



CORDIS Results Pack on deep renovation

A thematic collection of innovative EU-funded research results

April 2024

New approaches to transform the renovation market



Research and
Innovation

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Editorial

New approaches to transform the renovation market

Renovating Europe's building stock offers great potential for meeting its climate commitments. The most challenging aspects are how to increase the rate, quality and effectiveness of building renovation. This CORDIS Results Pack highlights the work of 13 EU-funded projects helping to accelerate energy-efficient upgrades to Europe's housing stock.

Buildings contribute 40 % of the EU's final energy demand, and offer a large untapped potential for energy savings. Therefore buildings have an important role to play in achieving the sustainability goals set out in the [European Green Deal](#), a set of proposals to reduce net greenhouse gas emissions by at least 55 % by 2030.

A major challenge lies in the current rate of renovation, which is only 1.2 % per year. Effective solutions need to be widely demonstrated and replicated in order to help increase the renovation rate to 2-3 % per year. In order to meet this challenge, it is necessary to reduce renovation costs as well as the time spent on-site, which in turn minimises disturbance of occupants.

Research funded through the Horizon programme can help deliver this change. This Pack showcases consumer-friendlier, cheaper, faster, more reliable services, technologies and approaches which will speed up deep renovations to improve the energy performance of the building stock.

The work carried out across these projects also demonstrates the advantages of deep energy renovation, and highlights good practice that helps to overcome specific barriers in order to target groups involved in contracting, planning, financing and implementing deep renovations of buildings.

In some cases, technological solutions can help achieve this ambition. However, there are also a range of non-technological barriers that need to be overcome, for example through financial innovations and improved regulatory frameworks.

The selected projects are helping to address market barriers in the value chain. They demonstrate innovative customer-centred processes leading to more cost-effective, higher quality, holistic and faster renovation of buildings. These will help deliver an ever greater number of energy-efficient homes that are more sustainable, more affordable and more comfortable.

Warming neighbourhoods with recycled heat

The EU-funded COOL DH project demonstrated how entire neighbourhoods can be heated using recycled low-temperature heat. This has resulted in new products on the market and underlined the cost benefits of deploying the latest generation of district heating systems in refurbishment projects.



The current energy crisis is fuelling fresh interest in [district heating](#) as an effective means of delivering low-carbon energy. Enabling such systems to run on [surplus heat](#) at low temperatures could further reduce our reliance on fossil fuels to heat residential buildings.

In fact, if Europe were to exploit 50 % of waste heat, it would be able to replace 100 % of current natural gas used for heating buildings in Europe, according to the [Heat Roadmap Europe](#) project.

The EU-funded [COOLDH](#) project successfully delivered a broad range of methods and tools for making this possible and demonstrated their effectiveness in real-life scenarios. The project team deployed [low-temperature district heating](#) (LTDH) solutions in an existing city district of Høje-Taastrup, Denmark, and in an entirely new district in Lund, Sweden.

Implementing low-temperature district heating

In the Østerby district of Høje-Taastrup, Denmark, the traditional local district heating system was converted to operate at low temperatures. This allowed the system to use heat generated by a heat pump connected to a photovoltaic installation at a local shopping mall. In another subdistrict, it used surplus (otherwise wasted) heat from the cooling machines of a bank's data centre.

The district heating system was also refurbished. "Before this project, the heat loss through local distribution pipes in Østerby district was being paid by the tenants themselves," says Reto Michael Hummelshøj, leading project manager at the engineering consultancy [COWI](#), the company coordinating the project. "This amounted to more than 35 % of the cost of heat paid for."

The project managed to reduce heat losses to less than 16 % of the delivered heat, in part through lowering the network temperature. The system serves a total of 159 dwellings, and the project's demonstrations in Høje Taastrup together save over 600 tonnes of CO₂ every year.

In the new Brunshög district of Lund (Sweden), the main source of low-grade waste heat is a particle accelerator at the [MAX IV research facility](#). This heat is made available to the

district through a network set to become Europe's largest LTDH facility, also drawing on other renewable energy sources.

Polyethylene with raised temperature resistance

One of the project's key innovations was the development of a new type of PE-RT pipe, which uses weldable polyethylene with raised temperature resistance. These pipes offer benefits including easier deployment (as they can literally be rolled out), a leak detection system, better insulation and operation at higher pressures of up to 13 bar in LTDH systems, enabling reduced heat loss. Several kilometres of PE-RT pipes were installed at both demonstration sites.

The pipes also open up the possibility of using electrofusion welding. When this process is standardised and approved for use in LTDH systems, it could help remove a major bottleneck, Hummelshøj explains: "There is a lack of certified steel welders. Electrofusion fittings would enable normal workers to connect pipes with just a few days of training."

Saving potential on the utilities side

Since project completion, an industry member of the project consortium has gone on to commercialise the new PE-RT pipe.

"Based on their experience in the project, a manufacturer has been able to launch new pipe types as part of its product range, under the brand [LOGSTOR PertFlextra](#)," adds Hummelshøj. "There are several ongoing projects which are to use these plastic pipes to supply areas with modern low-temperature district heating."

Hummelshøj notes that several other manufacturers are also bringing new pre-insulated multilayer plastic pipes to the market. Furthermore, new fittings are in the pipeline – one type on the way is electrofusion muffs as used in pipes for drinkable water.



Based on their experience in the project, a manufacturer has been able to launch new pipe types as part of its product range.

“The most important lesson is that pipe distribution systems should not be neglected in refurbishment schemes,” remarks Hummelshøj. “Too many renovation projects focus on improving the building envelope and forget the big saving potentials on the heat distribution side. These were clearly underlined throughout the COOL DH project.”

Another learning from the project is that taking common decisions in housing associations can be difficult. “The consequences for each tenant must be calculated, and the benefits clearly explained in order to get a majority when voting for changing the heating system,” concludes Hummelshøj.

PROJECT

COOL DH – Cool ways of using low grade Heat Sources from Cooling and Surplus Heat for heating of Energy Efficient Buildings with new Low Temperature District Heating (LTDH) Solutions

COORDINATED BY

COWI in Denmark

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/767799

PROJECT WEBSITE

cooldh.eu



Local solutions promoting a circular economy for renovations

The EU-funded Drive 0 project champions local solutions for deep renovation, boosting skills and knowledge. Achieving firsts in the sector, the project promotes the circular economy for the built environment.



