
Circular/ biobased materials? If yes what type	Wood, mineral wool
Photovoltaic panels?	Yes, integrated in the roof/ facade
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	Yes, ventilation, cables and pipes
Windows integrated in the panel?	No need to change windows
Heat pump? If yes, where has it been installed	yes, next to the building https://infinitebuildingrenovation.eu/news/heating-up-towards-spring
Monitoring system?	Yes
Total renovation cost (€)	Not available yet
Facade cost, supply + installation (€/m2)	Not available yet
Energy consumption post-renovation (kwh/m2)	Not available yet
% consumption covered by renewables (PV/ ST panels)	Not available yet
LCA, if any (tCO2eq/m2 or other KPIs)	Not available yet
Antiseismic improvement	No
Performance guarantee duration	Not available yet
Lessons learnt (optional)	Not available yet

available here https://ipi.eprostor.gov.si/jv/?e id=10020000010203065 3%2610030000031236671 4

PROTOTYPE

Find out more

Aligra

The latest modification of the Catalan Urban Planning Law (2022) allows the volumetric expansion of residential properties in exchange for implementing substantial improvements in their habitability, accessibility and water and energy efficiency.
They are structures that add a new façade to buildings, allowing them to gain space through balconies, new rooms or community areas while improving their insulation and comfort. They also include installing solar panels, green roofs and rainwater harvesting systems on rooftops.
December 2022 – March 2024: Manufacture and installation of the prototypes.
April 2024- May 2025: Monitoring of the prototypes (to assess their impact on health and comfort, urban resilience, energy efficiency, circular economy and biodiversity).

Aligra is an integrated system of prefabricated timber modules designed for the renovation and expansion of residential buildings. The system is based on a wide range of prefabricated modules that adapt to all kinds of architectural preexistences, weather contexts and regulatory frameworks.
These are two-dimensional modules composed of different wooden elements. Their dimensions and lightness facilitate handling, storage, transportation and installation. They are assembled by means of reversible and accessible joints that facilitate assembly, repair, reuse and recycling. Furthermore, the modules are combined with each other in order to configure five three-dimensional kits that response to different recurring needs: the insulation of facades, the addition of galleries or terraces, the creation of photovoltaic canopies, the use of cisterns to accumulate rainwater and the deployment of smart sensors to monitor the performance of the building.
Over the course of a year, its sensors will collect indicators to test the water and energy efficiency of this open source solution, which is completely free of proprietary patents.

GENERAL DATA	
Address	Campus Diagonal-Besòs. Avinguda d'Eduard Maristany, 16 08930 Sant Adrià de Besòs. Barcelona
Year of renovation	23/02/2024
Housing owner	BIT Habitat foundation. Barcelona City Council
General contractor	Straddle3, Societat Orgànica, Aiguasol, Tallfusta and Tejido
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	N/A
Number of buildings	N/A
Number of floors (ground floor included)	N/A
Number of dwellings	N/A
Balconies?	N/A
Total living area (m2)	N/A
Facade surface (m2)	N/A
Roof surface (m2)	N/A
Type of structure	N/A
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	N/A
Energy consumption pre-renovation (kwh/m2)	N/A

RETROFIT INFORMATION	
Internal renovation	N/A
Volume increase	Yes
Type of structure	Aligra has a wide range of cladding panels that respond to the construction system of the ventilated façade.
Scaffoldings	
Inhabited during renovation?	N/A. It is a prototype
Tenant engagement process?	N/A
Total onsite works duration (days)	-
% facade renovated offsite	100 %
% roof renovated offsite	100 %
New balconies?	-
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Aligra has a wide range of cladding panels that respond to the construction system of the ventilated façade. They are able to cover façades and party walls of existing buildings and also adapt to the other kits in the system. Based on a structural frame made of light wooden framework, each module offers the possibility of adding or replacing certain layers to improve its performance. The finishes off
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	It can be both options, hanged to the existing facade or to the new structural frame (self-suported) made of microlaminated wood (LVL) that are attached to the facades of existing buildings.
Circular/ biobased materials? If yes what type	Structural frames made of microlaminated wood (LVL). Rainwater cistern is made from reused high-density polyethylene (HDPE) fruit boxes.
Photovoltaic panels?	They can be both types, installed on roof in a traditional way and integrated in the facade.
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	Rainwater cisterns collect and accumulate rainwater on the roofs of pre-existing buildings, after checking their capacity to handle the excess weight, or on the enlarged parts. Bioclimatic ventilation panel with an active system integrated in the panel.
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	No
Monitoring system?	Yes
Total renovation cost (€)	187,500.00
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	No
Lessons learnt (optional)	-

PROTOTYPE

Find out more

InnoFAB

The latest modification of the Catalan Urban Planning Law (2022) allows the volumetric expansion of residential properties in exchange for implementing substantial improvements in their habitability, accessibility and water and energy efficiency.
They are structures that add a new façade to buildings, allowing them to gain space through balconies, new rooms or community areas while improving their insulation and comfort. They also include installing solar panels, green roofs and rainwater harvesting systems on rooftops.
December 2022 – March 2024: Manufacture and installation of the prototypes.
April 2024- May 2025: Monitoring of the prototypes (to assess their impact on health and comfort, urban resilience, energy efficiency, circular economy and biodiversity).

InnoFAB project proposes a metal structure, hung or supported, with a series of components that provide the home with a larger exterior and interior surface, as well as optimal bioclimatic conditions and environmentally friendly finishes. The system allows the concept to be replicable and adaptable to a wide variety of situations and needs. It consists of the following main layers:
1. light metallic structure
2. Light corrugated sheet metal casing
3. 100% recyclable technological wood flooring with 70% local wood content and no toxicity
4. Solar protection
5. photovoltaic planter
6. Light roof with integration of renewable energy production
7. vegetation integration
All these layers are independent, they can be installed at any time, they can be dismantled and reassembled in another building. This independence is achievedthrough the following system features:
- Modularity of 2.5m in plan
- Purely mechanical connections throughout the system
- Independent location of each system on the structure
Green roofs with rainwater storage and photovoltaic planters that combine vegetation and electricity generation.
Lamps with the possibility of dimming and that can be turned on or off from the monitoring application.

