



**CBDC powered Smart PerFORrmance contractS for Efficiency, Sustainable,
Inclusive, Energy use**

D3.4 Report on the renovation technologies for each building and deployment approach M20

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Abbreviations

€G	green-euro
AHU	Air Handling Unit
AS-P	Automation Server Premium (in the context of building management systems) or Application Service Provider
BiPV	Building-Integrated Photovoltaics
BMS	Building Management System
CBDC	Central Bank Digital Currency
CO ₂	Carbon Dioxide
eMMC	Embedded MultiMediaCard (flash memory)
EPC	Energy Performance Certificate
EPS	Expanded Polystyrene (a type of insulation material)
ErP	Energy-related Products
ESIE	Efficient, Sustainable and Inclusive Energy
ETICS	External Thermal Insulation System
EU	European Union
EWI	External Wall Insulation
HVAC	Heating, Ventilation, and Air Conditioning
PV	Photovoltaic
SSH	Social Sciences and Humanities
TCP/IP protocol	Transmission Control Protocol/Internet Protocol
VFD	Variable Frequency Drives
VFDs	Installation of Variable Speed Drivers

Executive Summary

This report provides a comprehensive overview of the renovation progress across multiple pilot sites as outlined in D3.1. It details the status of various renovation technologies, including challenges encountered, milestones achieved, and resource allocation.

The report offers valuable insights into the implementation phase, highlighting the current stage of each project and providing a clear picture of the renovation strategies employed. Furthermore, it outlines the subsequent steps for deploying renovation technologies, complete with planned activities, key milestones, and associated timelines.

This document serves as a crucial resource for understanding the trajectory of renovation initiatives within the project, enabling informed decision-making and strategic planning for future endeavors.

1 Introduction

1.1 Project Introduction

The overall vision of FORTESIE is to design, demonstrate, validate and replicate innovative renovation packages in the building industry with Smart Performance-Based guarantees and financing, aiming at Efficient, Sustainable and Inclusive Energy (ESIE) use to accelerate the Renovation Wave in Europe. The renovation packages will combine state-of-the-art construction materials and technologies components (prefabricated facades, BIPV, heat pumps, etc.), innovative digital technologies for measurement and verification, and attractive financing (e.g. contractual frameworks for smart performance guarantees, financing mechanisms, engagement techniques, green-euros, etc.), to raise the overall EPC value proposition. The renovation packages will be tailored to specific target groups needs and optimised to improve the ESIE performance considering energy, CO₂ and comfort. Each package will be demonstrated and validated in real life use cases and customised for replication in all other partner countries for immediate market take-up.

Methodologies from Social Sciences and Humanities (SSH) will be adopted for:

- a. the creation of collaborative business models that boost the Renovation Wave by considering all stakeholders' value and revenue streams,
- b. novel incentivisation and behavioural change models that aim to stimulate long term engagement with focused interactions to adopt green behaviour
- c. the incorporation of a digital currency, green-euro, (€G) for financing, rewarding and creating an inclusive / collective narrative in the fight against climate change
- d. the collection of feedback for recommendations to policy and business stakeholders,
- e. Mapping and understanding the complex interplay between the different stakeholders to deliver an engagement strategy across the value chain.

These demonstrations will potentially constitute the green-euro as a retail Central Bank Digital Currency (CBDC), hence revolutionising the financing of renovation approaches. An online marketplace, will be offering first level advice, directing consumers through the value chain of stakeholders and facilitating access to these “packaged” renovation services.

1.2 Deliverable Purpose

This deliverable offers a comprehensive update on the status of renovations identified in D3.1 across pilot sites, detailing progress, challenges, and milestones achieved for each project up to month 20. It provides insights into the current stage of implementation, resource allocation, and project management efforts. Additionally, the report outlines the next steps in the deployment of renovation technologies, including planned activities, milestones, and timelines. Overall, this report serves as a valuable resource for understanding the progress of renovation initiatives within the project and guiding future actions to ensure their success.

2 Renovation Technologies

The built environment plays a critical role in our lives, impacting our work, health, and overall well-being. However, many existing buildings suffer from inefficiencies, outdated systems, and a limited capacity to meet modern demands for sustainability and comfort. This is where renovation technologies come to the forefront. By harnessing the power of renovation technologies, we can breathe new life into existing structures, creating buildings that are not only efficient and sustainable but also contribute to a healthier and more comfortable environment for occupants.

2.1 Renovation Technologies in FORTESIE

Building on the meticulous analysis conducted within the FORTESIE project, this section dives into the heart of our renovations implementation progress throughout the various pilots cases and renovation technologies. By carefully scrutinising each pilot site, the FORTESIE project identified the most suitable technologies that would yield the greatest benefits for each unique building. This ensures a targeted approach, maximising the impact of the renovations and addressing the specific needs of each structure, but at the same time considering the needs, the fitting packages are being designed for each target group.

Renovation Technology	Demo 1	Demo 2 (SAR)	Demo 2 (VED)	Demo 2 (RKT)	Demo 3	Demo 4	Demo 5	Demo 6	Demo 7
Smart windows with integrated PV panels	■								
External thermal insulation of facade	■	■	■	■	■	■			
Ventilation system	■			■	■	■	■	■	■
Green roof	■								
Roof insulation		■	■	■	■	■			
Photovoltaics		■	■		under technical evaluation			■	
Building integrated Photovoltaics							■		
Windows/doors' retrofit		■		■	■				
Lighting renovation			■		■				
SCADA installation			■						
District heating solution			■						
Basement ceiling insulation				■					
Water heater				■					
Heat pump				■					
Heating substation								■	
IoT platform for monitoring conditions and devices							■		
Platform for heating and ventilation system management									■

Figure 1 Renovation Matrix

This is depicted in a comprehensive matrix showcasing the renovation technologies assigned to each pilot building. This allows for easy comparison and analysis of the diverse renovation approaches employed across the project.

3 Pilots Status Update

Beyond the matrix, we'll delve deeper into the individual pilot buildings. For each pilot, we'll provide a detailed update on the implementation status of the assigned renovation technologies. This will include information on progress made, any deviations from the initial plan, and revised timelines if applicable.

3.1 Pilot 1

3.1.1 Summary of the Pilot 1 Progress

The progress and current plan of the renovation of the building is presented below, so far, all the installations except the green roof and the smart windows have been completed. These are expected to be completed in September /October 2024.

Component /Status	DONE BY	ONGOING TILL	DELAY-EXPECTED DELIVERY
1. EPS external thermal Insulation	March 2024	/	/
2. Heating and cooling upgrade	/	April 2024	/
3. Green Roof	/	/	September/October 2024
4. PV on the roof Pergola	/	June 2024	/
5. Smart Windows with integrated PV	/	/	September/ October 2024

Table 1 Pilot 1 overview of renovations

3.1.2.1 Pilot 1: Museum : Detailed Update on Renovation Technology Implementation

1. EPS external Thermal insulation

Insulation with EPS 80 of 7cm thick insulation panels was installed on the north and part of the northeast and north west facades of the building, to cover the area of the staircase.

The examination of the building's overall insulation was found poor, negatively impacting energy consumption, humidity levels, temperature, and comfort. Although initially, it was planned to insulate only the north facade of the building, due to limited initial budget), it was found necessary to also insulate the north side of external wall part of the northwest facade, as it had no insulation, leading to significant energy wastage, humidity issues, and discomfort but also due to the building's design.

A licence was obtained to install scaffolding, which was extended after deciding to insulate more walls of the building's facade. The insulation resulted also to a new building facade, that contributes positively to the external image of the building.

As planned, the insulation took place by first checking the wall, cleaning, and drying it to ensure it is dust-free. The surface needed to be cleaned of paint and other substances that may affect/negatively impact the performance of EPS facade. First a penetrating water-based primer was applied. The primers took approximately 4 hours to dry. However, additional coats were required to ensure absorptivity of the substrate. Materials used for the insulation were EWI-301 Water-Based Substrate Primer (5 liters), EWI-310 Universal Primer (20 liters) and Surface Preparation Substrate Suitability Check Surface Priming. Once the walls were primed, starter track needed to be installed. The starter track was attached to the substrate above the DPC. This not only provided a level surface for easy installation of the insulation; and protected the bottom of the surface of the insulation against weather, damp, and other damage. The EPS insulation boards were attached to the substrate with adhesives. The correct preparation of EPS adhesive was crucial and for that the compound was mixed using a heavy-duty power plaster mixer on a slow-rotating setting. A freshly mixed compound was left for approximately 5–10 minutes and then re-mixed for a short period of time before use. The EPS adhesive needed to be applied to the perimeter of the EPS board, and 3 large dabs were applied in the centre of the board. To ensure the EPS insulation boards are aligned properly when attached to the substrate they needed to be aligned correctly both horizontally and vertically, and this is best achieved using a spirit level. Gaps between the EPS boards and these are larger than 2mm, they were filled with polystyrene strips (cut from the insulation boards). Drilling the holes for fixings took place at least 2-3 days after the EPS boards have been attached to the substrate with the EPS Adhesive and prior to adding the reinforcing fiberglass mesh layer. When installing EPS insulation around window and door openings, it is important that the joints between boards are not in line with these openings. This would prevent cracks from appearing in the future. The surface of the EPS boards must be smooth and level throughout the facade. All uneven areas were made smooth prior to applying the reinforcement layer. Smoothing of EPS boards should take at least 1-2 days after they have been installed to ensure the EPS Adhesive had sufficient time to go off. Once the render has been applied, it was smoothed out using the trowel, taking out the excess off the wall (to ensure an extremely thin layer). Using a PVC float, the render is worked by moving it in circular movements; this will provide the textured finish of the render.



Figure 2 Museum Facade during and after the renovation 1.



Figure 3 Museum Facade during and after the renovation



Figure 4 Museum Facade during and after the renovation



Figure 5 Museum Facade after the renovation

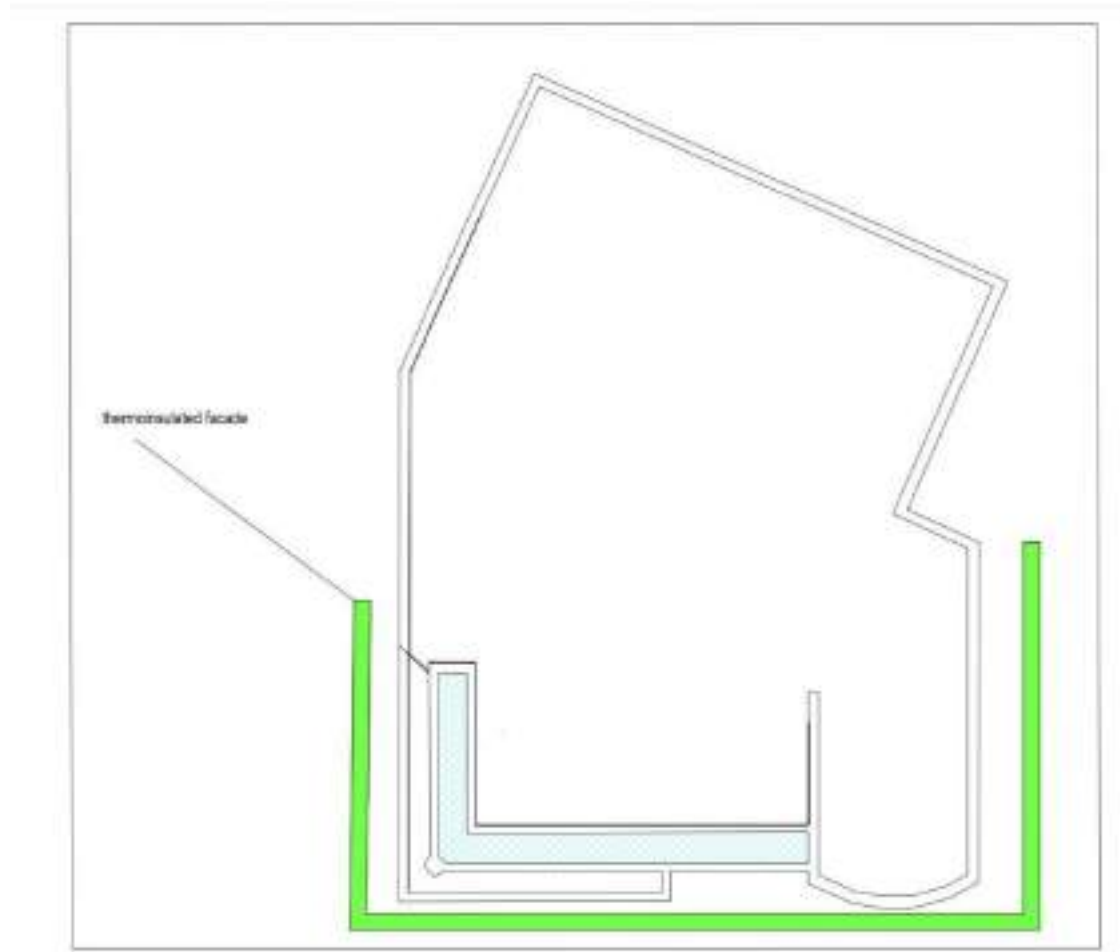


Figure 6 Museum Facade insulation area

Comparison with work planned (measurements)

The initial plan was to insulate only the north facade but during the works we realised that there was no insulation around the staircases so we decided to thermoinsulate also this.