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Building renovation is often held up as a pathway to sustainability. Yet the reality can fall short. “Despite their sustainability claims, most renovation solutions perpetuate the linear economy,” says Ana Tisov, coordinator of the EU-funded [Drive 0](#) project. “We need a paradigm shift to the circular economy.”

Drive 0 conducted [pilots in seven countries](#) with very different local contexts: Estonia, Greece, Ireland, Italy, the Netherlands, Slovenia and Spain. Learning from the first generation of renovation-themed Horizon 2020 projects, the project aimed to put as much emphasis on end users and local context as it did on technology and business models.

“Putting circular renovation principles into practice, we raised skill levels within the building industry, partly thanks to our innovative tools, still in use,” adds Tisov. “Despite some initial reservations, we have received really encouraging feedback from homeowners.”

‘Plug and play’ solutions

The Drive 0 pilots encompassed a mix of social and private housing, with the renovations supported by either public funds, EU subsidies or private investment. The work was undertaken by local industry and academic partnerships.

After identifying the needs of each building, including assessing the total life-cycle performance, including material flows and energy use, the most sustainable approach was identified.

To reduce construction time, cost and disruption, Drive 0 designed a 'plug and play' modular solution which leverages the local marketplace, knowledge, skills and building materials.

The Dutch pilot demonstrated a complete net zero retrofit, including a refurbishment of the envelope of terraced housing using prefabricated panels, reusing masonry and window frames, and recycling glass panes and stones into new products such as glass wool insulation.

"Our approach, of great interest to the local government, used more circular techniques than expected. The work was completed in seven days, but we could get this down to three with further optimisation," notes Tisov.

Meanwhile the Irish pilot improved the energy efficiency of two-storey semi-detached social houses constructed of masonry block cavity walls with a solid concrete ground floor, timber first floor and attic timber roof.

A pre-existing light gauge steel structural wall system was adapted to retrofit an external wall insulation system, with modular wall panels added onto the front alongside triple-glazed windows. One house had a mechanical ventilation system added, including heat recovery, along with solar panels.

While still being monitored, preliminary results indicate annual primary energy savings of 55-85 %, with accompanying CO₂ emission reductions.

What is probably the first demonstration of modular circular retrofit systems in Ireland has instigated discussion among industry and state agencies.

"These demos highlight why local context is crucial to circular renovation. In the Netherlands, the recycled building material trade is well established and so uses second-hand material certification, but in Ireland that isn't the case," explains Tisov. Consortium members are currently advising on a national circularity roadmap for the construction sector.

Steps along the transition pathway

The pilots in Drive 0 demonstrate that, as well as technical innovations such as computer-aided manufacturing for precision parts, achieving the paradigm shift to circular renovation depends on a fundamental transformation of the marketplace, with suppliers taking responsibility for the life cycle of their products.

Therefore, Drive 0 delivered training courses, alongside their pilots, to increase knowledge and skills about circular renovation techniques.

An interactive digital toolkit called [circular homes](#) has also been launched. It targets principally householders and includes tips on aspects such as water use and insulation.

"When Drive 0 began, consumers and industry struggled with the circularity concept, now the focus has shifted to debates about implementation," concludes Tisov.



When Drive 0 began, consumers and industry struggled with the circularity concept.

PROJECT

Drive 0 – Driving decarbonization of the EU building stock by enhancing a consumer centred and locally based circular renovation process

COORDINATED BY

Huygen in the Netherlands

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/841850

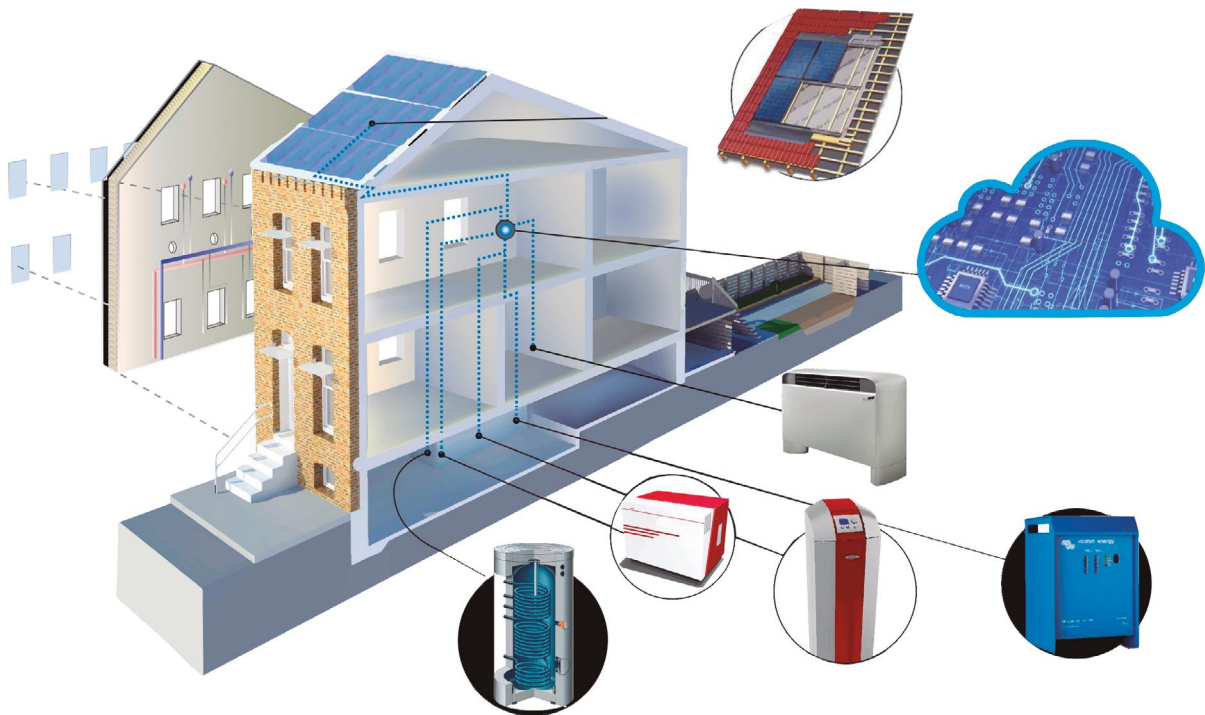
PROJECT WEBSITE

drive0.eu



Retrofitting toolkit targets enhanced energy efficiencies

Successful demonstrations of a toolkit for retrofitting older buildings by the EU-funded HEART project has led to growing market interest, the commercialisation of components and a follow-up project.