GENERAL DATA	
Address	Campus Diagonal-Besòs. Avinguda d'Eduard Maristany, 16 08930 Sant Adrià de Besòs. Barcelona
Year of renovation	23/02/2024
Housing owner	BIT Habitat foundation. Barcelona City Council
General contractor	Pich Aguilera Arquitectes, Pich Architects y Pich Innovation, Metalperfil Ros, Verdtical Urban Biotechnology
Panel manufacturer	Garcia Faura

BUILDING INFORMATION	
Year of construction	N/A
Number of buildings	N/A
Number of floors (ground floor included)	N/A
Number of dwellings	N/A
Balconies?	N/A
Total living area (m2)	N/A
Facade surface (m2)	N/A
Roof surface (m2)	N/A
Type of structure	N/A
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	N/A
Energy consumption pre-renovation (kwh/m2)	N/A

RETROFIT INFORMATION	
Internal renovation	N/A
Volume increase	Yes
Type of structure	It is a metal structure, hung or supported, with a series of components that provide the home with a larger exterior and interior surface, as well as optimal bioclimatic conditions and environmentally friendly finishes.
Scaffoldings	No
Inhabited during renovation?	N/A. It is a prototype
Tenant engagement process?	N/A
Total onsite works duration (days)	Assembly: 1 day. Finishing: 1 month, but it wasn't continuous work; each tradesperson came when it suited them. In total, the full days dedicated to the finishing work can be considered as 7.
% facade renovated offsite	100 %
% roof renovated offsite	100 %
New balconies?	Yes. There are 3 possibilities: hanged to existing facade at each floor; hanged to the existing building; and discharged to the ground.
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Industrialized, lightweight, multi-layer closure and finishing systems, with materials that, 80%, come from recycled products or that can be reused (Light corrugated sheet metal casing).
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Mechanical connections throughout the system
Circular/ biobased materials? If yes what type	The windows are made of recycled aluminum and with low energy consumption glass and solar protection systems.
Photovoltaic panels?	Yes, installed after the panels
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	Solar protection with automated blinds, connected to the Smart Building Kit, which controls the desired lighting level.
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	No
Monitoring system?	Yes
Total renovation cost (€)	138,153.38
Facade cost, supply + installation (€/m2)	N/A
Energy consumption post-renovation (kwh/m2)	60% improvement in the thermal transmittance of the existing facades (U = 0.30 W/m2K) and 35% for the roof (U = 0.29 W/m2K)
% consumption covered by renewables (PV/ ST panels)	Not calculated yet
LCA, if any (tCO2eq/m2 or other KPIs)	Not calculated yet
Antiseismic improvement	No
Performance guarantee duration	-
Lessons learnt (optional)	-

Photovoltaic planter

The planter is designed as an industrialized, modular product, with the aim to decrease terrace or a balcony of the user.
It introduces vegetation to the façade, by giving a base to climbing plants that can efficiently cover the façade area.
The planter provides an inclination to the photovoltaic panel closer to the optimal one, compared to vertical placement.

Integration of local renewable energy production for individual users.
Introduction of vegetation to the façade or urban landscape both to improve the energy efficiency of buildings and the urban environment in terms of heat island and aesthetics.

GENERAL DATA	-
Address	-
Year of renovation	-
Housing owner	-
General contractor	-
Panel manufacturer	-
Useful links	-

BUILDING INFORMATION	
Year of construction	N/A
Number of buildings	N/A
Number of floors (ground floor included)	N/A
Number of dwellings	N/A
Balconies?	N/A
Total living area (m2)	N/A
Facade surface (m2)	N/A
Roof surface (m2)	N/A
Type of structure	N/A
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	N/A
Energy consumption pre-renovation (kwh/m2)	N/A

RETROFIT INFORMATION	
Internal renovation	N/A
Volume increase	No
Type of structures	Stainless steel
Scaffoldings	-
Inhabited during renovation?	-
Tenant engagement process?	-
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	-
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	-
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	-
Solar thermal panels?	-
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	-
Windows integrated in the panel?	-
Heat pump? If yes, where has it been installed	-
Monitoring system?	-
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	The complex urban development regulations and laws, the decision-making process between multiple property owners, difficult accessibility of the boundary walls, which in combination with the high maintenance needs of photovoltaic and green facades caused high installation and maintenance costs, and the lower energy production of the photovoltaic panels on the façade compared to roof and related business models, in overall led to the idea of developing the photovoltaic planter as a product instead of an integratated facade module.

Find out more

Photovoltaic planter at Eco Hub

The planter is designed as an industrialized, modular product, with the aim to decrease terrace or a balcony of the user.
It introduces vegetation to the façade, by giving a base to climbing plants that can efficiently cover the façade area.
The planter provides an inclination to the photovoltaic panel closer to the optimal one, compared to vertical placement.

The photovoltaic planters were installed to the south wall of the building. Renovation of a hall into office and meeting space.

GENERAL DATA	
Address	Barcelona
Year of renovation	-
Housing owner	ECO HUB
General contractor	Vertical
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	N/A
Number of buildings	N/A
Number of floors (ground floor included)	N/A
Number of dwellings	N/A
Balconies?	N/A
Total living area (m2)	N/A
Facade surface (m2)	N/A
Roof surface (m2)	N/A
Type of structure	N/A
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	N/A
Energy consumption pre-renovation (kwh/m2)	N/A

RETROFIT INFORMATION	
Internal renovation	N/A
Volume increase	No
Type of structure	Based on steel frame
Scaffoldings	Yes, just for a small part of the facade
Inhabited during renovation?	N/A
Tenant engagement process?	N/A
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	No, building has no balconies-
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	-
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Hanged to the existing facade. Mechanical connections only.
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes, integrated in the roof/ facade
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	"Smart irigation and management system with sensors"
Windows integrated in the panel?	N/A
Heat pump? If yes, where has it been installed	N/A
Monitoring system?	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-




Photovoltaic planter at Gonsi

The planter is designed as an industrialized, modular product, with the aim to decrease terrace or a balcony of the user.
It introduces vegetation to the façade, by giving a base to climbing plants that can efficiently cover the façade area.
The planter provides an inclination to the photovoltaic panel closer to the optimal one, compared to vertical placement.
The photovoltaic planters are installed on the roof of an office building, and demonstrates the capacity of the planter to be used instead of a railing as well.

GENERAL DATA	
Address	Barcelona
Year of renovation	-
Housing owner	GONSI
General contractor	Vertical
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	N/A
Number of buildings	N/A
Number of floors (ground floor included)	N/A
Number of dwellings	N/A
Balconies?	N/A
Total living area (m2)	N/A
Facade surface (m2)	N/A
Roof surface (m2)	N/A
Type of structure	N/A
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	N/A
Energy consumption pre-renovation (kwh/m2)	N/A

RETROFIT INFORMATION	
Internal renovation	N/A
Volume increase	No
Type of structure	The system was especially designed to resolve the structural integrity of the installation without the need to penetrate the waterproofing layer of the roof.
Scaffoldings	-
Inhabited during renovation?	N/A
Tenant engagement process?	N/A
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies?	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	-
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Railing
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes, integrated in the roof/ facade
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	"Smart irigation and management system with sensors"
Windows integrated in the panel?	N/A
Heat pump? If yes, where has it been installed	N/A
Monitoring system?	-
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-