2. Green Roof and PV on the roof pergola.

The green roof and PV on the roof contribute to the energy generation and micro climate efficiency of the building. The following figure depicts the final design of the terrace. On the left the green roof plan appears which also depicts the areas of green and the areas where tables will be installed to create an enjoyable place for the visitors to sit and enjoy the view, the outdoor garden. The green part in the back side will be tall to cover the building landscape in that side of the terrace. The green roof is the last step of the terrace renovation. However it is still not implemented, as it needed to have complete all the work on the PV and the insulation of terrace.

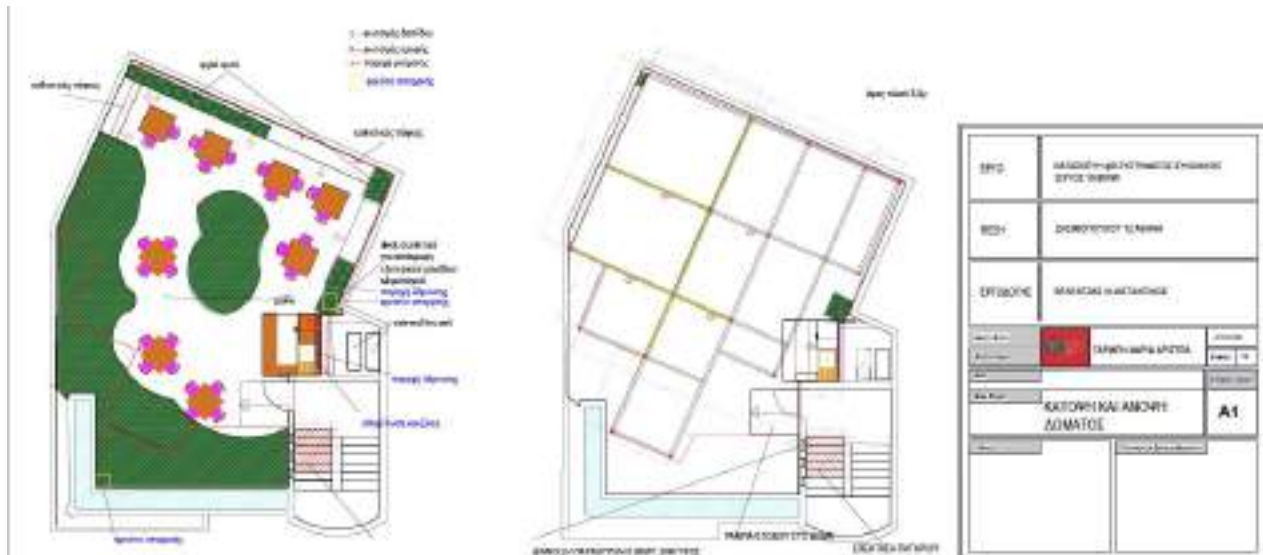


Figure 7 Design of the green roof

The design of the green roof faced the challenge of accommodating 15 cm of soil and plants over an existing roof while ensuring proper rainwater drainage and maintaining access through the existing door. To address these challenges, we replaced and modified the door leading to the roof to gain additional height. Additionally, we redesigned the entrance from the door to the deck to effectively manage water drainage, considering the increased thickness of the roof.

To further enhance the functionality and aesthetics of the green roof, we implemented the following measures:

1. **Optimized Soil Composition:** We selected a lightweight, nutrient-rich soil mix that supports plant growth while minimizing the load on the existing roof structure.
2. **Access and Safety:** The new door design includes a secure, weather-resistant seal, and the approach to the deck features non-slip materials and handrails for safe access in all weather conditions.

By addressing these key aspects, we have created a green roof that not only enhances the building's aesthetic appeal but also contributes to environmental sustainability and provides a pleasant outdoor space for occupants to enjoy.

Until now the roof was further insulated using standard asphalt membrane for the waterproof insulation. However, before the green parts are installed with the water drainage system, extra water insulation is needed to ensure that the waterproofing of the roof is in excellent condition to put soil and plants all over it.

The remaining of the works for the green roof will be reported and demonstrated in the next version of the deliverable.

PV on the roof pergola

The PVs were installed to the roof as shown in the right figure above. Overall 36 pieces ...

Key features and specifications

PV module specifications for each building:

- Number of panels installed on the roof: 36units
- Annual production: 20,000 kWh
- Solar panel dimensions:
 - o Width: 1 m
 - o Height: 2 m
- System losses: 14%
- Solar panel power: 550 watts
- PV technology: Crystalline silicon
- Installed PV: 19.8 kWp
- Peak power: 32.4 kW

The PV installation on the roof needed a specialised pergola licence, which was obtained. The neighbours created issues and complains as their view was disturbed.

The road in-front of the building required a license to close in order the panels and the equipment for the pergola to be delivered on the roof. This required another licence from the municipality.

The pergola design was discussed and modified in collaboration with the building owner a few times, to satisfy different requirements: the necessary structure to hold the weight of the PV panels, the considerations of the free space to allow for an enjoyable terrace for the visitors, the aesthetics overall and balance with the surrounding area.. In addition, a design consideration was to decorate the lower part of the pergola with some beautiful material to create nice easthetics.

The pergola was created based on a steel structure of metal solid rectangular beams.

The PVs were installed in specialised aluminium basis appropriate for solar panels.

The PVs are connected to the network, by the inverter which monitor the energy generation. For this an application to the Hellenic Electricity Distribution Network Operator S.A. is needed to ensure the point where the FORTESIE data sovereignty module will be connected.



Figure 8 Pergola instalment

3. Smart windows integrated PV

The renovation of the existing windows of a museum had the difficulty to take the measurements of the windows outside of the building since all the windows inside are covered with plasterboard in order to have more walls for the exhibits.

The smart windows are produced in Australia and extra problems with the order and the custom authorities were occurred, and till now the delivery is not possible.

3.1.2.3 Budget Updates and Explanations for Deviations (if applicable)

So far not significant deviations from the original plan have been monitored.

3.2 Pilot 2 (GAR)

3.2.1 Summary of the GAR's Pilot Progress

Pilot overview

Building Type	Residential buildings with multiple housing units in a degraded urban environment.
Location	San Vicente Neighbourhood, El Entrego (Asturias – Spain)
Size	Surface area: 2.556,00 m ² (1.278,00 m ² per building)
Number of Houses	36 apartments
Initial Energy Efficiency Rating	F (69,2 kgCO ₂ / m ² year)
Renovation Technology Status	On Schedule/ Delayed /Issues

Table 2 Pilot 2 GAR overview

Component /Status	ONGOING TILL
ETICS	June 2025
Roof insulation	June 2025
PV modules	June 2025
Window retrofit	June 2025

Table 3 Pilot 2 GAR Timeline

3.2.2 Individual Pilot Building Progress Reports

The pilot site comprises two identical three-storey residential blocks with poor thermal insulation. This deficiency leads to issues such as condensation, lack of indoor comfort, and other problems. The renovation project aims to address insufficient thermal and acoustic insulation, lack of maintenance and building envelope pathologies.

The intervention includes rehabilitating the building envelopes with an External Thermal Insulation System (ETICS) to minimise energy losses through the exterior cladding and installing a renewable energy generation system by placing photovoltaic panels on the roof. Additionally, insulation will be installed in the under-roof space, and windows in common areas will be replaced to create a uniform aesthetic, improve performance, and comply with current regulations.

The overall goal of the pilot site is to achieve a significant reduction in energy consumption, heating and cooling demands, and emissions, while extending the lifespan of the buildings and ensuring indoor comfort and the well-being of the residents.

The set of technologies selected for this energy rehabilitation is the result of a thorough energy efficiency assessment, considering both intervention costs and the homeowners' economic capacity.

As will be explained in detail in the following chapters, there were two delays. Firstly, a delay occurred because the pilot building selected at the outset of the project was discarded as it was receiving a public grant from the regional government. Secondly, another delay happened once the new pilot site was selected due to a public administrative process beyond the project's control. As a result, the renovation work has not commenced yet, but it is expected to start shortly.

3.2.2.1 Detailed Update on Renovation Technology Implementation

1. ETICS

The façades will be externally rehabilitated using an exterior insulation system that offers improved hygrothermal performance. This approach also eliminates thermal bridges associated with the building's structure, particularly those arising from pillars and slab edges that interrupt the air gap and connect the façade layers.

The cladding of the façades, including the eaves and plinth, will employ an External Thermal Insulation Composite System (ETICS). This system incorporates 120 mm thick expanded polystyrene panels with graphite, featuring a lambda value of 0.032 W/mK.

As mentioned earlier, the rehabilitation works have not yet commenced. Once the necessary building permits have been obtained, prior to the installation of the ETICS, it will be necessary to perform preliminary work. This includes inspecting the existing cladding on vertical walls to identify areas with poor adhesion to the substrate, removing those areas, and demolishing the defective cladding. The

demolished areas will then be repaired with a cement and sand mortar. The work will also involve the assembly and disassembly of rainwater downpipes, replacing them with PVC alternatives, modifying existing facade pipes for boiler flue outlets to accommodate the new façade thickness, pre-installation of electrical, telephone/data connections, and TV sockets, and finally, disassembling and reassembling existing clotheslines.

Once the preliminary work is completed, the installation of the ETICS will proceed as follows: placement of 120 mm expanded polystyrene panels with graphite, arranged edge to edge and staggered, using a single-component, waterproof polymer mortar, applied in two open strips and a central spot, ensuring no mortar seeps through the joints. The panels will be mechanically fixed using dowels, with five units per panel (one in each corner and one in the centre). A protective surface layer of insulating cladding will be applied with a trowel, reinforced with fibreglass mesh overlapping 10 cm at the joints. Two coats of primer will then be applied with a roller before the final finish, which consists of an acrylic mortar with mineral fillers, organic pigments, fungicides, and special additives. This finish will be applied with a stainless-steel trowel and smoothed with a slightly dampened plastic float.

2. Under-roof Insulation

Mineral wool insulation will be placed within the space beneath the roof on the slab that separates the last dwelling from this under-roof area. This is done to ensure the upper partition operates efficiently in terms of thermal performance and to prevent heat loss through the uninhabited space beneath the roof.

As with the ETICS systems, the installation of insulation in the roof has not commenced yet as the corresponding municipal licences for the construction work are still being processed.

Before the installation of the mineral wool, it will be necessary to perform a series of preliminary tasks once the renovations can commence. These tasks include manually creating openings in the hollow brick partition walls of the under-roof space. Once the debris has been removed, non-combustible thermoacoustic mineral wool insulation, 200 mm thick with a thermal conductivity of 0.04 W/mK, will be placed on the upper surface of the horizontal slab.

3. PV Modules

In addition to the intervention planned for the envelope, the installation of photovoltaic panels on the roof is proposed for the generation of electricity for self-consumption. These panels are expected to produce over 33,000 kWh per building, complementing the envelope improvements aimed at reducing non-renewable primary energy consumption, with a goal of surpassing a 60% savings. Notably, this renewable energy system benefits both the environment by reducing reliance on non-renewable energy sources and the housing unit occupants economically over its operational lifespan.

The installation process for the photovoltaic (PV) modules begins with the supply and installation of the mounting structure to secure the panels on the sloped roof. This step includes assessing the roof structure and determining the necessary ballast to ensure stability.

Each building will be fitted with 63 monocrystalline silicon photovoltaic solar modules, each with a peak power of 545 W and dimensions of 2279x1134 mm. The conversion from direct current (DC) to

alternating current (AC) will be managed by the installation of a grid-connected three-phase inverter. Additionally, a DC protection panel and an AC protection panel for the three-phase inverter will be installed to ensure electrical safety and proper interconnection.

4. Window Retrofit

The renovation project involves replacing the external window frames for both staircases and building entrance doors. The goal is to achieve a consistent appearance, enhance performance, and align with current energy efficiency regulations in the buildings' common areas. The replacement will use PVC frames with double low-emissivity glazing. For the staircase windows, the white PVC frames will have mitre-jointed frames and casement leaves, with two operable windows—one equipped with a tilt-and-turn function. The glazing will be double-pane, measuring 4-16-4 mm in the upper sections and 4-14-(3+3) mm in the lower sections. Likewise, the entrance doors will incorporate PVC frames with identical specifications, maintaining their current layout.

3.2.2.2 Revised Timeline with Rationale for Changes

The building initially selected as the pilot for the FORTESIE project was deemed ineligible due to receiving concurrent regional government funding for renovation costs. After this setback, GAR initiated a new selection process, facing difficulties scheduling meetings during the summer months. Ultimately, two three-storey buildings in El Entrego (Asturias) were chosen as the current pilot site. Before selection, a preliminary analysis was conducted, resulting in a detailed report presented to homeowners and the Municipality, securing their preliminary commitment. Upon confirming alignment with FORTESIE's objectives and securing homeowner involvement, the new pilot site proposal was submitted for project coordination approval.

Since selecting the San Vicente neighbourhood as the new pilot site, a delay in project commencement was encountered: the municipal architect vacated the position, and due to the limited staff resources available in this small municipality, there was no other technician available to assume the responsibilities associated with the role while the position was vacant. Coordination with the Municipality, particularly with the municipal architect, is essential for drafting the technical projects for the renovation. Additionally, it falls within the role of the municipal architect to grant the municipal license for executing the rehabilitation works. As a public institution, there is a protocol for personnel selection, which entails an extensive process that, in this case, lasted for three months.