© HEART

Europe's buildings are responsible for a third of the EU's energy-related greenhouse gas emissions, making energy efficiency renovations essential for meeting climate goals.

The [HEART](#) project developed a range of solutions that support the retrofitting of buildings to improve their year-round energy

performance. The project focused on European multistorey residential buildings dating from the second half of the 20th century, located in midlatitude regions with a moderate climate – a category which covers over 1 million buildings.

Cloud-based computing platform

A key benefit of the project's innovation is that it tightly integrates a number of aspects of managing a building's energy performance into a single toolkit.

"The central element of this is a cloud-based computing platform," says project coordinator Niccolò Aste from the [Polytechnic University of Milan](#) in Italy. "This runs various active and passive subsystems, designed to transform an old building into a highly efficient smart building."

For example, the platform supports operational decisions concerning the energy management of buildings. It monitors external weather conditions and adapts the operation of heating, air conditioning and other technical systems to provide maximum comfort with minimum energy consumption.

The platform also integrates building elements that produce energy, such as photovoltaic roof tiles. Thanks to a heat pump and to latent thermal storages, surplus electricity can be stored in the form of thermal energy to heat or cool the building.

Even when solar radiation is poor, the HEART system can exchange energy with the grid. The project also developed techniques and components for the complete or partial replacement of windows.

Successful refurbishment in large buildings

The HEART team used the toolkit to carry out major refurbishments in two large buildings. A key aim was to ensure compliance with Europe's building energy guidelines on [nearly zero-energy buildings](#) (NZEBs). This means that the building produces at least 50 % of the energy it consumes.

"A main challenge was to ensure good interaction between the toolkit's different components, to guarantee effective operation," adds HEART project manager Claudio Del Pero, also from the Polytechnic University of Milan.

The project consortium successfully completed two deep renovations. In Bagnolo in Piano, Italy, a four-storey apartment block built in 1985 was retrofitted using the whole HEART toolkit.

Existing gas-powered generators were replaced with high-efficiency heat pumps. Each apartment was equipped with several smart

fan-coils, connected to heat pumps to provide both heating and cooling.

In Lyon, France, a large two-storey building built in 1975 was also retrofitted. Multifunctional external thermal insulation and window refurbishment was carried out, to reduce energy demand.

"These demonstration projects showcased the effectiveness and practical feasibility of our proposed toolkit," explains Del Pero. "This helped to raise interest within the market, both in the toolkit as a whole and in its single elements. Some components have since been patented and further developed, including a [new photovoltaic tile](#)."



Some components have since been patented and further developed, including a new photovoltaic tile.

Upgrading several toolkit subcomponents

A key lesson gleaned from HEART was the importance of involving inhabitants in discussions from the beginning. "Involving users was pivotal to the success of the project," says Del Pero, adding that inhabitants were kept up to date about installation phases and proposed technologies throughout the process.

The success of the project has led to a new EU-funded project, [RE-SKIN](#), which runs until June 2026. This intends to upgrade several toolkit subcomponents to further strengthen and broaden the expected impact of HEART.

PROJECT

HEART – Holistic Energy and Architectural Retrofit Toolkit

COORDINATED BY

Polytechnic University of Milan in Italy

FUNDED UNDER

Horizon 2020-LEIT-ADVMANU

CORDIS FACTSHEET

cordis.europa.eu/project/id/768921

PROJECT WEBSITE

heartproject.eu



Community-centred regeneration in the Basque Country

Building renovations delivered by the EU-funded HIROSS4all project helped reduce energy bills and improve the quality of life for vulnerable communities, aided by their active participation.



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Building renovations to improve energy efficiency, building integrity and aesthetics are costly. The EU-funded [HIROSS4all](#) project set up a one-stop shop home renovation service in Spain's Basque Country, coordinated by regional government.

With HIROSS4all's unique Social Support Mechanism for Financing, local authorities guaranteed portions of loans to help vulnerable communities.

Local hubs called Opengelas ('open living rooms') were established to support communities throughout the renovations. Starting with two pilot programmes in neighbourhoods in Eibar and Bilbao, there are now Opengela offices in 25 communities.

"We learned a lot about supporting vulnerable neighbourhoods. If we can get it right in these areas, it will work anywhere," notes Ignacio de la Puerta, project coordinator.

Tapping people power

To start, an 'urban vulnerability inventory' identified housing stock needing renovation. This included 65 indicators related to socio-economic and socio-demographic conditions, building stability, building and equipment accessibility, habitability and energy efficiency.

"To avoid breeding mistrust by imposing solutions, citizen involvement is critical," adds de la Puerta. "The Opengela offices offer a range of technical, legal, financial, administrative and social support and guidance."

The vision stretched beyond renovation or energy improvement, towards urban regeneration that brings wider social benefits. HIROSS4all engaged the Departments of Employment and Inclusion and the Department of Health, leading to 17 neighbourhood residents taking part in training courses and 30 in energy management work.

A digital tool is also now under development to analyse possible links between health conditions and the urban environment.

Implementing renovation solutions

HIROSS4all's inclusive approach sought approval for the proposed action plans by governance bodies called Communities of Owners. Actions to increase energy efficiency included minimising energy demand with passive measures, for example by adding external insulation. This was followed by active clean energy measures such as adding solar panels to roofs, or upgrading existing equipment.

Having upgraded 425 homes, it was found that passive measures reduced energy consumption by around 60 % on average; when accompanied by active measures, savings exceeded 90 %. Monitoring of indoor air conditions confirmed other positive side effects: temperatures were raised by over 2 °C, while relative humidity was reduced by at least 40 % and CO₂ levels by over 20 %.

From buildings to neighbourhoods

HIROSS4all's Opengela model contributes to a range of EU initiatives, including the [New Leipzig Charter](#), [Renovation Wave](#), [New European Bauhaus](#), [Energy Efficiency Directive](#) and [Energy Performance of Buildings Directive](#).

Adherence to the programme was over 80 % among inhabitants with lowest incomes, demonstrating an appetite for this model of urban renewal, which continues as the Opengela programme under the successor [BIRTUOSS](#) project.

"Our model is now recognised as a reference, regionally, nationally and Europe-wide. But to decarbonise most of the building stock by 2050, we must scale up from the level of buildings to neighbourhoods, incorporating elements such as community energy production and nature-based solutions. This is BIRTUOSS's focus," says de la Puerta.



Passive measures reduced energy use by around 60 % on average.