Plug-n-Harvest

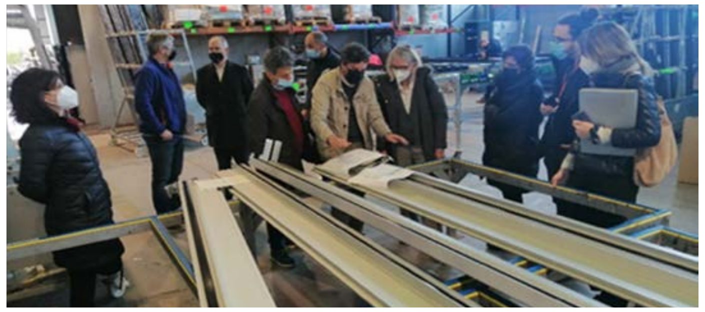
Find out more

Plug-n-play passive and active multimodal energy harvesting systems, circular economy by design, with high replicability for self-sufficient districts and near-zero buildings.
The main strategic goal of the PLUG-N-HARVEST proposal is to design, develop, demonstrate and exploit a new modular, plug-n-play concept for ADBE- Adaptable/Dynamic Building Envelopes, deployable to both residential and non-residential existing buildings. The system should be able to provide the maximum possible energy use reduction and the maximum possible energy harvesting from RES (Renewable Energy Sources), both at the single-building and the district scale, while requiring medium-to-low installation costs and almost-zero operational costs.
System innovation
Considering the façade system as such, there are multiple advantages partly shared with other industrialized systems, but also unique features.
• The final developed prefabricated modular solution using an innovative profile- ADBE, manufactured by García Faura
• Includes window profiles from the same provider
• The solar shading length and position is adjustable
• The PV panels are well ventilated (min 10 cm ir gap + ventilation openings)
• The cladding is based on aluminium sheet and can have the same or different aspect as the profiles
• Ventilation of the PV panels- special ventilation profiles were added below and above the PV panels, in order to ensure the air flow behind these panels, while protecting the façade from rainwater. The ventilation helps to decrease the overheating of the PV panels and so to improve their efficiency.

GENERAL DATA	
Address	"Sant Quirze del Vallès Ronda d'Arraona 29"
Year of renovation	2022
Housing owner	INCASÒL but managed by AHC.
General contractor	Picharchitects/Pich-Aguilera y Pich Innovation
Panel manufacturer	Garcia Faura

BUILDING INFORMATION	
Year of construction	2003
Number of buildings	1
Number of floors (ground floor included)	4
Number of dwellings	6
Balconies?	No
Total living area (m2)	264,6 m2 (44,10 m2 each dwelling)
Facade surface (m2)	130,80 m2 (101 m2 renovated)
Roof surface (m2)	18,6 m2
Type of structure	The structure of the building has bidirectional concrete slabs (0,30 m thickness), reinforced steel bars, and pillars of 0,36 x 0,40 m. No pathologies in the structure have been detected.
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	There are electric radiators for heating and part of the domestic hot water demand is covered by means of solar thermal panels located in the rooftop of the building. There is no cooling system or capacity in the building. Electricity is the only source of energy.
Energy consumption pre-renovation (kwh/m2)	257,5 kWh/m2 año (Primary non-renewable energy consumption)

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Type of structure	The structure of the panels is a framework formed by aluminium profiles with a section of 228 mm, composed of two separate pieces of aluminium to guarantee the breaking of the thermal bridge. The profile has three levels of waterproofing in its section. All the profiles are anodized matt silver, 15 microns. Regarding the openings, the panels will incorporate new windows, with double glazing and an aluminium frame with thermal break. The profile is 75 mm thick and complies with the thermal requirements of the Spanish Technical Code. A silver anodized aluminium railing is placed in front of the balcony at a height of 1100 mm for safety reasons and compliance with the SUA. The interior space of the panels, with a thickness of 10 cm, is filled with 100 mm mineral wool thermal insulation (described below), encapsulated by two 1,5 mm thick aluminium sheets. The outer faces of the panels are formed by aluminium sheets with a thickness of 3 mm (the full opaque parts). All sheets have been fixed using stainless screws according to DIN 7981.
Scaffoldings	None
Inhabited during renovation?	Yes
Tenant engagement process?	No
Total onsite works duration (days)	67 days The entire process of implementation can be broken down into 6 clearly differentiated steps: 1- Dismantling of the existing façade. 2- Preparation works for the implementation 3- Installation of the new ADBE façade panels 4- Dismantling of the existing windows from the interior 5- Finishing works: window frame, crowning and lateral of the façade, etc. 6- Placement of the PV modules."
% facade renovated offsite	Panels 100%
% roof renovated offsite	No
New balconies?	No
Facade installation time (m2/day)	Modules were installed in 54 days. 2 m2 per day.
Panel structure (material + dimension + other info)	Aluminium panels that include an internal thermal insulation layer to reduce heat loss and exterior photovoltaic panels of amorphous silicon to generate electricity (in our case, with a photovoltaic installed capacity of 6.22 kWp). Thermal insulation and photovoltaic panels will only be installed on the opaque elements. The energy generated will be equally distributed to all homes in the property. The system will have plug-n-play features reducing the length of installation work.
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	L-profiles anchored to existing slabs and ceramic walls where modules are installed.
Circular/ biobased materials? If yes what type	Within the possibilities, the products with environmental features and available information were selected for the project, such as aluminium with the highest certified recycled content.
Photovoltaic panels?	Yes, installed after the panels
Solar thermal panels?	Yes, integrated in the roof/ facade
Systems (ex. pipes/ cables/mechanical ventilation) integrated in the panel?	No
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	"HVAC: installation of individual electric heat pumps using aerothermal technology in every dwelling."
Monitoring system?	Yes
Total renovation cost (€)	178.778 € + IVA
Facade cost, supply + installation (€/m2)	same as total renovation
Energy consumption post-renovation (kwh/m2)	The new industrialized south facade with the ADBE system has a thermal transmittance of Opaque modules U=0.27 W/m2K and Windows U=1.18 W/m2K.
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	N/A
Antiseismic improvement	No
Performance guarantee duration	-
Lessons learnt (optional)	-