The municipal architect position has since been filled, and subsequently, coordination meetings with the Municipality were scheduled. GAR then proceeded to draft the projects in accordance with the Municipality's criteria and is currently in the process of obtaining the necessary building licenses to initiate the renovation execution work.

3.2.2.3 Budget Updates and Explanations for Deviations

The renovation budget has been formulated to remain within the initially allocated budget for GAR, with the primary expenses covering technical fees and monitoring devices. Renovation costs will be covered by the homeowners.

3.3 Pilot 2 (VEO)

3.3.1 Summary of the VEO's Pilot Progress

Table 4 Pilot 2 VEO overview

Building Type	Residential building
Location	South-East of Valladolid
Size	24,700 m ² .
Number of Houses	20 buildings
Initial Energy Efficiency Rating	G (76,66 kgCO ₂ / m ² year)
Renovation Technology Status	Done

Table 5 Pilot 2 VEO Timeline

Component /Status	DONE BY	ONGOING TILL	DELAY-EXPECTED DELIVERY
Façades insulation and insulating sandwich panels	Acciona	Done	No delay
Roof insulation	Acciona	Done	No delay
Photovoltaic ventilated façade	Acciona	Done	No delay
Lighting renovation	Acciona	Done	No delay
Monitoring equipment installation and data acquisition	GMV	Done	No delay
District heating solutions	VEO	Done	No delay

It must be clarified that the renovation of the building took place before the project. The project aims to support the digital execution and monitoring of the EPC contracts with accurate measurements and the mobile app.

3.3.2 Individual Pilot Building

3.3.2.1 Detailed Update on Renovation Technology Implementation

TECHNOLOGIES:

1. Component 1: Façades insulation and insulating sandwich panels

No updates, it was already done. The features and information of this technology have already been explained in D3.1.

2. Component 2: Roof insulation

No updates, it was already done. The features and information of this technology have already been explained in D3.1.

3. Component 3: Photovoltaic ventilated façade

No updates, it was already done. The features and information of this technology have already been explained in D3.1.

4. Component 4: Lighting renovation

No updates, it was already done. The features and information of this technology have already been explained in D3.1.

5. Component 5: Monitoring equipment installation and data acquisition

No updates, it was already done. The features and information of this technology have already been explained in D3.1.

6. Component 6: District heating solutions

No updates, it was already done. The features and information of this technology have already been explained in D3.1.

3.4 Pilot 2 (OKT)

3.4.1 Summary of the OKT's Pilot Progress

Table 6 Pilot 2 OKT overview

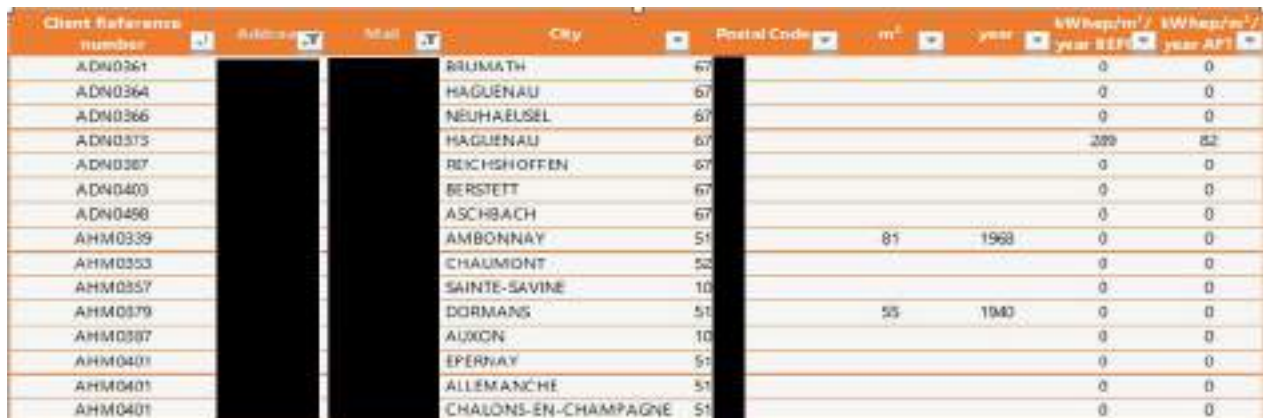
Building Type	Individual Homes
Location	Grand Est Région FRANCE

Size	90m ² - 140m ²
Number of Houses	current ambition is 100 houses
Initial Energy Efficiency Rating	more than 250kWhep/m ² /year
Renovation Technology Status	onboarding will start in September 2024

The OKT pilot has changed focus from executing the building renovations, to exploiting the national subsidies for them. As this is normal business of the OKT the renovation will not take place within the project, but OKT is interested to complement their business with the digital monitoring and EPC contracts. So they replaced the work of renovation with bring 100 houses for monitoring with digital tools. The benefit for FORTESIE is that we will obtain a larger data collection of the impact of renovations and will test and validate the digital components of the project.

3.4.2 Individual Pilot Building Progress Reports (one section for each building)

List of 110 potential candidates to be selected for the monitoring.



Client Reference number	Address	Mail	City	Postal Code	m ²	year	kWhep/m ² /year BEF0	kWhep/m ² /year AP1
ADN0361			BRUMATH	67			0	0
ADN0364			HAGUENAU	67			0	0
ADN0366			NEUHAEUSEL	67			0	0
ADN0375			HAGUENAU	67			209	62
ADN0387			REICHSHOFFEN	67			0	0
ADN0403			BERSTETT	67			0	0
ADN0498			ASCHBACH	67			0	0
AHM0339			AMBONNAY	51	81	1968	0	0
AHM0353			CHAUMONT	52			0	0
AHM0357			SAINTE-SAVINE	10			0	0
AHM0379			DORMANS	51	55	1943	0	0
AHM0387			AUXON	10			0	0
AHM0401			EPERNAY	51			0	0
AHM0401			ALLEMACHE	51			0	0
AHM0401			CHALONS-EN-CHAMPAGNE	51			0	0

Figure 9 List of 110 potential candidates for the OKT pilot

3.4.2.1 Detailed Update on Renovation Technology Implementation

- Progress on each technology identified in D3.1

Oktave will produce a graphic with stats on work planned :

- wall insulation
- roof insulation
- bassement insulation
- window replacement
- ventilation installation

- heat pump installation
- solar pv/solar water heater installation
- We will gather data on
 - energy performance BEFORE renovation
 - estimated performance AFTER renovation based on energy simulation,
 - measured performance AFTER renovation using sensors and LINKY API for real time energy consumption

We will analyse if there are significant discrepancies between the simulation and the measured performance.

3.4.2.2 Revised Timeline with Rationale for Changes

Deployment of sensors, and onboarding of 100 families, will start when we have a LINKY API developpement calendar.

Deploying sensors before being certain we can measure the energy data with an API would be too risky.

3.4.2.3 Budget Updates and Explanations for Deviations

The OKT budget was significantly reduced because we decided to centre our efforts on

- deploying sensors at scale,
- developing an LINKY API for the french smart metres (instead of installing extra MESH smart metre solution),
- and testing the EPC rules and risque management,

It is to be noted that home renovation work is very well subsidised in France.

3.5 Pilot 3 (JUST)

3.5.1 Summary of the Pilot 3 Progress

Table 7 Pilot 3 overview

Building Type	Single houses
Location	Across Portugal, namely in Porto, Viana do Castelo, Murça, Golegã, Alvaiázere, Odemira, Tomar, Famalicão, Vila Pouca de Aguiar and Lagoa.
Size	4 out of 10 collected measures: 19m2 (House 6), 40m2 (House 2), 47m2 (House 1), 67m2 (House 4). The other measures are in the collecting process.

Number of Houses	10
Initial Energy Efficiency Rating	A partner is responsible to deliver this information. It involves some bureaucratic procedures and due to that, we are still waiting for its delivery.
Renovation Technology Status	On Schedule. The first house in Porto was completed. The other 9 houses will be renovated over the next months as planned. The last house renovation is scheduled to be completed on the 15th of September 2024.

Following in the table a summary of the components and interventions planned in the 10 houses:

Table 8 Pilot 3 summary of components and interventions

Component /Status	DONE BY	ONGOING TILL 15th of September 2024
Roof	Reinforcement of the roof structure and complete replacement of roof tiles Removal of the asbestos-cement roof from the annex Installation of a new sandwich panel roof on the outbuilding	roof repair or replacement; installation of gutters; chimney inspection; isolate asbestos;
Bathroom	Installation of a fully equipped bathroom inside the house Laying ceramic flooring in the bathroom Installation of hot and cold water pipes in the new bathroom Creating a plasterboard partition for the new bathroom Covering the walls of the new bathroom with tiles	installation of entire new bathrooms; installation of extractor fan; installation/replacement of sanitary ware; replacement of bathtub with shower;
Doors and windows	Installation of 1 exterior door and 4 windows	recovery, replacement or installation of several doors and windows;
Thermal insulation	Installation of a plasterboard ceiling throughout the house (with rock wool thermal insulation)	plasterboard covering of walls and ceilings; thermal insulation in walls and ceilings; outside wall isolation; put ceilings
Piping and sanitation networks		new piping and sanitation networks, water heater replacement; plumbing repairs; installation of hot water; circuit improvements

Façade	Painting of the exterior walls	cladding of exterior walls with hood; reparations; wall thermal isolation (EPS); painting of exterior walls;
Painted insides	General painting of interior walls and ceilings Installation of an equipped kitchen	cleaning; furniture; home appliances; repair and painting walls and ceilings, including mold removal; tile application; countertop repairs or substitutions; repair floor where it is necessary or application of floors (floating, wood or tile), electric system revision;
PV		We are still analyzing which houses are viable for its installation.
Sensors	Sensors installed	The 10 sensors will be installed until the 19th of July according to our plan.

3.5.2 Individual Pilot Building Progress Reports

3.5.2.1 Detailed Update on Renovation Technology Implementation

Table 9 House n. 1 - Porto

Description of done (if done) and/or plans of remaining work (if not done),	<ul style="list-style-type: none"> ● Installation of certified scaffolding ● Reinforcement of the roof structure and complete replacement of roof tiles ● Removal of the asbestos-cement roof from the annex ● Installation of a new sandwich panel roof on the outbuilding ● ETICS exterior wall cladding ● Repair of the entire electrical circuit ● Installation of a fully equipped bathroom inside the house ● Laying ceramic flooring in the bathroom ● Installation of hot and cold water pipes in the new bathroom ● Creating a plasterboard partition for the new bathroom ● Covering the walls of the new bathroom with tiles ● Installation of a plasterboard ceiling throughout the house (with rock wool thermal insulation) ● Installation of 1 exterior door and 4 windows ● General painting of interior walls and ceilings and exterior walls ● Installation of an equipped kitchen
Comparison with work	The kitchen was entirely equipped differently from what was initially

planned (measurements)	planned due to necessities identified later.
Issues vs challenges raised in D3.1 or new issues encountered.	Lack of volunteers solved through more workers hired The roof was in the neighboring property so the work was adjusted to everyone's needs.
Lessons learnt towards large scale planning	The organization has been working on this area for a long time so the main learnings come with the novelties of the project: - installation of sensors and collection of data. Based on issues and challenges encountered, we identify the lack of volunteers as one of the potential limits to large scale planning. The organization is investing in the recruitment of volunteers to enable scalability.

Photos:

Before

After



Figure 10 House n. 1 - Porto before



Figure 11 House n. 1 - Porto after



Figure 12 House n. 1 - Porto Before



Figure 13 House n. 1 - Porto After



Figure 14 House n. 1 - Porto Before

Figure 15 House n. 1 - Porto After

Table 10 House n. 2 - Viana do Castelo

<p>Description of done (if done) and/or plans of remaining work (if not done),</p>	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Bathroom - installation of extractor fan in the bathroom and sanitary ware ● Doors and windows - installation of 3 windows, 2 exterior doors and 3 interior doors ● Façade - cladding of exterior walls with hood ● Painted insides - kitchen furniture installation, kitchen extractor fan installation; painting walls and ceilings, electrical inspection
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Table 11 House n. 3 - Murça

<p>Description of done (if done) and/or plans of remaining work (if not done),</p>	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Roof - roof repair ● Doors and windows - install window in the kitchen; install 3 interior doors and 1 exterior ● Thermal insulation - Application of floating floors [living room and 2 bedrooms]; Plasterboard covering of walls [throughout the house], with insulation [in the kitchen]; Plasterboard application on ceilings (with thermal insulation) [entire house] ● Piping and sanitation networks - Installation of hot water for showers and kitchens and circuit improvements
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	<ul style="list-style-type: none"> ● Façade - Comprehensive painting of exterior walls [the entire house] ● Painted insides - Cleaning (entire house); tile application (kitchen); Assembly of kitchen countertop and exhaust equipment; Comprehensive painting of interior [the entire house]; Installing an extractor fan in the WC ● PV - Repair of the entire electrical circuit
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Table 12 House n. 4 - Golegã

Description of done (if done) and/or plans of remaining work (if not done),	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Roof - Replacement of the roof and ceiling so to address thermal insulation issues ● Painted insides: laying of flooring
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Table 13 House n. 5 - Alvaiázere

Description of done (if done) and/or plans of remaining work (if not done),	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Bathroom - interior door of the bathroom, replacement of the bathtub with shower, replacement of sanitary ware ● Doors and windows - recovery of windows ● Thermal insulation - improvements of the thermal insulation ● Piping and sanitation networks - water heater replacement; plumbing, countertop and dishwasher repair ● Façade - repair and painting ● Painted insides - wall repair and painting; plasterboard ceiling; wood flooring
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Table 14 House n. 6 - Odemira

