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Overcoming Underperforming Renovations in Central and Eastern Europe

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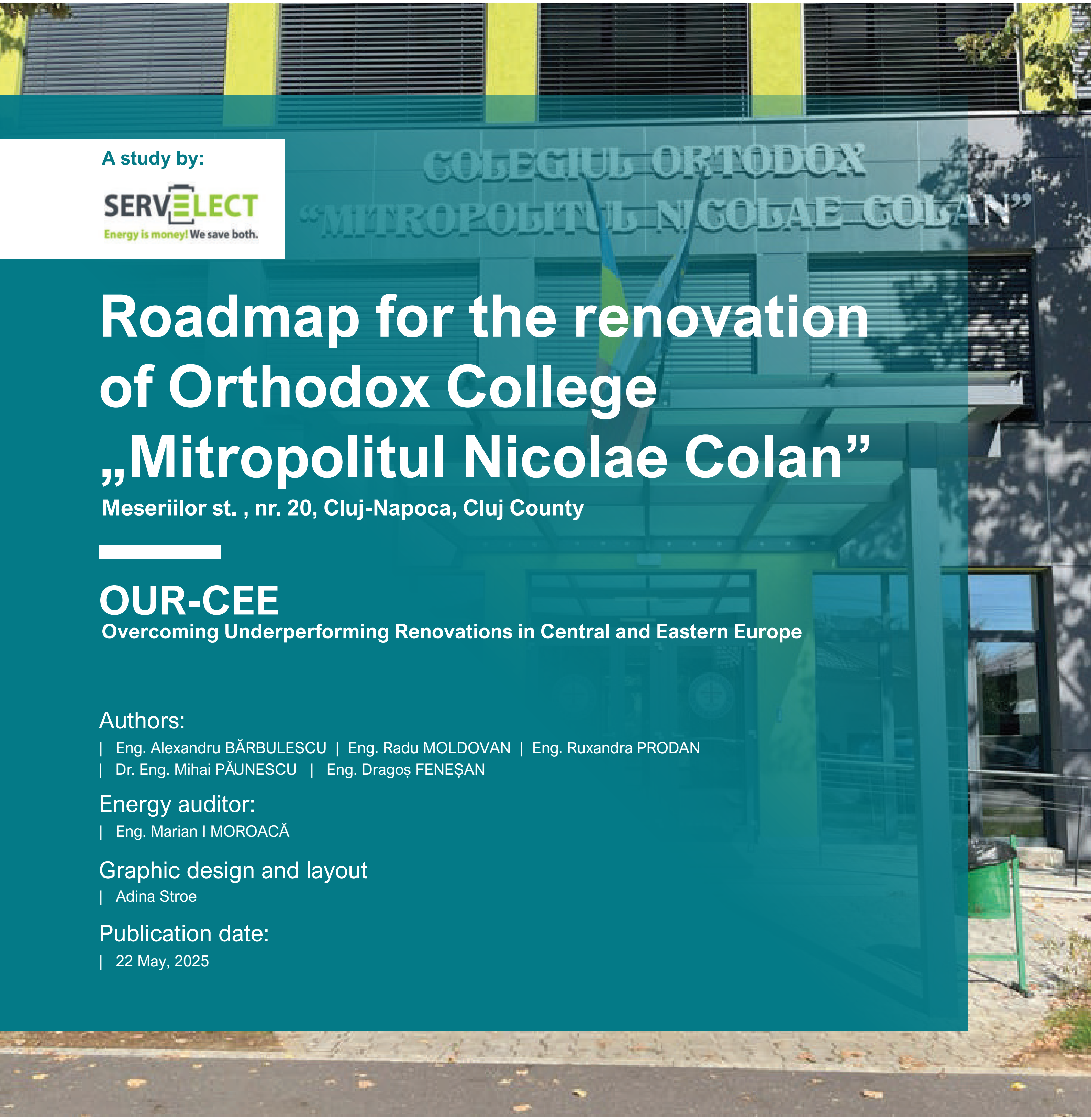