Plural

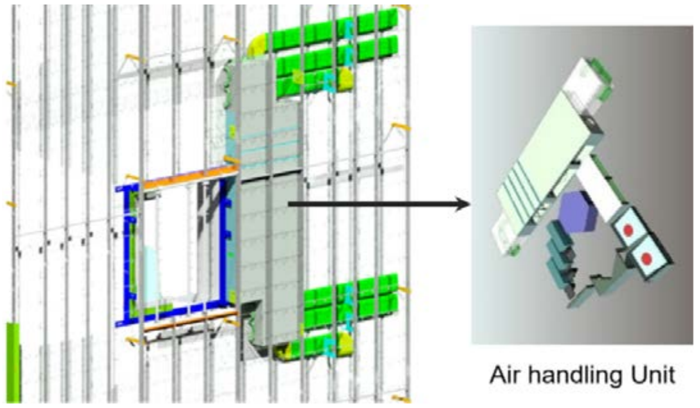
Find out more

The building is composed of two residential blocks, and a commercial space (not included in the pilot case). All of them are placed in a "U" form with a common courtyard in the middle. PLURAL solutions will be implemented in one block (18 dwellings).
The Denvelops Comfort Wall is an off-site prefabricated ventilated façade system composed of vertical stainless-steel guidelines and connectors that allow to attach and bear loads of the cladding.
The cladding system is made of 1 mm thick painted aluminium cladding tiles with resistant powder coating.
PV panels are integrated into the façade, locally replacing the final cladding.
The thermal insulation is made of mineral wool and is protected by a weathering layer. Both are attached to the system’s vertical guidelines in order to achieve the required thermal and water-tightness performance. The mineral wool is covered by a glass-fibre layer that can protect against mechanical damage.
Thermal resistance equal to 2.90(m2·K)/W is achieved with a 100 mm thick Denvelops Comfort Wall façade, considered the optimum passive measure.
The Denvelops Comfort Wall contains an innovative HVAC system called Air Handling Unit (AHU) developed by Czech Technical University and located in a vertical position. The AHU incorporates two stages of heat recovery: the first is a passive heat exchanger (plate), and the second is an active heat exchanger with thermoelectric modules that provides supply air temperature control. The unit is connected to the interior space via supply and extract channels. The electric power for the thermoelectric modules is derived from the PVs or the grid.

GENERAL DATA	
Address	Terrassa
Year of renovation	-
Housing owner	-
General contractor	-
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	-
Number of buildings	-
Number of floors (ground floor included)	-
Number of dwellings	-
Balconies?	-
Total living area (m2)	-
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	-
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	-
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	-
Volume increase	No
Type of structure	Off-site prefabricated ventilated façade system composed of vertical stainless-steel guidelines and connectors that allow to attach and bear toads of the cladding.
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation?	Yes, inhabited for the total works duration
Tenant engagement process?	-
Total onsite works duration (days)	-
% facade renovated offsite	100
% roof renovated offsite	-
New balconies?	No, building has no balconies
Facade installation time (m2/day)	Ongoing
Panel structure (material + dimension + other info)	Off-site prefabricated ventilated façade system composed of vertical stainless-steel guidelines and connectors that allow to attach and bear toads of the cladding. The cladding system is made of 1 mm thick painted aluminium cladding tiles. The thermal insulation is made of mineral wool attached to the system’s vertical guidelines.
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Hanged to the existing facade.
Circular/ biobased materials? If yes what type	-
Photovoltaic panels?	Yes, integrated in the roof/ facade
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	Air handling Unit located in a vertical position. The AHU incorporates two stages of heat recovery: the first is a passive heat exchanger (plate), and the second is an active heat exchanger with thermoelectric modules that provides supply air temperature control. The unit is connected to the interior space via supply and extract channels. The electric power for the thermoelectric modules is derived from the PVs or the grid.
Windows integrated in the panel?	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	-
Monitoring system?	-
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-



Regenerar Barcelona

Find out more

The latest modification of the Catalan Urban Planning Law (2022) allows the volumetric expansion of residential properties in exchange for implementing substantial improvements in their habitability, accessibility and water and energy efficiency.
They are structures that add a new façade to buildings, allowing them to gain space through balconies, new rooms or community areas while improving their insulation and comfort. They also include installing solar panels, green roofs and rainwater harvesting systems on rooftops.
December 2022 – March 2024: Manufacture and installation of the prototypes.
April 2024- May 2025: Monitoring of the prototypes (to assess their impact on health and comfort, urban resilience, energy efficiency, circular economy and biodiversity).
The project is presented as an open system that consists of a self-supporting wooden support - which is joined to the existing structure with anchors without transmitting loads - modular and dry assembled, capable of hosting diverse and adaptable forms of occupation and appropriation of space, different pre-existing situations and typologies and, in general, to diverse needs.
The prototype of the bioclimatic envelope is made up of the primary and secondary support structure plus the cistern kit, the vegetation and biodiversity kit, the photovoltaic kit, the volume expansion kit, the smart building kit and the community space kit.
Gravent Hervent model recycled aluminum tilting windows that allow regulating air renewal without invading the space of the home.
Recycled plastic planters with various elements of horizontal vegetation and climbing plants to cover the building, especially on the exterior of the façade.
Didactic and informative screens in common outdoor and private indoor spaces with data visualization from the smart building kit.

GENERAL DATA	
Address	Campus Diagonal-Besòs. Avinguda d'Eduard Maristany, 16 08930 Sant Adrià de Besòs. Barcelona
Year of renovation	March 2024
Housing owner	BIT Habitat foundation. Barcelona City Council

General contractor	Research Group on Architectural Rehabilitation and Restoration (REARQ) from the Polytechnic University of Catalonia (UPC), GICITED (UPC), and CONSTRAULA
Panel manufacturer	Sorigue
BUILDING INFORMATION	
Year of construction	N/A
Number of buildings	N/A
Number of floors (ground floor included)	N/A
Number of dwellings	N/A
Balconies?	N/A
Total living area (m2)	N/A
Facade surface (m2)	N/A
Roof surface (m2)	N/A
Type of structure	N/A
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	N/A
Energy consumption pre-renovation (kwh/m2)	N/A
RETROFIT INFORMATION	
Internal renovation	N/A
Volume increase	Yes
Type of structure	It is a self-supporting wooden structure that adapts to the facade of the buildings to configure interior and exterior spaces. The vertical structure is made of solid Girona pine wood in the form of 2D frames, modular and dry assembled on site with machined joints. It is a structure of porches and a removable and dry-assembled wooden framework.
Scaffoldings	-
Inhabited during renovation?	N/A. It is a prototype
Tenant engagement process?	N/A
Total onsite works duration (days)	-
% facade renovated offsite	100%
% roof renovated offsite	100%
New balconies?	Yes, discharged to the ground.
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Exterior wooden facade slats mounted on wooden framework and thermal insulation, finished painted with photocatalytic paint.
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	On a removable and dry-assembled wooden framework,
Circular/ biobased materials? If yes what type	Insulation with 100% natural and ecological expanded cork conglomerate pressed in a closed autoclave.
Photovoltaic panels?	Yes, installed after the panels
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	System of atomized cisterns on the roofs connected to a drip irrigation system and complemented by planters with incorporated cistern trays that allow rainwater to be collected, stored and used by the irrigation system, and channeled to a larger volume tank. on the ground floor.
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	No
Monitoring system?	Yes
Total renovation cost (€)	187,500.00
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	-
Lessons learnt (optional)	-

Find out more

StepUp Spanish pilot

StepUP project has developed affordable solutions and technologies aimed at transforming the energy renovation market and making the decarbonisation of existing buildings a reliable, attractive and sustainable investment.
Renovation of the R&D facilities of the University of Navarra: Two test cells, small buildings each one with two floors using the P&P façade solution, incorporating P&P modules to address corner elements, and integrating third-party technologies.
StepUP Plug& Play envelope system: The plug-and-play façade system comprises customizable layers tailored to each project's requirements, emphasizing prefabrication for swift on-site assembly and minimal manual intervention. Developed by MANNI, specialists in steel-based products, the final design integrates metal-faced sandwich panels on a lightweight steel structure. Prefabricated off-site, these elements are installed as a single unit using a flexible anchoring system, allowing movement in three directions. The system's flexibility accommodates diverse existing building structures. Modular in design, the façade can be adjusted in dimensions. Its composition simplifies into seven main elements (Also seen in Figure 1) : (1) anchoring system, (2) galvanized steel structure, (3) insulated sandwich panels, (4) steel brackets, (5) aluminium profiles for cladding, (6) external cladding, and (7) flashing.
Neither construction permits nor public grants were needed to do the renovation. The facility provided a good opportunity to renovate the test cells using the StepUP façade P&P solution and the time required to install the Plug and Play façade in a multi-storey building.