Description of done (if done) and/or plans of remaining work (if not done),	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Bathroom - installation of a new bathroom from zero ● Doors and windows - Substitution of the front door and the only window of the house ● Thermal insulation - Thermal insulation in every ceiling (lã de rocha). Outside wall Isolation (EPS) ● Piping and sanitation networks - all new ● Façade - painting after wall thermal insulation ● Painted insides - painting and mold removal
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Table 15 House n. 7 - Tomar

<p>Description of done (if done) and/or plans of remaining work (if not done),</p>	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Roof - new structure ● Bathroom - New WC - sanitary ware, floor, walls and ceiling, insert window or other solution, Plumbing (Connection to the septic tank) ● Doors and windows - entrance door and window (kitchen) ● Piping and sanitation networks - heating water system (kitchen) ● Façade - reparation and painting ● Painted insides - Kitchen countertop; repair walls and ceilings, repair floor where it is necessary (hall and bedrooms); floating floor in all bedrooms
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Table 16 House n. 8 - Famalicão

<p>Description of done (if done) and/or plans of remaining work (if not done),</p>	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Roof overhaul ● Structural reinforcement/flooring ● Insulating the floor with XPS on the lower floor ● Tiling the worktop area in the kitchen ● Plasterboarding and thermal insulation on the walls of the bedrooms, living room and hallway in contact with the outside and the kitchen wall in contact with the living room ● Plasterboard and thermal insulation on all the ceilings in the house ● Installation of vinyl flooring in every room of the house ● Painting the entire interior of the house ● General electrical overhaul ● Installation of a shower tray, cubicle and washbasin ● Installation of an extractor in the bathroom, water heater, extractor fan, ceramic hob, oven, fridge, dishwasher and kitchen units and worktops ● Replacement of 7 windows ● Installation of 2 exterior doors
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Table 17 House n. 9 - Vila Pouca de Aguiar

<p>Description of done (if done) and/or plans of remaining work (if not done),</p>	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Roof - complete roof; installation of gutters; chimney
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not done),	<p>inspection</p> <ul style="list-style-type: none"> ● Bathroom - everything, does not have at the moment ● Doors and insulation - put ceiling and insulation on walls and ceiling ● Piping and sanitation networks - installation of sanitation ● Façade - clean and paint ● Painted insides - revise electric system; level the floor and install tile; furniture (kitchen); tile (kitchen wall), ventilation system (kitchen), stove (kitchen); plaster walls, clean mold from walls and paint (bedrooms).
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Table 18 House n. 10 - Lagoa

Description of done (if done) and/or plans of remaining work (if not done),	<p>Work planned for the house:</p> <ul style="list-style-type: none"> ● Roof - isolate asbestos and replace roof tiles ● Bathroom - install ware, shower and door ● Painted insides - walls and ceilings, lights, water heater, household appliances, ● PV - electric system revision
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3.5.2.2 Revised Timeline with Rationale for Changes

As reported during the Review meeting on the 29/05/2024 here is the revised and updated timeline.

October 2022

- Start date of FORTESIE project

October 2023 - April 2024

- Visits to 26 locations to gather information about possible houses to renovate.
- More than 40 possible houses were visited

February - April 2024

- Short-listing the houses visited, initial budgeting for each house/ renovation.

March - May 2024

- Final decisions taken; ten final houses chosen

March - June 2024

- Initial measurements will be made in the 1st house to serve as a prototype
- Renovation of the first house (ended on June 15th)
- Protocol for intervention with the local municipalities
- Planning dates of the intervention work

- Planning other logistical topics such as: housing for volunteers, meals, local contractors to hire, local supply chain for building materials, etc.

July - August 2024

- Renovation work that takes about two weeks (second house renovation started on the 7th of July in Viana do Castelo)
- Data collection immediately after the end of the intervention

October - December 2024

- Post-renovation data collection, in order to collect data during winter, to provide differentiating data (possibly throughout 2025).

3.5.2.3 Budget Updates and Explanations for Deviations

Please note that Just a Change incorporates a methodology where the budget for each house renovation includes a 15% safety margin to cover any unforeseen expenses, ensuring that we can guarantee the delivery of the work; in most cases, this margin is not used.

Table 19 Pilot 3 Budget overview

House - Location	Budgeted	Real Cost
House 1 - Porto	29.114,11	27.805,86
House 2 - Viana do Castelo	24.478,79	/
House 3 - Murça	19.149,88	/
House 4 - Golegã	22.466,98	/
House 5 - Alvaiázere	still undergoing	/
House 6 - Odemira	19.807,69	/
House 7 - Tomar	21.344,48	/
House 8 - Famalicão	23.734,05	/
House 9 - Vila Pouca de Aguiar	20.668,98	/
House 10 - Lagoa	20.895,39	/

3.6 Pilot 4 (COOP)

3.6.1 Summary of the Pilot 4 Progress

Table 20 Pilot 4 Overview of family house 1

Building Type	2-storey single family house (2640)
Location	Canas de Senhorim, Nelas, Portugal
Size	240,51 m ²
Number of Houses	1
Initial Energy Efficiency Rating	Not measured
Renovation Technology Status	Award phase

Table 21 Pilot 4 components status for family house 1

Component /Status	DELAY-EXPECTED DELIVERY
Ceiling insulation in the attic	it will be soon
Windows replacement with slotvents	the contactor will be selected very soon

Table 22 Pilot 4 Overview of family house 2

Building Type	2-storey + liveable attic single family house (2063)
Location	Silveira, Torres Vedras, Portugal
Size	244,11 m ²
Number of Houses	1
Initial Energy Efficiency Rating	Energy Class D (Nic-105,5 kWh/m ² .year and Nvc-6,3 kWh/m ² .year)
Renovation Technology Status	Award phase

Table 23 Pilot 4 components status for family house 2

Component /Status	ELAY-EXPECTED DELIVERY
External Thermal Insulation on north façade	not known yet when it will start
Windows replacement with slotvents, half of the house	contractor selected

Table 24 Pilot 4 Overview of family house 3

Building Type	2-storey single family house (3458)
Location	Sobreira, Paredes, Portugal
Size	298,5 m ²
Number of Houses	1
Initial Energy Efficiency Rating	Energy Class E (Nic-149,9 kWh/m ² .year and Nvc-11,7 kWh/m ² .year)
Renovation	Award phase

Technology Status	
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Table 25 Pilot 4 components status for family house 3

Component /Status	DELAY-EXPECTED DELIVERY
Ceiling insulation in the attic	it will be soon
Windows replacement with slotvents, ground floor and part of upper floor	contractor not selected yet

Table 26 Pilot 4 Overview of family house 4

Building Type	2-storey + liveable attic but not used single family house (3467)
Location	Pedrouços, Maia, Portugal
Size	217,68 m2
Number of Houses	1
Initial Energy Efficiency Rating	Not measured
Renovation Technology Status	Delayed

Table 27 Pilot 4 components status for family house 4

Component /Status	ELAY-EXPECTED DELIVERY
Windows replacement with slotvents	windows contractor will be selected soon

Table 28 Pilot 4 Overview of family house 5

Building Type	One Single family house + liveable attic single family house (397)
Location	Cacia, Aveiro, Portugal
Size	188,82 m2
Number of Houses	1
Initial Energy Efficiency Rating	Not known
Renovation Technology Status	Delayed

Table 29 Pilot 4 components status for family house 5

Component /Status	DELAY-EXPECTED DELIVERY
Roof Insulation	Expected on September- October
Windows replacement with slotvents	Contractor selected, replacement asap

Table 30 Pilot 4 Overview of family house 6

Building Type	Single storey family house (2450)
Location	Canha, Montijo, Portugal
Size	127,13 m2

Number of Houses	1
Initial Energy Efficiency Rating	Not known
Renovation Technology Status	Delayed: difficulty on getting budget proposals for the renovation works

Table 31 Pilot 4 components status for family house 6

Component /Status	DELAY-EXPECTED DELIVERY
Windows replacement with slotvents	one proposal budget not right
ETICS	selected but not in award phase

Table 32 Pilot 4 Overview of family house 7

Building Type	Single storey family house (2821)
Location	Vila Nova de Poiares, Coimbra, Portugal
Size	123,20 m ²
Number of Houses	1
Initial Energy Efficiency Rating	Energy Class A+ (Nic-42,4 kWh/m ² .year and Nvc-12,3 kWh/m ² .year) This EPC was incorrectly done!
Renovation Technology Status	Delayed: Difficulty to find contractors

Table 33 Pilot 4 components status for family house 7

Component /Status	DELAY-EXPECTED DELIVERY
double-flow VMC (ventilation)	selected. installation on septembre
Roof Insulation	on the way to find a contractor

Table 34 Pilot 4 Overview of family house 8

Building Type	2-storey single family house (2855)
Location	Póvoa do Varzim, Portugal
Size	196,70 m ²
Number of Houses	1
Initial Energy Efficiency Rating	Energy Class D (Nic-158,8 kWh/m ² .year and Nvc-1,32 kWh/m ² .year). Certificate from 2013
Renovation Technology Status	Award phase

Table 35 Pilot 4 components status for family house 8

Component /Status	DELAY-EXPECTED DELIVERY
Ceiling insulation in the attic	asap
Windows replacement	contractor selected

Table 36 Pilot 4 Overview of family house 9

Building Type	2-storey single family house (2901)
Location	Mira, Coimbra, Portugal
Size	190,28 m ²
Number of Houses	1
Initial Energy Efficiency Rating	Not known
Renovation Technology Status	Taking a lot of time to get a budget proposal

Table 37 Pilot 4 components status for family house 9

Component /Status	DELAY-EXPECTED DELIVERY
Roof Insulation	very delayed
Slotvents on the external walls	waiting for a budget proposal

Table 38 Pilot 4 Overview of family house 10

Building Type	2-storey single family house (286)
Location	Escalos de Baixo, Castelo Branco, Portugal
Size	169,67 m ²
Number of Houses	1
Initial Energy Efficiency Rating	Energy Class F (Nic-198,9 kWh/m ² .year and Nvc-55,5 kWh/m ² .year)
Renovation Technology Status	Delayed

Table 39 Pilot 4 components status for family house 10

Component /Status	DELAY-EXPECTED DELIVERY
Ground floor roof Insulation	contractor selected
Windows replacement with slotvents	contractor selected. works will start soon

3.6.2 Individual Pilot Building Progress Reports

household 1 - member 2640

This renovation has not started yet.

For this building, Coopérnico prioritised the implementation of passive improvement measures, which consist of thermal insulation of ceiling in the attic which consists in 100 mm thickness of national production mineral wool. Windows and doors replacement will be on PVC and low-E double glazing with a 16 mm air-gap.

These materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 2 - member 2063

This renovation has not started yet.

This house has some thermal insulation on the roof and the windows and doors on half of the house were recently replaced with efficient ones. The walls do not have thermal insulation and the north gable of the house reveals a lot of fungal accumulation, originated from condensation.

Coopérnico's proposal was to replace the windows and doors in the other half of the house and as there is still budget for this, it was decided to install ETICS on the north gable whose thermal insulation is 50 mm thick EPS. It will be tried to have the thermal insulation in double density rock wool instead of EPS.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 3 - member 3458

This renovation has not started yet.

This house dates back to 1937, is isolated in a rural context, has a very large area and is quite uncomfortable both in summer and winter. The windows on the upper floor have almost all been replaced, but those on the ground floor remain original in wooden frames and simple glazing.

The proposal is to thermally insulate the roof attic and replace the original openings with new ones made of PVC and low-E double glazing with a 16 mm air-gap. It will also be known what the budget is for placing ETICS in the bedroom area, an amount that will be up to the owner.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 4 - member 3467

This renovation has not started yet.

This house has a lot of humidity and strong condensation associated with this problem. Furthermore, the windows have poor thermal performance and are difficult to open, preventing correct natural ventilation of the spaces.

All glass openings will be replaced with new efficient ones that integrate slotvents to correct the entry of new air into the house.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 5 - member 397

This renovation has not started yet.

Thermal insulation will be placed on the roof of this house and the windows and doors will be replaced with integrated slotvents. The placement of ETICS on behalf of the householder throughout the buildings is being analysed. The budget proposal is awaited.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 6 - member 2450

This renovation has not started yet.

The focus in this house is to thermally treat the entire thermal envelope. The roof already has thermal insulation. The FORTESIE renovation involves the installation of ETICS and the householder will pay for the replacement of all the glass openings.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 7 - member 2821

This renovation has not started yet.

This house has a very peculiar history. It is the only house we included in the project that is less than 15 years old, it is from 2019 and came to us with an A+ energy class. The Coopérnico member was asked why he was applying with an exceptionally efficient house and it quickly became clear that the person was scammed by the contractor and everything went very wrong. The house does not have sufficient thermal insulation and suffers from extreme humidity.

This house is the exception to DEMO4 because we wanted to focus on an active improvement measure, and as priority number one, which is the installation of a VMC with double flow to deal with the strong humidity that the house has. We will also add thermal insulation to the roof.

It is very difficult to find contractors in this area and therefore this work will be phased. In other words, the installation of the VMC starts now and when we find a contractor for the thermal insulation we will move forward with this part.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 8 - member 2855

This renovation has not started yet.