PROJECT

HIROSS4all – HOME INTEGRATED RENOVATION ONE-STOP-SHOP FOR VULNERABLE DISTRICTS

COORDINATED BY

Department of Territorial Planning, Housing and Transport, Basque Government in Spain

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/846707

PROJECT WEBSITE

opengela.eus/en-2



Making Europe more energy-efficient one home at a time

A new one-stop shop and funding mechanism helps homeowners in Spain's Extremadura region with energy efficiency home renovations. The EU-funded HouseEInvest project helped users access initial assessments, planning, and even financial support.



The bulk of Europe's building stock is old and thus energy-inefficient. A case in point is Spain's Extremadura region. According to the EU-funded [HouseEInvest](#) project, most of the single-family homes and condominiums in the region were built before 1980. As a result, they tend to lack proper insulation.

"While these older homes can be made energy-efficient through renovation, many homeowners are reluctant to do so due to the perceived costs and the hassle of coordinating the work," says Francisco Javier Márquez Pocostales, project coordinator

at the [Extremadura Energy Agency](#) (AGENEX) Consortium, the HouseEInvest project's lead partner.

A one-stop shop

To help increase the number of renovations in Extremadura that improve the energy efficiency of homes, the HouseEInvest project established what is called a one-stop shop. "One-stop shops provide homeowners with all the information, resources

and support they need to conduct an energy efficiency home renovation,” explains Márquez.

The HousEInvest one-stop shop assists homeowners with everything from conducting an initial assessment to finding and working with contractors. It can also provide technical assistance and, after the renovation is completed, help monitor the energy savings achieved.

“By simplifying the often complex and intimidating renovation process, the one-stop shop concept helps bridge the gap between being interested in a home renovation and actually doing it,” adds Márquez.

Financing for energy efficiency renovations

One-stop shops also help homeowners secure the financing they need to pay for renovations. For the HousEInvest project, that financial support comes through the guarantee fund for energy efficiency of housing in Extremadura (GEEVE Fund).

“This is undoubtedly the project’s main objective and its most important result,” remarks Márquez.

The fund offers a public guarantee on the loans offered by private financial entities to pay for energy efficiency home renovations. The financial entities give loans to the homeowners or their associations to pay for renovation works, while the regional government provides a guarantee to the financial entity.

“This set-up allows owners to renovate their homes under better financial conditions than what is currently available on the market,” explains Márquez.

Although public housing providers cannot apply for GEEVE funding, Márquez notes that they can take advantage of the one-stop shop’s suite of services.

Ensuring continuity into the future

Even though HousEInvest has finished, the project’s partners have committed to continuing their work. Financial and technical advice for private homeowners is now provided by the Professional Associations of Architects and Engineers. Further financial and technical advice for public building owners (including public housing providers), private homeowners and their associations is provided by AGENEX.

“By ensuring continuity in everything achieved by the HousEInvest project, we guarantee that homeowners will continue to benefit from the one-stop shop concept,” says Márquez.

The project has published best practices and lessons learned that other entities can use to launch their own initiatives. These are available in [Spanish](#) and [English](#), with summaries available in [French](#), [Italian](#), [Polish](#) and [German](#).

Raising awareness of making buildings more energy-efficient

Over 300 condominiums and 50 single-family homes have benefited from the HousEInvest one-stop shop, with 80 buildings having started the renovation process by the close of the project.

However, the project has done more than only increase the number of home renovations happening in Extremadura, it also raised awareness of the need to make buildings more energy-efficient.

“If Europe is to achieve its ambitious goal of becoming the first climate-neutral continent, it must improve the efficiency of its building stock – and that starts with renovations,” concludes Márquez.



By simplifying the often complex and intimidating renovation process, the one-stop shop concept helps bridge the gap between being interested in a home renovation and actually doing it.

PROJECT

HousEInvest – Energy Efficiency Investments in multifamily houses

COORDINATED BY

Extremadura Energy Agency Consortium in Spain

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/784986

PROJECT WEBSITE

renuevatucasa.eu/en/home

Putting citizens at the heart of urban energy transition

Involving citizens in decision-making – and tapping into local expertise – can help cities make the challenging transition towards carbon neutrality, say the researchers behind the EU-funded mySMARTLife project.



Retrofitting buildings is an essential element of the transition towards climate neutrality. While solutions such as insulation materials and renewable energy systems are available, installing these can be a costly and inconvenient exercise for residents and the public at large.

"This is why engaging citizens in retrofitting, and creating reasonable financial models, is so important," explains mySMARTLife project coordinator Rubén García Pajares, from CARTIE in Spain.

"These discussions can be arduous," he says. "They involve convincing people of their needs and persuading them about future benefits, but with high financial upfront expenses and disruption to daily operations."

Smart people, smart economy

The mySMARTLife project sought to help cities implement transformative schemes by proposing and trialling an advanced urban planning strategy. “A key pillar of this strategy was called ‘Smart People’,” adds García Pajares. “Here, we included all activities related to working with citizens, including vulnerable groups, in city decisions.” These activities included public debates on the energy transition, as well as workshops on issues such as digitalisation of the grid.

A second pillar, called ‘Smart Economy’, was about strengthening local innovation ecosystems, and tapping into local skills and expertise. This combined approach was then pursued in implementing 150 actions in the fields of energy and mobility in the three target cities of Nantes, Hamburg and Helsinki, in France, Germany and Finland respectively.

Combined retrofitting strategies in action

A good example of this combined approach is the [‘Mon Projet Renov’ online platform](#) developed by the city of Nantes to offer citizens free information on retrofitting projects and link to local companies offering related services.

Another Nantes-based initiative sought to support homeowners in their renovation projects by offering [energy audits](#). Recommended actions were then proposed, such as insulation, boiler replacement and solar panelling.

In Helsinki, [smart controls](#) for managing heat demand were installed in 12 residential condominium buildings, providing 167 apartments with energy savings of 10-25 %.

In the same city, an office building was [retrofitted](#) with 572 square metres of solar panels and four wind turbines, supplying enough energy to cover 20 % of the building’s electricity demand. Renewable cooling was supplied through a borehole water system.

Successful integrated urban planning approaches

Following project completion in 2022, García Pajares notes that a total of 147 054 square metres of building space has either been retrofitted, or built to high performance standards, across the three target cities. “In addition, 29 % of the remaining final net energy used by these buildings is now covered by renewable energy sources,” he notes.

Some activities launched by project members have continued. These include the city coordinators group, the peer-to-peer learning programme and various task groups, whose activities still continue on a voluntary basis. Three ‘follower cities’ and 16 ‘observer/interested’ cities with high replication potential were also involved in the project.