GENERAL DATA	
Address	Pamplona
Year of renovation	2024
Housing owner	University of Navarra
General contractor	Construcciones ACR SAU
Panel manufacturer	Manni Group

BUILDING INFORMATION	
Year of construction	
Number of buildings	2
Number of floors (ground floor included)	2
Number of dwellings	N/A
Balconies?	No
Total living area (m2)	19.4 m2
Type of structure	
Facade surface (m2)	128 m²
Roof surface (m2)	29 m²
Type of structure	Brick layer façade
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	N/A
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Type of structure	5 regular modules per floor 4 square modules per floor 18P&P modules per test cell A total of 36P&P modules
Scaffoldings	Yes, just for a small part of the facade
Inhabited during renovation?	N/A
Tenant engagement process?	N/A
Total onsite works duration (days)	12
% facade renovated offsite	100%
% roof renovated offsite	0%
New balconies?	No, building has no balconies
Facade installation time (m2/day)	24
Panel structure (material + dimension + other info)	Ventilated high-pressure laminate (HPL) façade ultimately executed with concealed fixings. The renovation of each cell was accomplished through the installation of ten regular modules (five modules per floor) along with a total of eight corner modules (four per floor). This results in a total of 18 modules per test cell, covering an area of 64 m2 of façade. Consequently, for the entire renovation of facilities, a total of 36 modules were installed, which included 20 regular modules and 16 corner modules. These modules together cover an area of 128 square meters, distributed across two 2-storey buildings.
Panel weight handling (ex. hanged to the existing facade, new ground foundations)	Anchored to the existing facade
Circular/ biobased materials? If yes what type	
Photovoltaic panels?	No
Solar thermal panels?	No
Systems (ex. pipes/cables/ mechanical ventilation) integrated in the panel? If yes, what type	The integration of IT StepUP LEAN tools facilitated real-time monitoring of execution times, furnishing invaluable insights to assess the impact of on-site operations.
Windows integrated in the panel?	Yes
Heat pump? If yes, where has it been installed	No
Monitoring system?	No
Total renovation cost (€)	N/A
Facade cost, supply + installation (€/m2)	
Energy consumption post-renovation (kwh/m2)	N/A
% consumption covered by renewables (PV/ ST panels)	
LCA, if any (tCO2eq/m2 or other KPIs)	
Antiseismic improvement	No
Performance guarantee duration	
Lessons learnt (optional)	First, it was completed the installation of the P&P modules in one test cell before proceeding with the installation of anchor elements in the other test cell. This approach allowed the team to apply lessons learned to improve efficiency and reduce complications during the second test cell's installation. Key findings underlined the need to improve the adaptability of corner modules and streamline panel fixing systems, thus minimizing on-site adjustments and optimizing installation efficiency. Anchor elements: • They did not have the correct measurement • There was not enough space in the anchor elements to insert the screws that hold the lower P&P module to the upper one. Increase of the works on site: • The sealing rubber of the P&P modules was not installed at Manni's facilities. They had to be installed on site. • The size of the screws used to anchor the substructure of the ventilated façade to the sandwich panel were too long. • The dimensions of the HPL panels are not correct. Supply chain: The modules were ordered and assembled to be placed in columns. However, finally all those on the ground floor were placed first and then all those on the upper floor.

Henriëttedreef

The profound redevelopment of this 1960s social housing building demonstrates that Energiesprong is also applicable in large-scale and high-rise interventions.
The compactness of the complex offers little space for the installation of photovoltaic systems for the generation of electricity; for this reason it was decided to integrate photovoltaic panels into the prefabricated facade modules, in addition to heating and ventilation systems, to maximize the generation surface.
This approach overall made it possible to generate more energy than was used to operate the building and therefore return electricity to the grid.

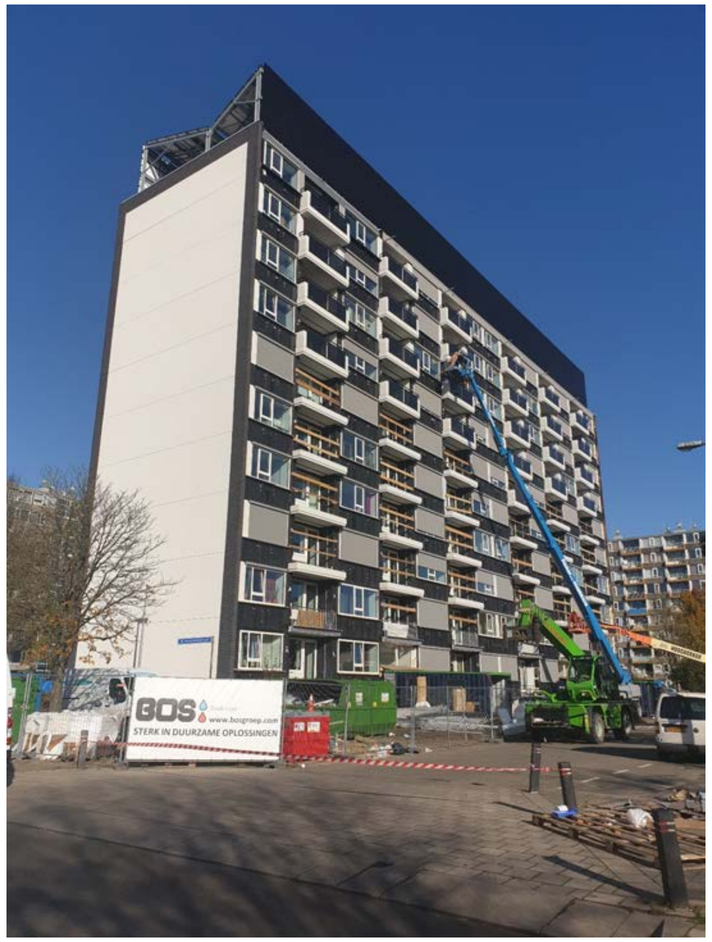
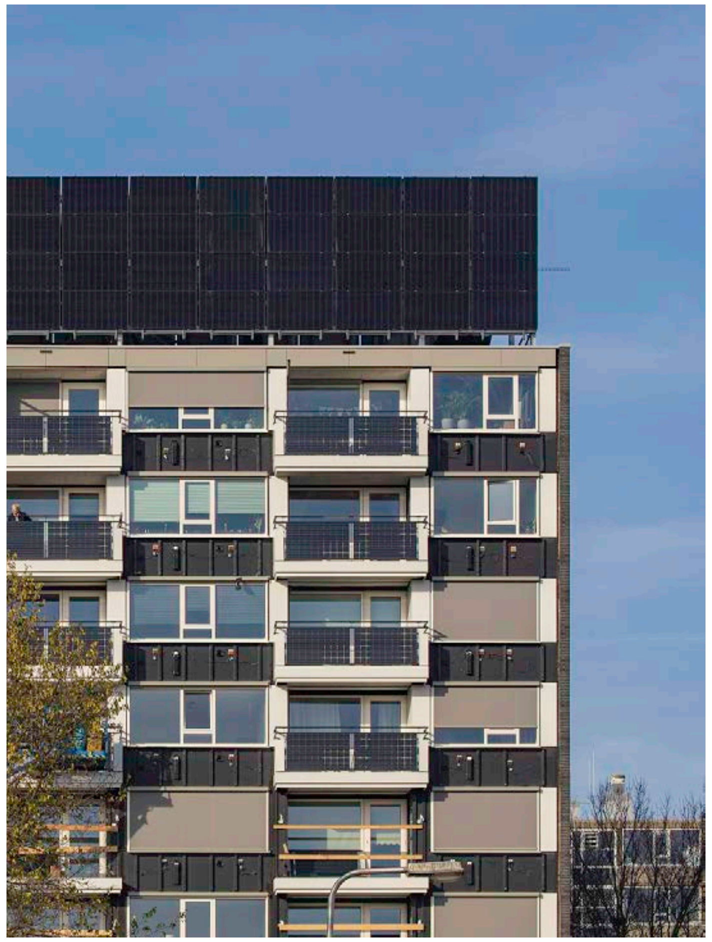
The monitoring of performance and consumption went in parallel with workshops with the tenants to introduce them to the responsible and conscious use of the apartments, guiding them to understand and correctly use the consumption control tools.
This process was fundamental for the satisfaction of the inhabitants and highlighted the importance of involvement and communication between those involved in the redevelopment.