For this house, thermal insulation was prescribed on the roof and the replacement of the ground floor windows because the upper floor has double windows and the money would not be enough for everything.

The householder is responsible for taking care of the thermal insulation of the roof, which will be installed very soon, at his own expense. The new windows chosen by the householders are extremely expensive and all the money allocated for the renovation of this house goes to pay part of these windows.

The current windows of this house are protected by blinds and the householder wanted to eliminate them, replacing the solution with extremely efficient blackout windows working in the air gap between the two glasses.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 9 - member 2901

This renovation has not started yet.

This house recently replaced all the windows but did not take care of adequate ventilation in the house. The house is large, appears to have been expanded in an evolutionary way without professional support, at least from a thermal point of view, and has no thermal insulation. To overcome thermal discomfort, thermal insulation will be placed in various parts of the house's thermal envelope, including the roof. We are also evaluating the possibility of placing several ventilation grilles in the walls to allow fresh air to enter the house.

The problem we are facing was the time it took for the contractor to send a budget proposal and now he says he can no longer carry out the work this year.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

household 10 - member 286

This renovation has not started yet.

All windows in this house will be replaced with efficient ones, made of PVC and low-E double glazing with integration of slotvents. The ground floor roof will be thermally insulated.

All the materials were chosen for their technical characteristics (U-value) in order to comply with the minimum energy performance requirements applicable to building envelopes for the region in question.

3.6.2.1 Detailed Update on Renovation Technology Implementation

The use of national, natural and ecological materials and the involvement of local contractors in home renovation cannot be taken for granted. The reason for this is that there is great difficulty in finding local contractors and obtaining budget proposals for the improvement measures that were prescribed. As such, it became a priority to find available contractors and put pressure on them to obtain budget proposals in a timely manner.

The difference in price between PVC and aluminium with thermal break frames forced practically all homes to choose the first option, even though it comes from fossil fuels. The rise in prices for construction materials and labour scheduled from the FORTESIE proposal to the present has generated the lesson that future proposals related to the energy transition and renovations should take into account inflation and price changes when shaping the budget for each renovation.

○ Lessons learnt towards large scale planning

The civil construction sector in Portugal is very demanding and full of work, we think that the time it takes or took for contractors to send us budget proposals is due to the fact that they are also suspicious of those who do not know or have any reference. There is a term that contractors use for people unknown to them who ask for quote proposals: “parachute”. This fact shows that there is oftentimes some level of mistrust between contractors and beneficiaries that want to renovate their homes.

3.7 Pilot 5 (CRD)

3.7.1 Summary of the Pilot 5 Progress

Table 40 Pilot 5 Overview

Building Type	Public Administration building
Location	Moscato Attica (close to the city centre of Athens, Greece)
Size	The total area of the building is approximately 30,000 m ² .
Initial Energy Efficiency Rating	Energy Class B (according to energy efficiency certificate), Primary Energy Consumption 201,8 kWh/m ²
Renovation Technology Status	All the equipment has been installed and on boarded on the platform, except for connecting the PV to the electrical grid. It will be completed in the mid to the end of August.

Table 41 Pilot 5 Components Status

Component /Status	DONE BY	ONGOING TILL	DELAY-EXPECTED DELIVERY
IoT Energy Platform development and installation	External partner after the public tender	Done	No delay
Building-Integrated Photovoltaics (BiPV) and HVAC Systems (Heating, Ventilation, and Air Conditioning)	External partner after the public tender	The PV connection will be completed in the mid to the end of August	Delays in bureaucratic procedures
Installation of air quality sensors & energy meters	External partner after the public tender	Done	No delay

Installation of Variable Speed Drivers (VFDs)	External partner after the public tender	Done	Delay in receiving materials
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3.7.2 Individual Pilot Building Progress Reports

These technologies were chosen for this particular building because public buildings' energy bills have not improved despite several efforts from the EU to impose energy efficiency practices. However, it is worth noting that the Greek Government's special plan envisages an immediate reduction in consumption by 10 % in 2022, with a target of 30 % in 2030 for public buildings and the application of a digital system for monitoring energy consumption. That is why the specific applications aimed at better monitoring of “building behavior” (digitalization) and energy optimization (15 % estimated energy consumption decrease), better indoor environmental conditions, CO2 emissions reduction, wasted energy minimization and savings creation. It’s a good opportunity through the FORTESIE program and the application of new renovation technologies, to improve the energy efficiency, reduce the energy and the maintenance costs of the building.

GSIS provided the renovations with an external partner after the public tender and there was 100% funding of the renovation cost by the EU. The external partner (after the public tender), was responsible for electrical and mechanical installations.

3.7.2.1 Detailed Update on Renovation Technology Implementation

All the equipment has been installed in the building and on boarded on the platform except for the PV system. All the measurements from air quality sensors and energy meters, as well as the Variable Frequency Drives (VFD), monitor by the Energy Management Platform, which collect and analyse building systems' operational based on external factors such as occupancy patterns, weather forecasts, utility rates and energy performance data.

Depending on the pilot's space needs, the following interventions were carried out:

- 200 air quality sensors were installed to record the environmental conditions in the measurement areas, specifically taking measurements of temperature (°C), humidity (%) and CO2 (ppm) levels.
- 128 energy consumption meters were installed in most of the electrical panels of the building to record and visualise the desired electrical quantities. The points of interest for consumption measurement concern loads such as Central Air Conditioning Units and specifically their fans, ventilation fans, heat exchangers, pumps (water, boiler heating, cold and hot pumps, etc.), hot water heater.
- 23 Variable Frequency Drives were installed to the HVAC (Ventilation, and Air Conditioning) system to control the speed of the fan motors.
- The Photovoltaic system has been installed on the roof of the pilot building, but the connection to the electricity grid is on hold due to the bureaucratic procedures. It is expected that it will be connected in the mid to the end of August.

Regarding the inverters that have been installed in the building, 22 inverters installed for 22 KCM motors and are receiving the Active Energy kWh from 27/6/24 due to incorrect schedule of measurements during the integration into the platform. Also, in a KCM B2 motor, the Active Energy kWh measurements started from 17/7/24 and displays a large consumption value which is under investigation.

- Photos.

Below some indicative photos of the panels after installing the energy meters and inverters:



Figure 16 Panels after the energy meters and inverters

- Issues vs challenges raised in D3.1 or new issues encountered.

The challenges that addressed in the context of pilot 5 revolve around three main issues. The first issue related to delays in the development of renovations and digital services resulting from delays encountered in the public tender, procurement of materials, public bureaucratic procedures and the renovation work. The second issue had to do with the employees of the building. As approximately 500 people work daily in the building, it was very important to protect their health and safety, so some of the renovation works could not be carried out during working hours. Another challenge faced was the good coordination and cooperation of the building's technical team, the external partner and the facility manager.

- Lessons learnt towards large scale planning

GSIS provided the renovations with external partner (after the public tender) who was responsible for electrical and mechanical installations. CORDIA was responsible to supervise the works and ensured that

technical and operational issues that arose were resolved by the external partners. CORDIA was in the pilot building during the equipment installations in order to ensure the correct function of the equipment.

The experience and the knowledge basis on system integration and best practices to ensure safety and efficiency can be expanded and operated as a good case study for prospective clients of the company.

3.7.2.2 Revised Timeline with Rationale for Changes

The Photovoltaic system will be connected in the mid to the end of August.

3.8 Pilot 6 (+48/GKW)

3.8.1 Summary of the Pilot 6 Progress

Table 42 Pilot 6 overview

Building Type	Public swimming pool in the building of Sports and Recreation Center (pol. Ośrodek Sportu i Rekreacji w Górze Kalwarii).
Location	Town called Góra Kalwaria (urban area) in Masovian Voivodeship in Poland. Exact address of the building is Pijarska 119 Street, 05-530 Góra Kalwaria (51°59'17.8"N; 21°12'00.6"E).
Size	The swimming pool facility has a total usable area of 4,052.60 m2.
Initial Energy Efficiency Rating	-
Renovation Technology Status	Delayed

Table 43 Pilot 6 Components Status

Component /Status	DELAY-EXPECTED DELIVERY
Modernization of the mechanical ventilation installation of the swimming pool complex	31.12.2024
Heating substation	31.12.2024
PV installation	31.12.2024 (depending on weather conditions on the roof)

3.8.2 Individual Pilot Building Progress Reports

3.8.2.1 Detailed Update on Renovation Technology Implementation

As part of this renovation project, specific technologies have been chosen to upgrade the building to modern standards and improve its energy efficiency. The current renovations cover several key areas.

To ensure optimal climate conditions in the pool building, the ventilation system will be modernised. New ventilation units, NW1 and NW2, will replace the old systems, improving efficiency by approximately 20%. These new units will feature integrated automation, a heat pump, and a heat recovery exchanger, significantly enhancing energy efficiency. The modernization includes the removal of existing units and ventilation ducts and the installation of new units integrated with the Building Management System (BMS), allowing for better control and monitoring.

The renovation of the heating substation includes modernising the heating system, replacing the flooring with a technical floor painted in RAL3000, upgrading lighting fixtures to IP65-rated LED lamps, and installing new sanitary equipment. Modern heat exchangers and electronically controlled pumps are being installed, contributing to increased energy efficiency and system reliability. Each renovation stage, from lighting upgrades to installing advanced heating and water systems, helps create a more energy-efficient and reliable heating infrastructure.

As part of the pool water treatment system modernization, existing circulation pumps are being replaced, and new frequency converters for the pump motors are being installed. The new pumps are more energy-efficient, reducing energy consumption and increasing system reliability.

The modernization of the main electrical switchboard includes replacing distribution circuits supplying the TN1/W1, TN2/W2, 01/TO2, 01/TS6, and 01/TS2 panels. Additionally, a power circuit is being installed for the newly designed RBMS switchboard and the photovoltaic system inverter. The main switchboard will also be equipped with a PowerLogic network parameter meter and PowerTag measurement transducers on selected outgoing circuits. These technologies have been chosen for their ability to enhance the efficiency and reliability of the electrical system and provide capabilities for monitoring and managing energy consumption.

The photovoltaic installation on the building's roof is another step towards sustainable development. Photovoltaic panels will be mounted on a dedicated mounting structure and connected to the inverter using double-insulated cables resistant to UV radiation and varying weather conditions. The inverter will be installed on the roof and connected to the building's existing electrical installation. Before installing the photovoltaic panels, the roof covering will be reinforced with styrofoam boards and layers of roofing felt, ensuring the stability and durability of the installation. This reinforcement will also improve the roof's thermal insulation, reducing heat loss. Photovoltaics will allow the building to generate its own renewable energy, reducing reliance on external energy sources and lowering overall energy consumption.

Additionally, a Building Management System will be installed to manage the entire process and monitor energy efficiency. A voting panel has been installed to assess user satisfaction, and a weather station has been installed to monitor atmospheric conditions. All these technologies have been selected for their ability to enhance energy efficiency, reliability, and compliance with modern

standards. The project is currently at different stages of implementation, depending on the specific area of modernization.

- Progress on each technology identified in D3.1

Required and obtained permits during the process:

- Notice to the county office regarding planned works;
- Conceptual coordination and approval with the firefighter regarding safety measures (approvals for industry projects of the Sanitary and Safety Inspectorate were not required for this type of construction);
- Technical specification for the execution and acceptance of works
- Terms of reference/tender specifications;
- Technical and executive designs for photovoltaic installations,
- Technical expertise of roof structures;
- Feasibility analysis of placing PV panels on the roof;
- Technical and executive design project of roof reinforcement
- Architectural project regarding the renovation of the fan room and the heating station;
- Technical and executive design project for the disassembly and assembly of a new heating substation;
- Technical and executive design project of swimming pool pumps;
- Technical and executive design project of ventilation units;
- Technical and executive design project of electrical engineering: Modernization of the electrical network: replacement of central heating, BMS installation, connection to PV panels + approval from the firefighter;
- Cost estimates;
- Bill of quantities.

- For each technology :

Ventilation renovation:

The facility is equipped with six main supply and exhaust systems serving individual zones of the building. The ventilation room is located on level -1. The NW1 and NW2 systems serve the swimming pool and sports swimming pool hall. Air is supplied to the swimming pool hall through air supply grilles installed in the floor along the external glass walls. Air exhaust is carried out in the upper part of the hall, along the wall opposite to the air supply.

Parameters of the N1/W1 sports swimming pool control unit:

- Supply air temperature: 38°C;
- Relative humidity in the ground 45%;
- Relative humidity in summer 60%;
- Moisture content in the air in summer 16.2 g/kg;
- Moisture content in the air in winter 11.4 g/kg;
- Amount of air supplied to the swimming pool hall: 15,070 m³ /h;
- Amount of air exhausted from the swimming pool hall: 15,830 m³ /h.

Parameters of the N2/W2 recreational swimming pool unit:

- Supply air temperature: 38°C;
- Relative humidity in the ground 45%;

- 7. • Relative humidity in summer 60%;
- 8. • Moisture content in the air in summer 16.2 g/kg;
- Moisture content in the air in winter 11.4 g/kg;
- Amount of air supplied to the swimming pool hall: 9,800 m³ /h;
- Amount of air exhausted from the swimming pool hall: 10,290 m³ /h.