Overall, García Pajares sees the mySMARTLife project as an example of how integrated approaches to urban planning can lead to outstanding results, and notes that more and more cities are embracing new and more ambitious climate neutrality targets.



These discussions involve convincing people of their needs and persuading them about future benefits, but with high financial upfront expenses and disruption to daily operations.

PROJECT

mySMARTLife – Smart Transition of EU cities towards a new concept of smart Life and Economy

COORDINATED BY

CARTIF in Spain

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/731297

PROJECT WEBSITE

mysmartlife.eu/mysmartlife

Quality and cost-effectiveness key to successful renovation

Renovation concepts that enable residents to make fast, reliable and cost-effective improvements could play a critical role in achieving energy efficiencies, according to the EU-funded outPHit project.



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Buildings are responsible for 40 % of the EU's energy consumption and 36 % of its greenhouse gas emissions. Simply transitioning away from fossil fuels towards renewables will therefore not be enough for us to meet our [climate goals](#). Huge efforts will also be needed to make our buildings more energy-efficient.

"Something like [85 %](#) of the buildings currently standing in Europe are 20 or more years old, and 95 % of those will still be around in 2050," notes [outPHit](#) project member Sarah Mekjian, from the [Climate Alliance](#) in Germany. "This means that renovating Europe's existing building stock is absolutely critical."

Mekjian also points out that achieving building energy efficiency is a pressing social issue. Some [40 million Europeans were unable to keep their home adequately warm in 2022](#).

Environmental and social aspects of renovation

The outPHit project, which is being coordinated by the [Passive House Institute](#) in Germany, was launched in 2020 with the aim of addressing both the environmental and social aspects of renovation. This was achieved by focusing on quality assurance, as well as speed and cost-effectiveness.

On the issue of quality assurance, the project has carried out a number of case study renovations that meet the energy performance requirements of the [EnerPHit Standard](#) – “perhaps the world’s most stringent and comprehensive standard for energy retrofits,” says Mekjian.

The second key element of the project has been the application of prefabricated elements as a fast and cost-effective means of meeting EnerPHit standards. “We wanted to show that you can achieve deep renovation in a more streamlined way, and that it is not rocket science,” adds Mekjian.

Prefabrication involves assembling components such as wall and roof structures off-site, and transporting them to the construction site. With the addition of solar panels, such concepts can transform existing buildings into completely renovated producers of renewable energy in a matter of weeks.

Climate goals and energy poverty

The project applied the principles of prefabrication and EnerPHit standards to a number of case studies in seven European countries. Buildings renovated included multifamily apartments, administrative offices and social housing.

“There have been a number of success stories,” says Mekjian. “One renovated office building in France was able to remove its heaters, because occupants didn’t need them anymore.”

In Greece, reticence within one apartment building turned to enthusiasm after the residents who participated in renovation

works saw their energy bills drastically reduced. “Extreme energy performance is not just about reaching our climate goals,” remarks Mekjian. “It is also about the only way we are going to tackle energy poverty.”

Making basic renovation decisions

The project, which is due for completion at the end of August 2024, will continue to [update and post](#) the results of its case studies as they come online. The team also plans to develop and publish a tool that helps housing associations and residents to make basic renovation decisions.

For professionals, training materials will be developed to increase awareness of prefabricated solutions, while lessons extracted from the case studies will help planners to tackle difficult situations. Once the project is completed, all information will end up on [Passipedia](#), a comprehensive online platform for information on low-energy housing.



One renovated office building in France was able to remove its heaters, because occupants didn’t need them anymore.

PROJECT

outPHit – PROMOTING ENERGIESPRONG RENOVATIONS AND ONE-STOP-SHOP RETROFIT CONCEPTS IN HIGHLY EFFICIENT NZEBs IN ENERPHIT STANDARD, TO MAKE RENOVATION MORE RELIABLE, FASTER AND COST-EFFECTIVE

COORDINATED BY

Passive House Institute in Germany

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/957175

PROJECT WEBSITE

outphit.eu/en



Smart facade solution for building energy efficiency

The EU-funded POWERSKIN PLUS project developed prefabricated, modular glazing that features solar panels and energy storage capabilities. Suitable for building renovations, it could significantly reduce the energy consumption of Europe's building stock.



Curtain wall systems consist of lightweight aluminium-framed or timber facade structures that envelope a building. Typically seen on commercial buildings, they hold in place large glass, metal or composite panels, which can be replaced if necessary.

“Retrofitting superior insulation into existing curtain wall systems is sometimes necessary to meet more stringent building codes,” explains [POWERSKIN PLUS](#) project coordinator Jorge Corker, from the [Pedro Nunes Institute](#) (IPN) in Portugal. “However, engineers and architects frequently struggle to install traditional insulating solutions, due to limited space, and the need to ensure that any added weight derived from

retrofitting does not jeopardise the building's integrity or stability.”

Storing and using renewable energy on-site

The POWERSKIN PLUS project sought to address these challenges through the development of an innovative facade solution. The system integrates highly energy-efficient components, solar energy harvesting and energy storage components.

“European countries need to [decarbonise](#) their national building stocks by 2050, and promote the cost-effective conversion of existing buildings into nearly zero-energy buildings (NZEBs),” says Corker. “Achieving these objectives requires the development of innovative approaches and smart solutions.”

During the project, prefabricated panel systems were developed to enhance external wall insulation (given by the U-value, a measure of how much heat passes through a square metre of material). Due to their low weight (opaque elements can be as low as 5 kg/m² and triple glazed transparent ones around 30 kg/m²), they do not require additional building structural modification when retrofitted, making them easy to swap in. A number of state-of-the-art energy-efficient materials were applied, including superinsulation elements (insulated glass units with U-values 35 % better than standard double glazing, and lightweight opaque modules able to reach U-values of as low as 0.098 W/m² K), multifunctional nano-enabled coatings that add anti-reflective, self-cleaning, antifungal and fire-resistant properties, and advanced solar energy harvesting components.

To make use of the captured solar energy, a storage and management system for buildings was also developed, using second-life Li-ion batteries recycled from electric vehicles.

Successful retrofitting at demo sites

The project team was able to demonstrate its innovative facade system at sites in Czechia, Germany and Portugal. On the IPN campus, panelling was retrofitted onto an office building dating from the early 1990s. A battery storage system was installed, and the energy performance monitored.