GENERAL DATA	
Address	Henriëttedreef, Utrecht
Year of renovation	2018 - 2021
Housing owner	Bo-Ex
General contractor	Bos Installatiewerken
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1960s
Number of buildings	1
Number of floors (ground floor included)	10
Number of dwellings	58
Balconies?	Yes
Total living area (m2)	-
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	-

"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	-
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	-
Volume increase	No
Scaffoldings	-
Inhabited during renovation	-
Tenant engagement process	Yes
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies	-
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	-
Panel weight handling	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels	Yes
Solar thermal panels	-
Systems integrated in the panel? If yes, what type	-
Windows integrated in the panel	-
Heat pump? If yes, where has it been installed	Yes, on the roof
Monitoring system	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-


Hoog Lindoduin

The deep redevelopment of this 1960s social housing building demonstrates the potential for large-scale, sustainable renovation. The building stripped to its concrete shell, prefabricated and well-insulated timber-frame facades with durable ceramic cladding enhance enegry performance and protect against coastal conditions. Wider pre-cast concrete galleries replace the previous deteriorating structures using anchors, ensuring durability without altering the original frame. Advanced systems, including individual heat pumps connected to a geothermal source and CO2-controlled ventilation with heat recovery, significantly reduce energy demand. Resident training sessions introduced the proper use of these systems, fostering sustainable living practices.

A combination of modern prefabricatuon and traditional craftsmanship ensures a seamless fit - despite the building's mid-century construction variability - and achieved a comprehensive upgrade, improving energy efficiency, living comfort, and aesthetic quality.

GENERAL DATA	
Address	Westduinweg Scheveningen
Year of renovation	2018-2021
Housing owner	Woningcorporatie Vestia
General contractor	BAM Wonen
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1963
Number of buildings	1
Number of floors (groundfloor included)	14
Number of dwellings	182
Balconies?	Walkways
Total living area (m2)	Around 60/home
Facade surface (m2)	
Roof surface (m2)	
Type of structure	Beton structure / timber frame façade
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Gas
Energy consumption pre-renovation (kwh/m2)	Label F

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	(only the balconies)
Scaffoldings	None
Inhabited during renovation	No, move out for the total works duration
Tenant engagement process	Yes
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies	Yes, demolished and hanged to new facade
Facade installation time (m2/ day)	-
Panel structure (material + dimension + other info)	Rc-panels > 4.5 K.m2/W
Panel weight handling	-
Circular/ biobased materials? If yes what type	Yes, timber frame façade
Photovoltaic panels	Yes, installed after the panels
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	-
Windows integrated in the panel	Yes
Heat pump? If yes, where has it been installed	Yes, each appartment has its individual heatpump connected to a ground source (for heating and cooling)
Monitoring system	-
Total renovation cost (€)	Around 200,000/home
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	-
Lessons learnt (optional)	-






Nieuw Buinen

The project includes the in-depth redevelopment of three residential buildings from the 1970s and concerns a very common cluster and therefore has a high potential for replicability and scalability.

Using prefabricated and pre-finished elements of facades and roofing with integrated fixtures and systems and having previously prepared the anchoring and preliminary works, the complete intervention was carried out in just one day of construction for each house.
All the components of the systems have been integrated into a new element, a vertical column integrated into the external facades; this allows for any maintenance without inconvenience for residents and repairs even without their presence.
A new heat pump generates energy for heating and domestic hot water, powered by a photovoltaic system that occupies the entire roof.

The intervention therefore made it possible to reach the Net Zero standard, which was guaranteed for 30 years.

GENERAL DATA	
Address	Nieuw Buinen
Year of renovation	2016
Housing owner	Lefier
General contractor	Rottinghuis / VolkerWessels
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1960s
Number of buildings	5
Number of floors (ground floor included)	2
Number of dwellings	30
Balconies?	No
Total living area (m2)	-
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	-
"Energy generation pre-renovation (type/fuel + centralized or autonomous)"	-
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	-
Volume increase	Yes
Scaffoldings	No
Inhabited during renovation	-
Tenant engagement process	-
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies	-
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	-
Panel weight handling	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels	-
Solar thermal panels	-
Systems integrated in the panel? If yes, what type	-
Windows integrated in the panel	-
Heat pump? If yes, where has it been installed	-
Monitoring system	-
Total renovation cost (€)	100 000 per home
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-

Woningen Molenbuurt

Find out more

The project involved the in-depth retrofit of 52 homes, demonstrating high-potential for replicability and scalability of the efficient and low-disturbance building upgrades.