Based on the site visits and analyses provided in the form of an Energy Audit of the swimming pool facility prepared by NAPE, it was found that the current mechanical ventilation system does not ensure proper microclimate parameters inside the swimming pool halls and generates high operating costs. The relative humidity in some places of the swimming pool hall reaches up to 90%, which constitutes a high risk of condensation of water vapour and, as a consequence, corrosion and destruction of elements of the swimming pool structure and equipment.

In order to ensure the correct amount of ventilation air to remove moisture gains from the swimming pool hall, it was assumed that the efficiency of the new NW1 and NW2 ventilation units would be increased by 20% compared to the existing condition, this is a reserve enabling future modernization of the ventilation installation (ducts). Drain condensate from the newly designed units in accordance with the standard of the old N1/W1 and N2/W2 units. Before installing new ventilation units, the existing N1/W1, N2/W2 units and ventilation ducts must be dismantled.

Parameters and requirements for selecting air handling units:

NW1 Unit:

- Supply air volume: maximum 18,080 m³ /h
- External static pressure 550Pa
- PSFP 1,244 kW/m³/s)
- The maximum amount of exhaust air is 19,000 m³ /h
- External static pressure 550Pa
- PSFP 1.122 kW/m³/s)

NW2 Unit:

- The maximum amount of supplied air is 11,760 m³ /h
- External static pressure 550Pa
- PSFP 1.122 kW/m³/s)
- The maximum amount of exhaust air is 12,350 m³ /h
- External static pressure 550Pa
- PSFP 1.122 kW/m³/s)

Basic dimensions not to be exceeded due to the existing installation volume:

- NW1 width 2085mm, length 5360mm, height 2965mm
- NW2 width 1445mm, length 4860mm, height 2325mm

General assumptions:

- Air temperature in the swimming pool hall in winter and summer: 30°C
- Relative air humidity in the swimming pool hall at the end of winter: 55%
- Relative air humidity in the swimming pool hall at the end of summer: 60%
- Plate heat exchanger with an efficiency of at least 80%
- AHUs equipped with integrated factory automation
- Reversible heat pump, which serves as a cooler in summer and heat recovery in winter. heat from the exhaust air

Description and technical data of the designed N1/W1 and N2/W2 control panels

Swimming pool units with a heat pump and an asymmetric heat recovery exchanger made of polypropylene or anodized aluminium.

Mechanical ventilation, heating and dehumidification of the indoor swimming pool will be carried out using supply and exhaust units in the swimming pool version with an asymmetric heat recovery exchanger integrated with an internal heat pump. Devices with a ready-made refrigeration system, factory wiring, a complete automation and control system with a remote visualisation and parameter control system via the Internet using WEBSERVER or BMS.

The sheathing of the AHU casing has a heat transfer coefficient U below $0.55 \text{ W/m}^2\text{K}$, which is ensured by a 55 mm thick casing fully insulated with polyurethane foam or the thermal equivalent of sheathing with mineral wool with a minimum thickness of 80 mm. Full and unchanging continuity of the insulating material in the panel, guaranteeing lower energy losses compared to traditional mineral wool cladding. The outer coating of the sheathing is made of galvanised sheet metal, coated with polyester or powder coated. The internal coating of the AHU casing is made of plastic, a material completely resistant to corrosion in a highly aggressive swimming pool environment. Sheathing panels made with a lateral thermal break (plastic insert), ensuring no heat conduction between the inner and outer shell of the unit. Front plating equipped with inspection covers and easy-open doors with hinges and handles enabling quick access to devices during maintenance or inspection.

The AHU frame profiles are made of powder-coated aluminium or electrochemically protected against the aggressive effects of chlorine compounds. Profiles ensuring continuity of insulation with a thermal break eliminating heat bridges in the TB1(M) class and eliminating moisture condensation on the external skin. Thermal break in profiles made of high-strength plastic ensuring stability and durability of the structure in the highest D1(M) class. The corners of the AHU frame are made of a composite structure (plastic), ensuring no condensation, no heat conduction and thermal insulation. Profiles connected with mounting screws to the corners to ensure the tightness of the housing in the L1(M) class.

The galvanised and powder-coated foundation frame of the unit must be equipped with anti-vibration feet with the possibility of adjusting the height and levelling of the device. The ability to set the height of the device is necessary to ensure proper condensate flow from the unit and maintain the minimum heights of syphons on both the overpressure and underpressure sides.

EC (electronically commutated) fans

Radial-axial fans with direct drive, statically and dynamically balanced as one system. Highly energy-saving EC motors, with smooth speed control. Motor class in accordance with ErP 2015 requirements, IP54 safety class. Fans and support arms are completely protected together with the engine housing by powder coating.

The unit is designed for smooth, stepless regulation of the air flow rate with readings in the controller in m^3/h . Its purpose is to compensate for the variable operating characteristics of the device (depending on the AHU operation cycle: drying, night operation, ventilation, etc.), filter contamination, maintaining the AHU flow rate at set level. Measurement of the actual air flow carried out by a system for measuring the pressure drop on the fan nozzle integrated with

measurement probes and impulse cables with flow control transmitters with the possibility of correcting the amount of air depending on its density.

Heat recovery exchanger – Recuperator

Asymmetric cross-counterflow exchanger made of polypropylene or anodized aluminium, adapted to work in swimming pool conditions with full anti-corrosion protection against aggressive gases and humid environments with chloride content in the highest class C5-M. The exchanger is equipped with a by-pass damper, protected against swimming pool conditions by electrochemical treatment and powder coating.

Heat pump

The unit contains a highly efficient heat pump with a COP coefficient of not less than 5 with the parameters attached to the documentation. The heat pump must operate effectively in the range from -24°C to +35°C, with the amount of fresh air limited to 50%. The factory-assembled, ready-to-operate heat pump section, filled with 407C refrigerant and oil, must have the CE marking... with the number of the authorized certification body. Heat pump elements: scroll compressor(s), 4-way valve, refrigeration automatics, liquid refrigerant tank with safety valve, highly efficient air eliminators, high and low pressure manometers placed on the outside of the AHU casing in order to visual control of the device's operating status while the refrigeration system is operating. The evaporator and condenser are completely protected against swimming pool conditions, powder coated after electrochemical treatment of the finned block. The finned heat pump exchangers are located in the section in such a way that the condensed water from the cross- flow exchanger flows down before the air flows onto the evaporator. Exhaust air from cross-flow exchanger (evenly washes the entire surface of the evaporator, which ensures uniform temperature and thus ensures the most effective operation of the entire exchanger)

Water heater

Water heater with valve, actuator and anti-freeze protection, powder or immersion coated, including mounting frame. Lamellas made of aluminium electro-chemically treated before painting.

Air filters

Pocket filters with longer life and lower pressure drop. The material of the frame structure and filter stiffeners is resistant to pool corrosion during the period of filter use for up to 12 months (no signs of corrosion). The filter mounting frame is equipped with an eccentric mechanism that ensures pressure and tightness of the filter and allows for its easy replacement. Filter protection (differential pressure switch) with adjustable pressure drop measurement and filter alarm signal on the controller display or visualisation system.

Bypass and recirculation mixing chamber dampers

Tight louvre dampers, equipped with gaskets, are made of powder-coated or electrochemically protected aluminium. Throttles with a built-in (hidden) internal rotating mechanism to avoid

jamming of the gears in the event of dust mixed with water getting into the spaces between the teeth. Intake and exhaust dampers are located inside the AHU casing to avoid condensation and moisture on their surfaces.

Water pump

CIRCULATION PUMP – PO1 – CIRCUIT I

The new circulation pump should have the same installation dimensions as the existing pump. This solution will allow for quick and easy replacement.

PUMP DESIGN:

- Centrifugal pump with a horizontal, closed structure that can be mounted in a vertical position
- Pump with internal circulation for washing the mechanical seal

ENGINE:

- Three-phase motor with water jacket (cooling and heat recovery from swimming pool water), protection type IP 55, with reinforced bearing
- Common shaft of the motor and pump (without clutch) made of acid-resistant steel 1.4571
- Thermistor temperature sensor (PTC)
- Grease nipples for replenishing grease in the upper and lower bearings without the need to dismantle the engine

TECHNICAL DATA:

- Efficiency: 100.0 – 280.0 m³/h
- Lifting height: 18.0 – 10.0 m
- Voltage: 400/690V
- Engine power: 11.0 kW
- Motor protection rating: IP 55
- Engine revolutions: 1450 rpm
- Rated current: 20.9 A
- Starting current: 121.0 A
- Cos phi: 0.86
- Suction flange: DN 150 PN 16
- Discharge flange: DN 125 PN 16
- Total pump weight: 200 kg

MATERIAL DESIGN W2:

- Pump body: EN-GJL-250
- Housing cover: EN-GJL-250
- Intermediate body: EN-GJL-250
- Rotor: CuAl10Fe5Ni5-C
- Motor shaft: X6CrNiMoTi17-12-2(1.4571)
- Mechanical seal: SiC / SiC / FKM FREQUENCY CONVERTERS

FREQUENCY CONVERTER – PC1 - CIRCUIT I

Frequency converters are expected to be used for circulation pumps,

The converters will be mounted on the wall in the room with circulation pumps.

The degree of tightness of the converters is IP66.

INPUT DATA:

- Supply voltage: 380 – 480V ± 10%
- Power frequency: 48 – 62 Hz
- Phase shift factor: >0.98
- Allowable phase asymmetry: 3% allowed max.
- Starting current: <Rated current
- Permissible number of cycles: max. 120 / hour, at regular intervals

OUTPUT DATA:

- Output power: 400V 3F in: 11.0kW
- Overload capacity: 150% for 60s or 175% for 2.5s
- Output frequency: 0 – 500 Hz,
- Typical efficiency: >98%

CASE:

- Degree of tightness: IP66

IMPORTANT CONTROL FEATURES:

- Control method: Scalar U/F | U/F energy optimizer
- PWM frequency: 4-32kHz Effective
- Stop Mode: Stop Ramp: User adjustable 0.1 – 600 seconds,
- Coast Braking: Motor jet braking, built-in braking transistor
- Skip rate: Single point, user adjustable
- Source of value setting:
 - Analog signal: 0-10V, 10-0V, 0-20mA, 20-0mA, 4-20mA, 20-4mA
 - Digital: Moto Potentiometer, Modbus RTU, CANopen

I/O SPECIFICATIONS:

- Supply voltage: 24VDC, 100mA, Overload Protection 10VDC, 5mA for potentiometer
- Programmable inputs: 4 in total
 - 2 Digital
 - 2 Analog / Digital selectable
- Digital inputs: 8-30 VDC, internal or external power supply, response time: <4ms
- Analog inputs:
 - 12 bit resolution,
 - Response time <4ms
 - Accuracy ±2% of full scale
 - Scaled and offset parameter
- Programmable outputs: 2 in total

- 1 Analog / Digital
- 1 Relay

CIRCULATION PUMP – PO2 – CIRCUIT II

The new circulation pump should have the same installation dimensions as the existing pump. This solution will allow for quick and easy replacement.

PUMP DESIGN:

- Centrifugal pump with a horizontal, closed structure that can be mounted in a vertical position
- Pump with internal circulation for washing the mechanical seal

ENGINE:

- Three-phase motor with water jacket (cooling and heat recovery from swimming pool water), protection type IP 55, with reinforced bearing;
- Common shaft of the motor and pump (without clutch) made of acid-resistant steel 1.4571
- Thermistor temperature sensor (PTC)
- Grease nipples for replenishing grease in the upper bearing to be lower without having to dismantle the engine;

TECHNICAL DATA:

- Efficiency: 120.0-240.0 m³/h
- Lifting height: 14.0-9.0m
- Voltage: 400/690V
- Engine power: 7.5 kW
- Motor protection rating: IP 55
- Engine revolutions: 1450 rpm
- Rated current: 17.1 A
- Starting current: 90.0 A
- Cos phi: 0.77
- Suction flange: DN 150 PN 16
- Discharge flange: DN 125 PN 16
- Total pump weight: 149 kg

MATERIAL DESIGN W2:

- Pump body: EN-GJL-250
- Housing cover: EN-GJL-250
- Intermediate body: EN-GJL-250
- Rotor: CuAl10Fe5Ni5-C
- Motor shaft: X6CrNiMoTi17-12-2(1.4571)
- Mechanical seal: SiC / SiC / FKM FREQUENCY CONVERTERS

FREQUENCY CONVERTER – PC2 - CIRCUIT II

Converters are expected to be used for circulation pumps frequency.

The converters will be mounted on the wall in the room with circulation pumps.

The degree of tightness of the converters is IP66.