“We were able to show that our prefabricated modules can be easily installed in either new or retrofitted curtain wall buildings,” adds Corker. “We believe that these panels will be able to cover different performance needs, regulatory and environmental requirements and budget options.”

Corker believes a key benefit lies in the modular nature of the system. The pilot studies were able to demonstrate swift installation and a reduction in unnecessary waste, which could be a critical affordability issue for building operators.

Contribution to climate change mitigation

Following project completion in March 2024, Corker and his team intend to continue improving the system, with the aim of commercialising their innovation. “We think we will be able to market this system within three years,” he says.

Some components are at a more advanced stage than others. For example, the building electric storage system is close to being market-ready, and will be offered to enterprises as a stand-alone product through licensing agreements.

Looking to the future, Corker believes that the deployment of innovative deep renovation technologies, such as the ones developed through POWERSKIN PLUS, will be of huge benefit to Europe. [Operational energy use](#) in buildings represents about 30 % of global energy consumption, so any significant improvement in building energy efficiency would have a major impact on achieving EU climate goals.

“Ultimately, the key contribution of this project will be measured by its positive contribution to future mitigation of climate change, reduced carbon emissions, enhanced energy security and improved quality of life for citizens,” concludes Corker.



We were able to show that our prefabricated modules can be easily installed in either new or retrofitted curtain wall buildings.

PROJECT

POWERSKIN PLUS – Highly advanced modular integration of insulation, energising and storage systems for non-residential buildings

COORDINATED BY

Pedro Nunes Institute in Portugal

FUNDED UNDER

Horizon 2020-LEIT-ADVMANU

CORDIS FACTSHEET

cordis.europa.eu/project/id/869898

PROJECT WEBSITE

powerskinplus.eu



Developing seamless services for housing renovation

A private energy efficiency retrofitting model developed by the EU-funded SHEERenov project is helping to make Bulgaria's housing greener.



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Bulgaria is supporting Europe's transition toward a climate-neutral region through an ambitious initiative to [renovate](#) its residential buildings. The move will help the country move from an energy efficiency retrofitting system based on multifamily buildings to a market-oriented model.

The [SHEERenov](#) project has developed and tested a new model for the provision of residential renovation services in Sofia. The team identified various obstacles and opportunities, to

create the conditions necessary to attract both public and private entities involved in energy efficiency renovation.

"The innovative aspect of our model lies in its ability to attract private investments by using public finance as a catalyst," explains Yordan Zdravkov, tech transfer and commercialisation expert at [Cleantech Bulgaria](#), and part of the SHEERenov project coordinator team. "Public funds are to be utilised to provide guarantees or subsidies, which in turn mitigate the risks associated with private investments," he adds.



The innovative aspect of our model lies in its ability to attract private investments by using public finance as a catalyst.

This strategy was designed to not only ensure the availability of financial resources for renovation projects but also encourage the participation of private financial institutions.

“The SHEERenov model incorporates a holistic approach, including technical assistance, financial advisory services and project implementation support, thereby facilitating a seamless process for building owners and residents,” says Zdravkov.

“This ‘one-stop shop’ system devised by the project represents an innovative solution designed to support everyday citizens in the renovation of their homes, streamlining the renovation process and making it more accessible and efficient for homeowners,” notes Zdravkov.

Uncovering market obstacles and stakeholder aims

To identify the major obstacles and requirements for attracting relevant market stakeholders, SHEERenov used a multifaceted approach including detailed situation analyses, stakeholder surveys and reviewing best practices from across Europe.

The project team engaged in a series of workshops, meetings and consultations with a wide range of stakeholders, including homeowners, business entities, financial institutions and local authorities. They also assessed the current market conditions, regulatory environment and financial mechanisms related to energy efficiency retrofitting.

Developing a ‘one-stop shop’ concept

Energy efficiency renovation of multifamily residential buildings is complex, and requires a wide range of expertise and professional competences, including technical, legal, economic and organisational, which condominium co-owners do not typically possess.

SHEERenov’s analysis showed the need for the inclusion of a ‘specialised intermediary’, professional management companies and energy efficiency consultants able to handle these tasks. In this way, professional building managers can deal with homeowners, while the specialised intermediary provides services to improve energy performance.

INSPIRing future work

Through their innovative work, SHEERenov became a focal point for innovation and reforms in the Bulgarian renovation sector, extending well beyond the project goals and becoming a vital part in the long-awaited reform in the sector.

The team successfully laid the foundation for a market model of housing renovation financing. After its test phase, the one-stop shop concept was integrated into the national recovery and resilience plan (NRRP) of Bulgaria.

“The capacity built among the public authorities, companies and citizens will actively support the upcoming campaign for the renovation of multifamily residential buildings,” adds Zdravkov.

The work continues under the [INSPIRenov](#) project. This aims to develop financial instruments and commercial bank products for the energy-efficient renovation of residential buildings in Bulgaria, and will introduce a new blended financing scheme to provide access to private financing for large-scale energy efficiency renovation.

PROJECT

SHEERenov – Seamless services for Housing Energy Efficiency Renovation

COORDINATED BY

Cleantech Bulgaria in Bulgaria

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/890473

PROJECT WEBSITE

sheerenov.eu



Making Europe's cities smarter and greener

The ambitious EU-funded SmartEnCity project is helping to foster a sustainable urban landscape across the EU, featuring more energy-efficient homes, eco-friendly transport and more.



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Cities must play a pivotal role in combating climate change. [Urban areas](#) use large quantities of energy and create similarly high CO₂ emissions. Yet their high population density also creates opportunities for large gains when retrofitting buildings, developing smart mobility services and using integrated computer systems across the cities.

The [SmartEnCity](#) project started with a vision to create 'Smart Zero Carbon Cities': carbon-neutral urban areas across Europe.

Beyond carrying out activities in urban centres to reduce energy demand, the team also designed 'Cities4Zero', a systemic approach that helps others replicate the SmartEnCity approach across European cities.

The measures delivered during the SmartEnCity project all aimed at reducing energy demand and maximising the supply of renewable energies.

Coordinated by [TECNALIA Research and Innovation](#) in Spain, SmartEnCity involved 38 partners from six European countries. The project had the ambition of creating cities that are more sustainable and inclusive, delivering higher quality of life to citizens and generating more opportunities for jobs and wealth.

“Under this seemingly straightforward set of goals lies the intention to empower citizens to be active actors in urban transformation,” says Francisco Rodríguez, SmartEnCity project coordinator. “The transition of cities towards climate neutrality needs to be driven by aware citizens as much as by traditional urban decision makers.”