The buildings were entirely enclosed with a highly-insulated envelope, using prefabricated panels for the façade and roof, improving energy efficiency and thermal performance. The panels also integrated photovoltaic and solar thermal panels and a mechanical ventilation system. The renovation was carried out with minimal disruption to the residents, who remained in their homes throughout the entire 150-day process. No relocation was necessary.

Resident engagement support the transition to sustainable living, demonstrating a holistic approach to energy efficiency and community integration.

GENERAL DATA	
Address	Molenwijk
Year of renovation	2021/2022
Housing owner	Woningstichting Plavei
General contractor	Klomps
Panel manufacturer	Rc-panels

BUILDING INFORMATION	
Year of construction	1967
Number of buildings	52
Number of floors (groundfloor included)	3
Number of dwellings	52
Balconies?	No
Total living area (m2)	125
Facade surface (m2)	77
Roof surface (m2)	84
Type of structure	Beton / tunnelbekisting
Energy generation pre-renovation (type/fuel + centralized or autonomous)	Gas
Energy consumption pre-renovation (kwh/m2)	Label F

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	No
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process	Yes
Total onsite works duration (days)	150
% facade renovated offsite	100%
% roof renovated offsite	100%
New balconies	No, building has no balconies
Facade installation time (m2/ day)	84
Panel structure (material + dimension + other info)	Rc-panels > https://www.rcpanels.nl/
Panel weight handling	?
Circular/ biobased materials? If yes what type	No
Photovoltaic panels	Yes, integrated in the roof/ facade
Solar thermal panels	Yes, integrated in the roof/ facade
Systems integrated in the panel? If yes, what type	MV-systeem, type D
Windows integrated in the panel	Yes
Heat pump? If yes, where has it been installed	No
Monitoring system	Yes
Total renovation cost (€)	4700000
Facade cost, supply + installation (€/m2)	43000
Energy consumption post-renovation (kwh/m2)	40
% consumption covered by renewables (PV/ ST panels)	25%
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	-
Lessons learnt (optional)	-

Nottingham

Find out more

The pilot project involved 10 homes in the city's housing association, the first in the UK to join Energiesprong. The buildings were particularly inefficient, with particularly cold conditions in winter and lighting problems.

The solution was contracted at a pre-established cost, which considered the entire lifetime cost of the building.

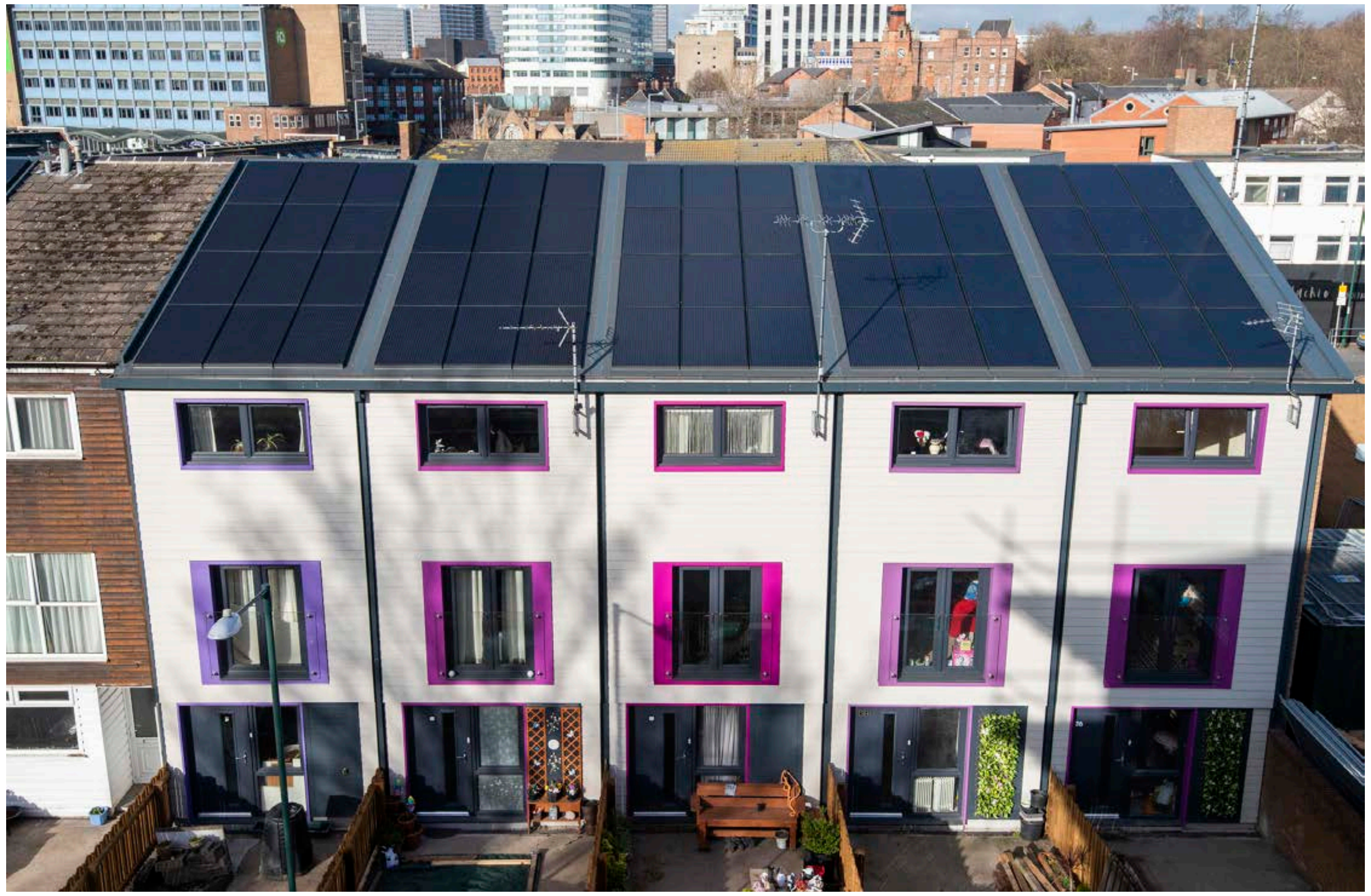
Tenants were involved in developing the design brief, meaning the solution provider was able to include small additional elements that made a big difference to tenants' lives. The wall panels arrived prefabricated complete with insulation, double glazed windows and a durable panel finish, ready to be craned into place. Tenants were able to remain in the residence throughout the renovation, which was completed in one week.

The project achieved significant productivity improvements compared to traditional, reducing installation time by 60% and costs by 45%.