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Roadmap for the renovation of Orthodox College „Mitropolitul Nicolae Colan”

Meseriilor st. , nr. 20, Cluj-Napoca, Cluj County

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Overcoming Underperforming Renovations in Central and Eastern Europe

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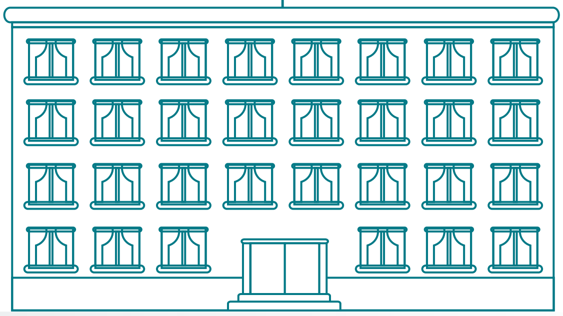
BUILDING DESCRIPTION AND CURRENT ENERGY PERFORMANCE

Orthodox College „Mitropolitul Nicolae Colan”



Education building

Cluj-Napoca, str. Meseriilor, nr. 20, județul Cluj

Edificat în anul 1961

The construction system is reinforced concrete frames with load-bearing brick masonry

Building importance category ”C”- normal according to HGR no. 766/1997

Building importance class II, according to P100/1-2013

Fire resistance rating II, according to P118-99

Built area of the school building - 6534 m^2

Height - P+3E

Energy performance class A

Final energy consumption 44,4 kWh/m^2*year

Primary energy consumption 67,0 kWh/m^2*year

CO_2 emission index - 9,1 $kgCO^2/m^2$,year

The site’s usual opening hours are between 8:00 - 16:00, from Monday to Friday, in accordance with the academic year calendar.

Approximately 67 kWh/m^2*year represents renewable share, including energy generated by solar panels and the national electricity grid mix (SEN).

The building does not comply with the nZEB standard. Both the primary energy consumption and the associated carbon emissions exceed the maximum threshold established by the national calculation methodology MC-001-2022.

The RERp indicator (percentage of energy consumed from renewable sources relative to the the total primary energy consumption) is 18.3%

Breakdown of areas and average standard indoor temperatures

Floor	Area [m^2]	Volume [m^3]	Avg. standardised indoor temp. [°C]
GROUND FLOOR			
Total	734,60	2121,43	
Heated area E	734,60	2121,43	17,97
Cooled area E	3734,60	2121,43	
1ST FLOOR			
Total	665,35	1929,52	
Heated area E	665,35	1929,52	17,90
Cooled area E	665,35	1929,52	

Floor	Area [m^2]	Volume [m^3]	Avg. standardised indoor temp. [°C]
2ND FLOOR			
Total	720,15	2088,44	
Heated area E	720,15	2088,44	17,81
Cooled area E	720,15	2088,44	
ETAJ 3			
Total	1382,65	2557,25	
Heated area E	1382,65	2557,25	17,29
Cooled area E	3502,75	8696,63	17,74

Previous renovations

The last major renovation of the building was carried out in 2022. The works included:

- upward extension;
- modernisation of the façade;
- Replacement of exterior joinery with high-performance, thermally insulated windows.
- installation of a centralised mechanical ventilation system with heat recovery;
- upgrade of the lighting installation;
- intallation and integration of building energy management and automatic control system (BEMS)

Energy sources used

Currently, the building uses two main energy sources to meet its functional requirements: natural gas (indirecly) and electricity.

- ***Natural gas*** is used to power remote cogeneration turbines, which provide heating via the municipal district heating network, as well as to supply domestic hot water. The wall-mounted boilers operate on combustion, and their energy efficiency varies. While the use of natural gas is cost-effective in the short term, it contributes significantly to CO2 emissions, directly impacting the building's carbon footprint.