INPUT DATA:

- Supply voltage: 380 – 480V ± 10%
- Power frequency: 48 – 62 Hz
- Phase shift factor: >0.98
- Allowable phase asymmetry: 3% allowed max.
- Starting current: <Rated current
- Permissible number of cycles: max. 120 / hour, at regular intervals

OUTPUT DATA:

- Output power: 400V 3F in: 7.5kW
- Overload capacity: 150% for 60s or 175% for 2.5s
- Output frequency: 0 – 500 Hz,
- Typical efficiency: >98%

CASE:

- Degree of tightness: IP66

IMPORTANT CONTROL FEATURES:

- Control method: Scalar U/F | U/F energy optimizer
- PWM frequency: 4-32kHz Effective
- Stop Mode: Stop Ramp: User adjustable 0.1 – 600 seconds,
- Runway Braking: Motor jet braking, built-in braking transistor
- Skip rate: Single point, user adjustable
- Source of value setting:
 - Analog signal: 0-10V, 10-0V, 0-20mA, 20-0mA, 4-20mA, 20-4mA
 - Digital: Motopotentiometer, Modbus RTU, CANopen

I/O SPECIFICATIONS:

- Supply voltage: 24VDC, 100mA, Overload Protection 10VDC, 5mA for potentiometer
- Programmable inputs: 4 in total
 - 2 Digital
 - 2 Analog / Digital selectable
- Digital inputs: 8-30 VDC, internal or external power supply, response time: <4ms
- Analog inputs:
 - 12 bit resolution,
 - Response time <4ms
 - Accuracy ±2% of full scale
 - Scaled and offset parameter
- Programmable outputs: 2 in total
 - 1 Analog / Digital
 - 1 Transmitter

Electrical design contains:

- selected electrical switchboards
- distribution circuits,
- power installations,
- plug socket installations,
- lighting installations
- surgical protection
- BMS installation

Electrical switchboards

In the existing RG main switchboard, the distribution circuits supplying the TN1/ W1, TN2/W2, 01/TO2, 01/TS6, 01/TS2 electrical boards will be replaced.

Additionally, a power supply circuit to the designed RBMS switchgear should be made and to the PV installation inverter. A PowerLogic network parameter meter will be installed on the power supply in the RG switchgear. PowerTag measuring transformers will be installed on the receiving circuits.

The designed RBMS switchgear will be installed in the main RG switchboard room.

Distribution circuits

Cables supplying individual department boards and switchboards of ventilation devices are designed with five-core cables, laid in perforated trays or ladders suspended from the ceiling and on vertical cable ladders. Lay the replaced cables along existing cable routes.

Lighting installation

Fan room and room lighting installations. The heating substation was designed with YnDYzo3/4x1.5 cables.

Surface-mounted IP65 LED lighting fixtures are being designed.

Required average lighting intensity: 200lx.

The above rooms will be equipped with emergency evacuation lighting, the operating time of the luminaires will be at least 60 minutes, and the lighting intensity will not be less than 1 lux.

Lay lighting cables in cable trays and electrical installation pipes. Use electrical installation equipment with IP44.

Installation of power and plug sockets

Install power and plug sockets with cables according to the descriptions in the diagrams. Lay cables in cable trays and electrical installation pipes in plastered rooms.

Use plug sockets in the ventilation and heating rooms IP44.

Multimedia kiosk

In order to measure the pool user's satisfaction, a multimedia kiosk in the form of a free-standing pole is designed. The kiosk will be installed in the entrance hall.

The kiosk's electrical power supply will be provided by the TS-3A switchgear. Connect the post computer to the building's LAN network. Kiosk designed for indoor use. Placed in a free-standing housing with high resistance to damage. The upper part of the info kiosk is inclined at an angle of 45° to the lower part. Operation via touch screen.

Designed kiosk equipment:

- 19" monitor with touch overlay,
- computer,
- operating system,
- service mouse and keyboard,
- guaranteed power supply (UPS),
- content management software,
- info kiosk management software.

System for recording time spent at the swimming pool

The building in question has an Electronic Customer Service System implemented - BASEN.

The system enables:

- Control of the movement of people within the indoor swimming pool complex.
- Full settlement of customers for the use of the facility.

In addition to extensive cashier and sales reports, the system has statistical reports, e.g.:

- average stay times for all types of customers in an hourly time frame and in a given period between dates,
- reports on the number of people for all types of customers in an hourly time frame and in a given period between dates and broken down by contractor, customer account or a given service,
- reports on the amount of turnover for all types of customers in an hourly time frame and in a given period between dates and broken down by contractor, customer account or a given service.
- moving between paid zones in which fees are charged differently,

BMS installation

System architecture

The central element of the system is the AS-P automation server.

The AS-P server performs the main functions of control logic, trend recording and alarm supervision, and also supports communication with I/O and field devices. The distributed intelligence of the

EcoStruxure BMS system helps maintain its high tolerance to detected failures and provides a fully functional user interface via WorkStation and WebStation.

The system consists of executive controllers located in the automation cabinets of individual devices. The controllers are equipped with input/output modules that expand their resources. The controllers have a built-in Modbus RTU or Modbus TCP/IP protocol. Air handling unit controllers have a built-in Web Server enabling remote access to configuration, settings and visualisation from a web browser. Each controller is equipped with a display, which facilitates configuration, diagnostics and service work. Drivers store all programs and logic locally, as well as connections to other drivers. When the BMS system fails, each controller operates autonomously. The BMS system logic and connections are implemented at the level of the controller itself and its related modules. Devices in the system are integrated in the Modbus protocol. All devices must be delivered in a protocol compatible with the system or equipped with an appropriate communication interface. The only exception are heat metres with the M-BUS protocol, which will be integrated by an additional gateway located in the RBMS cabinet. A separate workstation to be installed in the room. BMS is the access interface to the system. Additionally, local and remote access to the system is possible for any number of connections and users at the same time. Each user has an account with appropriate rights assigned.

The AS-P server has, among others: the following functions:

- Communication hub
- Variety of communication options
- WorkStation/WebStation interface
- Direct support for the BACnet protocol
- BACnet/SC node, hub or router
- Direct support for LonWorks networks
- Direct support for the Modbus protocol
- Support for additional building protocols
- Web services based on open standards
- Support for EcoStruxure web services

The AS-P server supports common web services based on open standards such as SOAP and REST to collect data for EcoStruxure BMS system. Using the Web, you can use incoming data (e.g. weather forecast, energy price) to determine operating modes, schedules or program programming of the installation

- Optional external logging database EcoStruxure BMS Server can be configured to automatically record all historical data, trend log data, logs, events and audit log data in an external database. If

data needs to remain available for longer periods of time, external log storage can be incorporated into the EcoStruxure BMS system without the need for extensive engineering.

Supported databases are TimescaleDB based on PostgreSQL and Microsoft SQL Server. Data contained in external log storage is natively available in browsers built into the EcoStruxure Building Operation client programming and built-in reporting functionality.

- Reporting

EcoStruxure BMS Server has a built-in basic reporting feature that can generate reports in text and XLSX formats without the need for using other external software. Reports in XLSX formats can be enhanced with advanced features such as formulas, conditional formatting, regular charts and sparklines. Reports can be generated on a schedule or when an alarm event or other unusual condition occurs, and results can be emailed or saved in the file.

- Scalable configurations
- I/O expansion option
- Text and graphical programming tools
- eMMC memory for data and backups
- IT-friendly networks based on the TCP/IP communication protocol suite
- Automatic addressing
- Simple installation on a DIN rail

WebStation Interface

EcoStruxure Building Operations's WebStation is a web-based user interface for everyday operations within the EcoStruxure BMS system. WebStation is built into the EcoStruxure BMS server and provides easy access to the software from anywhere in the world.

The station offers a rich, dynamic user interface that provides access to the EcoStruxure BMS server using popular web browsers for Windows computers, Mac OS, Android and iOS tablets, and smartphones. Users can view and manage graphics, alarms, schedules, trend logs, reports and user accounts. To ensure longer battery life and ergonomics of mobile devices, WebStation supports night mode (Dark Mode). EcoStruxure Building Operation software offers a range of built-in components for visualising live and historical data. It is possible to develop custom Dashboards using advanced graphical features. Alarms are displayed in a simple and efficient way, so no alarm will be missed. Alarms can be colour-coded, grouped and filtered for maximum efficiency. Using WebStation, a dispatcher or administrator can assign alarms to a specific user or group of users. The system can record data in various ways: periodically (every day, hour, minute) and change of value (COV) method, which only records volumes when certain threshold values are exceeded. Trend

recordings can be displayed in trend lists and graphs for visualisation for diagnostic and optimization purposes. Many series can be presented on one chart, so the values of different quantities can be easily compared. Trend data can be exported and downloaded as Excel files.

WebStation is based on standard web technologies and does not require any special configuration on the client or server side. Platform-agnostic technologies make it work on most popular browsers. No specific software needs to be installed on client computers and no browser plug-ins are needed.

Integrated devices

- Air handling units

The automation will be based on controllers and sensors from the manufacturer of ventilation units. The same drivers will be used to implement the automation functions of individual devices and as executive drivers of the BMS system.

The control panels will be integrated using the Modbus TCP protocol.

The drivers allow reading/writing parameters:

- Setpoints (read/write):

- set temperature:

- 1 – Supply

- 2 – Exhaust air

- 3 – Room

- minimum fresh air value

- set temperature of the condenser heater

- Numeric Points (read):

- exhaust temperature

- supply temperature

- mixing temperature

- temperature before the condenser

- evaporator temperature

- intake temperature

- exhaust efficiency

- airflow efficiency

- air flow damper control

- control of the exhaust damper

- mixing throttle control

- recovery throttle control

- heating coefficient

- cooling factor by Status Points (readout):

- Start-Stop

- work permit

- Alarm
- 4-way valve
- fan start signal
- compressor A start signal
- compressor B start signal
- condenser heater start signal

- Alarm Points (read):

- non-critical alarms:
 - sensor alarm
 - dirty exhaust filter
 - dirty air filter
 - phase control sensor alarm
 - compressor A alarm
 - compressor B alarm
 - compressor low/high pressure alarm
 - exchanger pressure switch
- critical alarms:
 - fan flow alarm
 - exhaust fan alarm
 - supply fan alarm

- Substation

The heat metres will be equipped with M-Bus communication modules. Cooperation with the BMS system will take place via an M-Bus to Modbus TCP converter.

The heating substation controller will be equipped with a Modbus TCP interface and will be controlled by the ECL Portal application implemented in the BMS system.

The system will enable:

- remote control of the heating system
- operating status and failure of circulation pumps
- pump control level
- water temperature values
- alarm states
- reading of heat meters

- Frequency converters for circulation pumps

The sanitary industry project assumes the replacement of existing circulation pumps in the swimming pool water treatment installation and the installation of new frequency converters for circulation pump motors.

The designed frequency converters will cooperate with the BMS system using the Modbus RTU protocol. The system enables, among others: reading/writing parameters:

- converter adjustment command
- reference speed setpoint
- converter status
- motor output frequency
- output current
- converter temperature

- PV installation

A photovoltaic installation will be installed on the roof of the building. The designed inverter will be equipped with a built-in monitoring module with communication via Ethernet or cellular network to ensure full visibility of the system. The inverter will be integrated into the BMS system.

- Weather station

The designed weather station enables the measurement of a number of weather variables, such as wind speed and direction, air temperature and humidity, atmospheric pressure, liquid and solid precipitation, total radiation with derivatives, i.e. information about twilight and brightness from the four cardinal directions of the world. The built-in GPS signal receiver allows you to determine the station's position (longitude and latitude), the station's azimuth, the station's absolute height, and also allows you to synchronise the time and date. A derivative of the above-mentioned there is also the ability to calculate the theoretical position of the sun. The station communicates in the RS485 digital standard, supporting the Modbus RTU protocol.

- RG main switchboard

In order to continuously analyse the quality of energy supplied to the building and control the operating parameters of the building's electrical installation, a three-phase PowerLogic parameter meter will be used.

This device provides information on:

- voltage on each of the three phases.
- interphase tension.
- current on each phase.
- instantaneous active, reactive and apparent power on each phase.
- current frequency.
- power factor.

The parameter meter will communicate with the BMS system through the Modbus EcoStructure Panel Server Universal PAS600 gateway.

PowerTag measuring transformers will be installed on the distribution circuits indicated in the RG switchgear diagram. Measuring transformers enable wireless communication with the EcoStructure Panel Server Universal PAS600 gateway.

Transmitted data from PowerTag measuring transformers:

- total and partial energy,
- active power, phase and phase-to-phase voltage,
- currents I1, I2, I3,
- power factor (cos j)
- information about power failure and overload

The EcoStructure Panel Server Universal PAS600 gateway will send data to the BMS system via the Modbus TCP protocol

General installation rules:

Due to the uniformity of loads, the division into phases for individual electrical circuits should be observed. All installed trays, brackets, handles, etc. must be galvanised. Wires and cables exposed to mechanical damage should be placed in vidinur tubes. All penetrations through walls and ceilings of fire partitions (separate fire zones) should be sealed with non-flammable foam with a fire resistance equal to the resistance of this partition. All devices and materials used must have factory markings. Devices and materials must be fully compliant with Polish Standards.

- Comparison with work planned (measurements),
- Photos

Pictures before (pictures after to be done after renovation):

1. The photo shows the existing main electrical switchboard, which is set to be modernised in accordance with the technical and execution project. The planned upgrades include replacing the distribution circuits that supply the TN1/W1, TN2/W2, 01/TO2, 01/TS6, and 01/TS2 electrical panels, as well as installing a power circuit for the newly designed RBMS switchboard and the PV system inverter. Additionally, the main switchboard will be equipped with a PowerLogic network parameter metre and PowerTag measurement transducers on selected outgoing circuits. These changes are necessary to enhance the efficiency and reliability of the electrical system, accommodate new energy sources, and improve monitoring capabilities. The modernization process will involve several stages, including the removal of outdated components, installation of new circuits and equipment, and thorough testing to ensure optimal performance. These renovations contribute to making the building more energy-efficient by optimising energy distribution, reducing losses, and enabling better control and management of energy consumption.