The project, which lasted six years, retrofitted over 1 800 homes in 95 buildings. The various activities of SmartEnCity brought benefits for nearly 30 000 citizens, and collectively reduced greenhouse gas emissions equivalent to over 11 000 tonnes of CO₂ per year.

Smart Zero Carbon Cities

The SmartEnCity concept was designed and implemented in three Lighthouse Cities: Vitoria-Gasteiz in Spain, Tartu in Estonia and Sønderborg in Denmark.

In Vitoria-Gasteiz for example, one of the city’s most vulnerable neighbourhoods, Coronación, had 302 dwellings across 26 residential buildings renovated to improve their energy efficiency and aesthetics. At the same time, a biomass heating network was deployed in the city to reduce energy prices, while the introduction of 13 new electric buses made the city’s public transport more sustainable.

In Tartu, a new district cooling system using heat pumps was installed – it uses residual heat from cooling to generate heat for almost 700 apartments. An LED smart street light control system replaced hundreds of old, inefficient lamps, a city-wide electric bike sharing system was installed and the city purchased over 60 new buses powered by biogas.

In Sønderborg, seven of the city’s social housing departments are being retrofitted to reduce energy consumption, in addition to solar cell plants twinned with battery storage being fitted in multi-apartment buildings.

These Lighthouse Cities all introduced smart digital infrastructure to not only provide useful data on energy use, but also integrate the various new systems as part of a comprehensive whole.

“The fact that SmartEnCity’s three Lighthouse Cities went on to be selected for the EU-funded [Mission for Climate-Neutral and Smart Cities](#), and that recently two of them have been amongst the first ten cities awarded the [EU Mission Label](#) for cities, is an achievement that makes the whole project team very proud,” adds Rodríguez.

Spreading sustainable practices across Europe

The SmartEnCity process has already been replicated in two ‘follower cities’: Lecce in Italy and Asenovgrad in Bulgaria. To encourage the SmartEnCity Network to spread further, the team also developed a series of tools, reports, scientific papers and videos on how other cities can transition to more sustainable and resource-efficient urban areas.

This includes the [SmartEnKIT](#), which compiles all lessons from Lighthouse Cities into a replication toolkit. With this online resource, the project aims to continue its successful work by inspiring other small and medium-sized European cities to progress along the road to a carbon-free future.



The transition of cities towards climate neutrality needs to be driven by aware citizens as much as by traditional urban decision makers.

PROJECT

SmartEnCity – Towards Smart Zero CO₂ Cities across Europe

COORDINATED BY

TECNALIA Research and Innovation in Spain

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/691883

PROJECT WEBSITE

smartencity.eu



Encouraging uptake of deep energy renovation

A new methodology developed by the EU-funded StepUP project shows how the decarbonisation of existing buildings can be a reliable, attractive investment.



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For Europe to achieve its ambitious goal of a decarbonised building stock by 2050, renovation is key. The most effective form is deep renovation, which takes a whole-building approach. Yet currently only 1 % of European buildings are renovated each year, and shallow retrofits persist, delivering only a low impact on energy consumption.

“The main reasons for the continued preference for shallow retrofits are the high initial investment costs for deep renovation, a lack of information on the performance gaps, and the inability to track improvements after retrofits have taken place,” explains Amisha Panchal, project manager at [Integrated Environmental Solutions](#) (IES) in Scotland, and [StepUP](#) project coordinator. “However, deep renovations have the potential to be significantly more impactful compared to shallow retrofits,” she says.

In the StepUP project, researchers developed a new methodology for deep renovation, based on an understanding of building performance and physics-based modelling to show the impact of interventions. StepUP also designed and introduced a range of 'plug and play' technologies that maximise the effects of deep renovations on energy, costs, air quality and comfort in the home.

A new, data-driven methodology

StepUP's methodology incorporates an iteration-based approach to renovation investments using continuous feedback loops, and is based on data from real buildings and calibrated physics-based models. It draws on a range of plug and play technologies that are easy and quick to install, and protocols to enable these technologies to operate within existing energy systems.

The project team developed their methodology together with stakeholders. They first identified the main challenges in deep renovation, then sought underlying solutions to enhance the renovation process, and finally added the scope and limitations of the renovation methodology based on the most relevant building stock and owner types. The methodology continues to be validated and investigated, and has been published in [scientific journals](#).

The modelling demonstrates to building users, deep renovation managers and design and construction teams the impact of the proposed solutions on building performance, both before and after retrofitting.

Developing plug and play technologies

The project created two main plug and play technologies that are easily to install: the plug and play envelope system and the plug and play active system, based on highly innovative prototypes from partners [Manni](#) and [HeatVentors](#), respectively.

The [envelope system](#) is modular, using preassembled enveloped panels and integrating windows, along with other insulation-based systems. The active system combines [energy storage using](#)

[phase-change materials](#), commercial solar panels, commercial heat pumps and an intelligent control and optimisation system based on technologies developed by IES and HeatVentors, that can be integrated into a building's heating or cooling systems.

"We are reviewing the initial data collected from the renovation in one of the project's pilots to analyse energy demand reduction," notes Panchal. "We expect a significant improvement due to the extensive testing and analysis carried out prior to the renovations, and early positive feedback from the occupants and building owners."

Accelerating deep renovations across the EU

The StepUP consortium believes their results have huge potential for accelerating the renovation market across Europe. "We hope that the methodology and the technical solutions are adopted by building owners and other stakeholders, and ultimately have a meaningful impact of renovation to the buildings and its occupants," adds Panchal.



Deep renovations have the potential to be significantly more impactful compared to shallow retrofits.

PROJECT

StepUP – Solutions and Technologies for deep Energy renovation Processes Uptake

COORDINATED BY

Integrated Environmental Solutions in the United Kingdom

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/847053

PROJECT WEBSITE

stepup-project.eu



Scaling up innovative retrofitting for Ireland's homes

Many people want to retrofit their homes, but lack the necessary skills, knowledge or expertise to do so. A one-stop shop from the EU-funded Superhomes2030 project is helping Ireland's housing sector become more energy-efficient.



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The [European Green Deal](#) is seeking to achieve climate neutrality in Europe by 2050. Renovating the existing housing stock will support this aim, increasing energy efficiency, cutting carbon emissions and improving quality of life for inhabitants.

Yet most building owners lack the necessary skills or time to retrofit homes, and renovations come with high implementation costs. Individuals seeking out information on retrofitting their homes can find it confusing and complex. To resolve these issues, the [Tipperary Energy Agency](#) in Ireland – in partnership with [Electric Ireland](#) – developed [Superhomes](#), a deep retrofit service for residential buildings in Ireland.