GENERAL DATA	
Address	Keswick Close, Nottingham
Year of renovation	2022
Housing owner	Nottingham City Homes
General contractor	Melius Homes
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1960's
Number of buildings	18 terraced houses, 13 terraced bungalows, 12 terraced flats
Number of floors (ground floor included)	3
Number of dwellings	43
Balconies	No
Total living area (m2)	102
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Crosswall House (Non-traditional)
Energy generation pre-renovation	Individual gas boiler
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	Yes
Volume increase	Yes
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process	Yes
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure	Factory produced timber and mineral wool facades with weather boarding, factory fitted windows, doors and flashing
Panel weight handling	
Circular/ biobased materials? If yes what type	
Photovoltaic panels	Yes, integrated in the roof/ facade
Solar thermal panels	No
Systems? If yes, what type	-
Windows integrated in the panel	Yes
Heat pump? If yes, where has it been installed	Air source heat pumps
Monitoring system	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-



Find out more

Sutton, London (Coulsdon 5)

The first phase of the Energiesprong Sutton program allowed the redevelopment of 5 terraced buildings from the 1940s originally built with non-insulated walls and therefore with poor energy and comfort performance.
The retrofit intervention made it possible, using prefabricated elements, to reach Net Zero energy standards, creating more high-performance and desirable homes.
Technical solutions were used such as insulated facade panels, a photovoltaic system on the roof, high-performance windows and doors and a heat pump generator.
The redevelopment project has a high potential for replicability: the next phase will involve 100 homes, with over 1900 suitable for equivalent redevelopment in the neighbourhood.
An effective process of involving the inhabitants was implemented, concluded with the monitoring of the inhabitants' satisfaction which highlighted very positive results.

GENERAL DATA	
Address	31 Longlands Avenue, Coulsdon, CR52QG
Year of renovation	2021
Housing owner	Sutton Housing Partnership
General contractor	Equans
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1950s
Number of buildings	5
Number of floors (ground floor included)	2
Number of dwellings	5
Balconies?	No
Total living area (m2)	83
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Unity house (Non-traditional)
Energy generation pre-renovation	Individual gas boiler
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process	Yes
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Wetherby External Wall Insulation system
Panel weight handling	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels	Yes, integrated in the roof/ facade
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	-
Windows integrated in the panel?	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	Air source heat pumps
Monitoring system?	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-

Sutton, London (St Helier)

Find out more

Bow Tie Construction were selected by EnergieSprong UK and Sutton Housing Partnership to deliver an Ofgem Eco funded deep retrofit of a terrace of four and a terrace of two houses. Bow Tie's designers were responsible for all design elements and construction was undertaken by Bow Tie's builders. The residents received the retrofit at no cost to themselves.

The project had to be delivered within a guaranteed maximum price per unit and would target an annual space heating performance of 50 kwh/m2/annum with an airtightness of 1 air change per hour. The houses would be taken off gas. All heating and hot water would be provided by the Ventive compact unit comprising exhaust air heat pump, MVHR and thermal store. Electricity from the PV panels would first go to the Ventive unit to charge the thermal store, then be used by the house, any surplus would be exported to the grid with residents receiving the benefit.

GENERAL DATA	
Address	476 Middleton Road
Year of renovation	2023
Housing owner	Sutton Housing Partnership
General contractor	Osborne and Bowtie
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	-
Number of buildings	10
Number of floors (ground floor included)	2
Number of dwellings	10
Balconies?	No
Total living area (m2)	64-67
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Cavity Wall
Energy generation pre-renovation	Individual gas boiler
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process	Yes
Total onsite works duration (days)	-
% facade renovated offsite	0%
% roof renovated offsite	0%
New balconies?	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Wetherby External Wall Insulation system
Panel weight handling	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels	Yes, integrated in the roof/ facade
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	Monodraught integrated energy module in porch
Monitoring system?	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	10 years
Lessons learnt (optional)	Improved monitoring on Monodraught Home Zero pod required

Enfield, London

Edmonton residents are set to benefit from a scheme that will make their homes more energy efficient after Enfield Council was awarded government cash. The council has begun 'retrofit' improvement works to boost energy efficiency at ten domestic properties in Edmonton Green and Haselbury wards, making them easier to heat and keep warm and replacing fossil fuels with renewable energy sources.
The works are part of a three-year partnership alongside seven other councils in London and are set to deliver more than 250 housing retrofits in total.
The Dutch 'Energiesprong' model will be used to make each property included in the scheme zero-carbon. This includes adding double-glazed windows and high-performance doors, rooftop solar panels to generate electricity, efficient heating and ventilation systems and external insulation.
The council was awarded almost £600,000 of government funding to enable the retrofit works. Deputy leader Ergin Erbil said: "Enfield Council has a strong track record in leading carbon reduction and innovative energy projects.

GENERAL DATA	
Address	167 Haselbury Road, London, N9 9BN
Year of renovation	2022/23
Housing owner	London Borough of Enfield
General contractor	Osborne Property Services
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	1930s
Number of buildings	10
Number of floors (ground floor included)	2
Number of dwellings	10
Balconies?	No
Total living area (m2)	81.92
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Traditional house
Energy generation pre-renovation	Individual gas boiler
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process	Yes
Total onsite works duration (days)	-
% facade renovated offsite	0%
% roof renovated offsite	0%
New balconies	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	-
Panel weight handling	-
Circular/ biobased materials? If yes what type	-
Photovoltaic panels	Yes, installed after the panels
Solar thermal panels	No
Systems integrated in the panel? If yes, what type	No
Windows integrated in the panel	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	Air source, rear garden
Monitoring system	Yes
Total renovation cost (€)	£1,562,776
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	No
Performance guarantee duration	10 years
Lessons learnt (optional)	-

Barking&Dagenham, London

Find out more

GENERAL DATA	
Address	Fanshawe Crescent
Year of renovation	-
Housing owner	-
General contractor	Equans
Panel manufacturer	-

BUILDING INFORMATION	
Year of construction	-
Number of buildings	20
Number of floors (ground floor included)	3
Number of dwellings	20
Balconies?	No
Total living area (m2)	81
Facade surface (m2)	-
Roof surface (m2)	-
Type of structure	Cavity wall
Energy generation pre-renovation	Individual gas boiler
Energy consumption pre-renovation (kwh/m2)	-

RETROFIT INFORMATION	
Internal renovation	No
Volume increase	No
Scaffoldings	Yes, for the majority of the facade
Inhabited during renovation	Yes, inhabited for the total works duration
Tenant engagement process	Yes
Total onsite works duration (days)	-
% facade renovated offsite	-
% roof renovated offsite	-
New balconies	No, building has no balconies
Facade installation time (m2/day)	-
Panel structure (material + dimension + other info)	Ultrapanel off-site manufactured EWI system
Panel weight handling	-
Circular/ biobased materials? If yes what type	
Photovoltaic panels	-
Solar thermal panels	-
Systems integrated in the panel? If yes, what type	-
Windows integrated in the panel?	No, windows replaced traditionally
Heat pump? If yes, where has it been installed	-
Monitoring system	Yes
Total renovation cost (€)	-
Facade cost, supply + installation (€/m2)	-
Energy consumption post-renovation (kwh/m2)	-
% consumption covered by renewables (PV/ ST panels)	-
LCA, if any (tCO2eq/m2 or other KPIs)	-
Antiseismic improvement	-
Performance guarantee duration	-
Lessons learnt (optional)	-