Figure 17 Existing main electrical switchboard

2. The photo shows the rooftop where a photovoltaic installation will be installed according to the technical and execution project. The photovoltaic modules will be mounted on a dedicated mounting structure and then connected to the inverter using double-insulated cables resistant to UV radiation and varying weather conditions. The inverter will be installed on the roof and paralleled with the building's existing electrical installation using an AC-rated cable. The entire installation will be equipped with appropriate protections on both the AC and DC sides. Before the photovoltaic panels are installed, the roof covering will be reinforced by using Styro boards under the mounting feet of the panels and layers of roofing felt, in accordance with the project guidelines. These changes are necessary to ensure the stability and durability of the photovoltaic installation. The stages of the renovations include reinforcing the roof covering, installing the mounting structure, connecting the photovoltaic modules to the inverter, and integrating the system with the building's electrical installation. These steps contribute to making the building more energy-efficient by allowing it to generate its own renewable energy, reducing reliance on external power sources and lowering overall energy consumption.



Figure 18 Pool rooftop

3. The photo shows the heating substation room, which will undergo renovation according to the technical project. The wall layout will remain unchanged, with equipment and installations updated based on detailed designs. The flooring and tiling will be replaced with a technical floor painted in RAL3000. Existing lighting fixtures will be upgraded to IP65-rated LED lighting, and switches and sockets will also be replaced with IP65-rated versions. The current sanitary ceramics will be evaluated and, if necessary, replaced with new industrial-standard fixtures. The project includes the

installation of a DN80 connection substation featuring a magnetic dirt separator (OISm 250/80), two FS-1 80 filters, a constant differential pressure regulator with flow control (Samson 42-39 DN50, $kvs=32.0$ m³/h), and a Kamstrup Ultraflow 54 DN65 flanged water meter ($qp=25.0$ m³/h, PN25). The central heating substation will be equipped with a compact Danfoss Poland unit, which includes a brazed plate heat exchanger (Danfoss XB12M-1-36, 36 plates, 0.4 mm thickness, AISI 316 stainless steel), a Grundfos MAGNA3 25-60 electronically controlled pump, and a Reflex N 100 diaphragm expansion vessel. Additionally, a membrane safety valve (SYR 1915, 1", 0.50 MPa) will be installed on the heat exchanger's outlet. For domestic hot water, a Danfoss Poland compact substation with a brazed plate heat exchanger (Danfoss XB52M-1-50, 50 plates, AISI 316 stainless steel) and a Grundfos MAGNA3 25-60 N electronically controlled pump will be used, along with a membrane safety valve (SYR 2115, 1", 0.6 MPa). These renovations are necessary to enhance the building's energy efficiency, improve reliability, and ensure compliance with modern standards. Each stage of the renovation, from updating flooring and lighting to installing advanced heating and water systems, contributes to creating a more energy-efficient and reliable heating infrastructure.



Figure 19 Heating substation room

4. The photo shows the existing water circulation pump for the pool water treatment system, which will be replaced as part of the project. This replacement involves updating the existing circulation pumps and associated power cables, as well as installing new frequency converters for the pump motors. The installation and wiring of the equipment will follow the specifications outlined in

drawing 01 – Pool Technology Equipment Layout. Electrical cables will be laid in cable trays, and power for the pumps will come from the existing power distribution cabinet. All existing power cables for the circulation pumps will be replaced with YDY 4x4mm² cables between the power cabinet and the frequency converters, and TOPFLEX EMV 4x4mm² shielded cables between the converters and the pump motors. The old circulation pumps will be dismantled and disposed of, to be replaced with new pumps that have identical mounting dimensions but higher efficiency motors, such as the HERBORNER PUMPEN UNIBLOCK-GFC 125-250/1104GFC-W2 or an equivalent model. The new pump will feature a horizontal centrifugal design with the option for vertical mounting, internal circulation for mechanical seal washing, and a three-phase motor with water jacket cooling. The motor will also have IP55 protection, reinforced bearings, and a stainless steel shaft, along with PTC temperature sensors and grease fittings for easy maintenance. The technical specifications for the new pump include a capacity of 100.0 – 280.0 m³/h, a head of 18.0 – 10.0 m, a voltage of 400/690V, a motor power of 11.0 kW, a speed of 1450 rpm, and a nominal current of 20.9 A. Additionally, frequency converters such as the INVERTEK OPTIDRIVE E3 or an equivalent model will be installed on the wall in the pump room, with IP66 protection. These converters will have an input voltage of 380-480V ±10%, a supply frequency of 48-62 Hz, a phase shift factor greater than 0.98, an overload capacity of 150% for 60 seconds or 175% for 2.5 seconds, and an output frequency range of 0-500 Hz. The control method for the converters will include scalar U/F with energy optimization, supporting both analog and digital input signals.



Figure 20 Water circulation pump for the pool water treatment system

5. The photo shows the existing air handling unit (AHU), which will be replaced as part of the modernization project. This AHU maintains air quality and climate control in the pool areas. The new AHUs NW1 and NW2 will replace the old systems to ensure optimal operation and reduce operating costs. The current system will be replaced with modern units that will improve efficiency by 20%. The new units feature integrated automation, a heat pump, and a heat recovery exchanger for high energy efficiency. The existing system does not adequately control humidity and temperature, leading to condensation, corrosion, and potential structural damage. The new units will prevent these issues, protecting the building's integrity. The renovation includes dismantling the existing units and ductwork, followed by installing the new NW1 and NW2 units. These units were chosen for their higher efficiency and capacity to meet increased ventilation needs. They will be integrated with the building's automation system for better control and monitoring. The new AHUs will enhance energy efficiency by increasing airflow by 20%, allowing more effective ventilation. The heat recovery exchangers will use exhaust air to preheat incoming air, reducing energy consumption. Integrated automation will optimise operation, and better insulation (class T2) will reduce heat losses. The NW1 unit will have a maximum supply air volume of 18,080 m³/h with a static pressure of 550 Pa and a PSFP of 1.244 kW/m³/s. The maximum exhaust air volume will be 19,000 m³/h with a static pressure of 550 Pa and a PSFP of 1.122 kW/m³/s. The dimensions of the NW1 unit are 2085 mm (width), 5360 mm (length), and 2965 mm (height). It will maintain the pool hall temperature at 30°C year-round with a relative humidity of 55% in winter and 60% in summer. The plate heat exchanger will have an efficiency of at least 80%. The NW2 unit will have a maximum supply air volume of 11,760 m³/h with a static pressure of 550 Pa and a PSFP of 1.122 kW/m³/s. The maximum exhaust air volume will be 12,350 m³/h with a static pressure of 550 Pa and a PSFP of 1.122 kW/m³/s. The dimensions of the NW2 unit are 1445 mm (width), 4860 mm (length), and 2325 mm (height). Both units will feature integrated factory automation, a reversible heat pump, and an asymmetrical heat recovery exchanger made of polypropylene or anodized aluminium. The new units will meet all required standards for thermal insulation (class T2), thermal bridges (class TB1), airtightness (class L1), mechanical strength (class D1), and filter mounting tightness (class F9), as confirmed by certification from an independent body such as TUV.



Figure 21 Existing air handling unit (AHU)

○ Issues vs challenges raised in D3.1 or new issues encountered.

It is crucial to meet formal requirements and procedures, especially in the context of public procurement law. Multidisciplinary coordination is essential as it encompasses various aspects, including formal requirements, municipal regulations, and the internal situation of the municipality, which often lacks in-house inspectors and must hire them for specific constructions. Uncontrollable situations, such as delays by designers or coordination issues, can pose challenges to project implementation. For public clients, it is important to conduct tenders considering the availability of financial resources, which can save time. Modernization and proposed solutions can significantly improve the situation, but it is necessary to address all factors related to the tender. Inspectors should be involved from the start of the process, and designers should provide data according to the schedule to avoid delays. Projects often need to be redesigned due to lost or unorganised documents and it causes late cost estimate discoveries, highlighting the need for strict guidelines from the client at the project's kick-off. The pre-planned schedule should include milestones to ensure the smooth and efficient execution of the project.

3.8.2.2 Revised Timeline with Rationale for Changes

Delays were reported due to the formal restrictions and bureaucratic procedures needed for public procurement rules. These procedures require certain time periods for validation (e.g., after selecting the tender, a specific fixed period for announcing the public tender for the selection of contractors, etc.). After completing the final project design for renovation (which was also subject to a public tender for selecting the designer), a period of project design formal and technical adjustments and corrections was needed from the Investments Office of GK Municipality.

Due to rising costs (caused by the war in Ukraine affecting the whole market prices - especially in construction - and also excessive inflation), expenses exceeded the budget for the renovation project, resulting in the need to explore alternative options (such as dividing the tender). Finally, an agreement was reached favouring the most efficient solution (announcing the entire procurement as one), but it required more time, as the tendering procedure starts from gathering of local council, who further need to accept the different sources to cover the renovation costs and new budget distribution.

3.9 Pilot 7 (MESH/LEIF)

3.9.1 Summary of the Pilot 7 Progress

Table 44 Pilot 7 overview

Building Type	The use of the building is an educational institution, Riga 9th Secondary School (School, class groups from 1st to 12th grade)
Location	Stamerienas Street 8, Riga, Latvia, in the Vidzeme suburb of Riga City
Size	Area - 5258 m ² . The building has 4 floors, but the classrooms are on floors 1-3. The classrooms of the school are all (more or less) the same size, between 50-70 m ² . There are 11 classes on the first floor, second floor – 11, third floor – 8 classes. All together 37 classrooms.
Initial Energy Efficiency Rating	-
Renovation Technology Status	On Schedule

Table 45 Pilot 7 Components Staus

Component /Status	ONGOING TILL
MESH on-demand management platform for heating and ventilation system	September, 2024

3.9.2 Individual Pilot Building Progress Reports

3.9.2.1 Detailed Update on Renovation Technology Implementation

MESH on-demand management platform for heating and ventilation system

In the end of 2024, in the school will be built BMS system – Mesh on-demand management platform for heating and ventilation system and each individual unit including all necessary licences self-service panels with sensors CO₂, VOC, Temperature, Humidity, Pressure (18.800) in classrooms and 232 microregulation points using Mesh RRC-030 controllers (12.500). Regulating/balancing valves for heating system in order to allow micro regulation per classroom (232 points, 10.900).

It is planned to build 37 air handling units and 58 sensors Mesh Air 500 m³/h (105.800), Wireless Mesh infrastructure for sensor gateways.

- Comparison with work planned (measurements),

Everything is implemented according to plans.

- Photos.

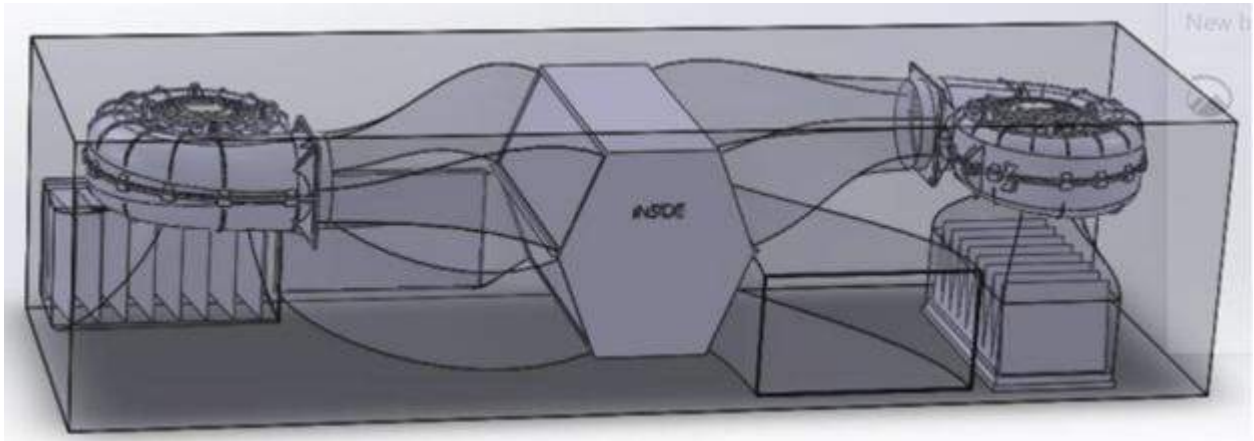


Figure 22 MESH air handling units

3.9.2.2 Revised Timeline with Rationale for Changes

Everything is according to plan.

3.9.2.3 Budget Updates and Explanations for Deviations

No budget deviations.

3 Conclusions

The report offers a detailed analysis of the renovation projects undertaken across different pilot sites. While significant progress has been made in certain areas, challenges such as administrative delays, supply chain issues, and unforeseen technical difficulties have impacted project timelines and budgets.

Key findings include variations in project maturity, with some sites nearing completion while others are still in the planning stages. The report underscores the importance of effective project management, resource allocation, and stakeholder collaboration for successful implementation.

Looking ahead, the successful deployment of renovation technologies will depend on addressing identified challenges, refining project plans, and leveraging lessons learned from the pilot sites. By continuously monitoring progress and adapting strategies as needed, the project can maximize its impact and contribute to the development of sustainable and energy-efficient buildings.

This document represents the initial version of the report, providing a baseline assessment of project progress. The next update on the status of renovations for each pilot will be presented in the D3.5 Report on the renovation technologies for each building, and deployment approach M25, scheduled for delivery in Month 25.

Overall, this report provides a solid foundation for evaluating project performance, informing decision-making, and guiding future actions to ensure the successful realization of renovation goals.