The concept retrofits homes to become highly efficient buildings using cost-effective technologies delivered through a one-stop shop service. The idea is to empower customers to transform their homes into climate-friendly environments, which are low-carbon, renewable-energy focused and more comfortable to live in.

In the Superhomes2030 project, a consortium of partners worked together to dramatically upscale the Superhomes concept through the creation of four regional one-stop shops across Ireland. These services doubled the number of engaged contractors to 80 through the project, to deliver high-quality retrofits across the country and boost national capacity building. The team trained more than 50 SMEs and over 200 professionals in Superhomes standards.

The project also offered training for homeowners, contractors, technical staff and surveyors, and developed finance solutions for home retrofits that do not rely on public funds. The intention is to retrofit 35 000 homes in Ireland by 2030. By the end of 2023, Superhomes2030 had scaled up from an initial rate of 100 homes per year to over 500. This figure is growing each year – on track to either meet or exceed the overall target.

One-stop shops for home retrofits

The one-stop shop service is available to homeowners who want to retrofit their homes, helping to guide them through all the new – and potentially confusing – technologies that could reduce their carbon footprint. It includes an initial consultation to assess retrofit potential, a home energy survey to examine the building and heating system and create a baseline assessment, assistance with a grant application and a subsequent retrofit.

New installations for improving energy efficiency in the home can include heat pumps based on renewable energy, insulation, reduced air leaks which could lose heat and advanced ventilation systems.

The project worked on a range of research and development activities, including optimising design systems, improving technical analyses and creating open-source energy performance data platforms to demonstrate values of retrofits.

Deep Retrofit Community of Practice

Superhomes2030 also facilitated the creation of a [Deep Retrofit Community of Practice](#) across Europe. Through this innovative community, best practices, standards, knowledge and technical solutions can be shared between a range of industry stakeholders, including experts, retrofit specialists and retrofit agencies.

The project team also ran a series of three Community of Practice webinars to compare similar one-stop shops around Europe and to share knowledge. The first online conference focused on skills shortage and training in the construction sector; the second was aimed at homeowners planning to retrofit their homes; and the final webinar showcased three one-stop shops across Europe, discussing the approach taken by each, along with the services offered and the process.

Open-source energy data

Superhomes2030 successfully opened four one-stop shops across Ireland, supporting jobs in the construction sector. Market research carried out through the project showed that financing options are limited in Ireland compared to other countries, but are growing.

The project also created open-source data platforms to share energy performance and to optimise technical analysis, design systems and retrofit solutions. These platforms were designed to demonstrate the value of bringing nearly zero-emission building retrofits to the market.

Thanks to international partners the [European Heat Pump Association](#) and [FEDARENE](#) in Belgium, the project is now exploring expanding the Superhomes model outside of Ireland.

PROJECT

Superhomes2030 – Up scaling integrated Home Deep renovation services for Ireland

COORDINATED BY

Tipperary Energy Agency in Ireland

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/890492

PROJECT WEBSITE

electricirelandsuperhomes.ie



Building a path towards energy efficiency

State-of-the-art, sustainable, prefabricated solutions are at the heart of the EU-funded Surefit project's effort to reduce domestic building energy consumption. Implemented in pilot schemes across diverse European climatic areas, the project demonstrated the solutions' versatility in achieving nearly zero-energy buildings.



The [Surefit](#) project was launched in response to the urgent need to improve the energy performance of Europe's buildings. Under the [European Green Deal](#), the EU is committed to reducing emissions by at least 55 % by 2030, and achieving climate neutrality by 2050. To help deliver on this ambition, Surefit seeks to revolutionise EU homes, making them more energy-efficient, cost-effective and carbon-neutral.

"We want to offer the technologies we develop to enterprises and partners all across Europe," says project coordinator Sérgio Tadeu from [ISQ](#). "This implies the creation of business models that take into account utilising a high level of prefabrication, akin to an easy-to-install approach."

Achievable objectives

The project's goals are ambitious: to reduce primary energy use and carbon emissions by 60 %, lower renovation costs by 50 % and decrease renovation time by 40 %. To achieve these objectives, the project brings together a diverse consortium of institutions and businesses from Finland, France, Germany, Greece, Portugal, Spain, Türkiye and the United Kingdom, pooling the collective expertise and resources of its partners.

The Surefit project incorporates a range of innovative technologies into its demo sites. They include prefabricated panels, photovoltaic vacuum glazing as a type of high-performance window for electricity generation, novel solar thermal and photovoltaic systems, panels filled with phase-change material to store heat, a novel evaporative cooling system, a window heat recovery device, and innovative multipurpose heat pumps.

Customisable and efficient

Instead of applying a one-size-fits-all approach, the project will customise renovations based on the distinct needs of each building and its location. So every renovation is specifically

tailored to meet the unique conditions, optimising energy efficiency. The importance of pilot testing in different countries is paramount in achieving these results, as Tadeu highlights:

"Climate conditions make a significant difference, so we have to choose suitable solutions according to location. This involves the selection of insulation materials and their thickness or technologies to take advantage of renewable energy sources according to the building's solar exposure, for example."

So far, the initial simulated results have been promising, showing the potential for significant reductions in carbon emissions. Additionally, the initiative has developed a guide on retrofitting residential buildings with a step-by-step methodology and produced a tool that guides stakeholders in selecting the best energy-saving options for renovations. Both will be made available in the coming months.

"The tool is extremely useful, because it balances economic and environmental criteria," explains Tadeu. "Some building owners have greater investment capacity than others, and this will determine the tech selected and the extent of the retrofitting."

PROJECT

Surefit – SUSTAINABLE SOLUTIONS FOR AFFORDABLE RETROFIT OF DOMESTIC BUILDINGS

COORDINATED BY

ISQ in Portugal

FUNDED UNDER

Horizon 2020-ENERGY

CORDIS FACTSHEET

cordis.europa.eu/project/id/894511

PROJECT WEBSITE

surefitproject.eu



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RESULTS PACK ON LOCAL CLEAN ENERGY TRANSITION

Sustainable energy actions at local level are decisive to implement the ambitious European energy and climate policies. The 13 projects featured in this Results Pack highlight activities that support the shorter-term implementation as well as the long-term goals and ambitions for the clean energy transition. Their aim is to accelerate the uptake of energy efficiency measures and the deployment of clean energy solutions.



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