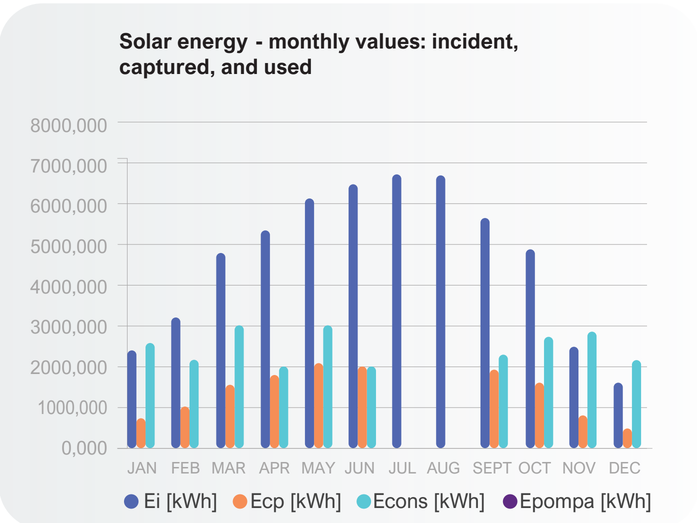
- ***Electricity*** is primarily used for interior and exterior lighting, powering electronic equipments, and various auxiliary systems. Currently, lighting is provided by LED fixtures, which reduce energy consumption compared to traditional sources. However, electricity supplied through the national grid is generated from an energy mix which includes both conventional and renewable sources, resulting in varying levels of CO2 emissions.

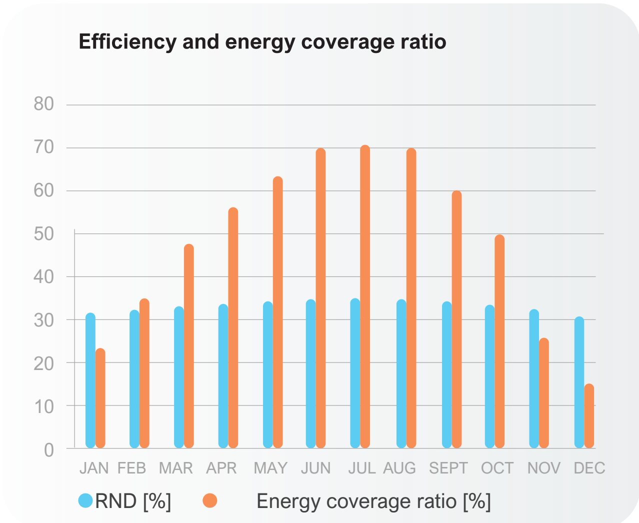
The integration of alternative energy sources, such as photovoltaic panels or energy recovery systems, could significantly reduce conventional energy consumption and help optimise long-term operational costs. Additionally, increasing the share of energy from renewable sources would reduce greenhouse gas emissions and support sustainability objectives.

On-site renewable energy

The building uses solar thermal panels for domestic hot water, as well as photovoltaic panels to generate renewable electricity on-site. In addition, a portion of the electricity consumed is sourced from renewables through the national energy grid, which includes hydro, wind, and solar power.

The contribution of the solar thermal panels





Primary and final energy demand

Primary energy consumption calculated in accordance with the national energy performance calculation methodology, MC001-2022 and current applicable regulations

System	Current			Reference building	
	Final/primary energy consumption	Annual CO_2 emissions	Energy Performance Class	Primary energy consumption	CO_2 emissions
1. Heating	20,5 / 21,6	4,4	A+		
2. Domestic hot water	9,7 / 9,9	1,0	A		
3. Cooling					
4. Mechanical ventilation	7,5 / 18,7	2,0	C		
5. Lighting	6,7 / 16,7	1,8	B		
TOTAL / CLASS	**44,4 / 66,9**	**9,1**	**A**	**82,7**	**13,1**

Energy bill

Natural gas consumption and costs over a two-year analysis period, 2019 - 2024, representing the timeframe before and after the renovation works.

Natural gas consumption

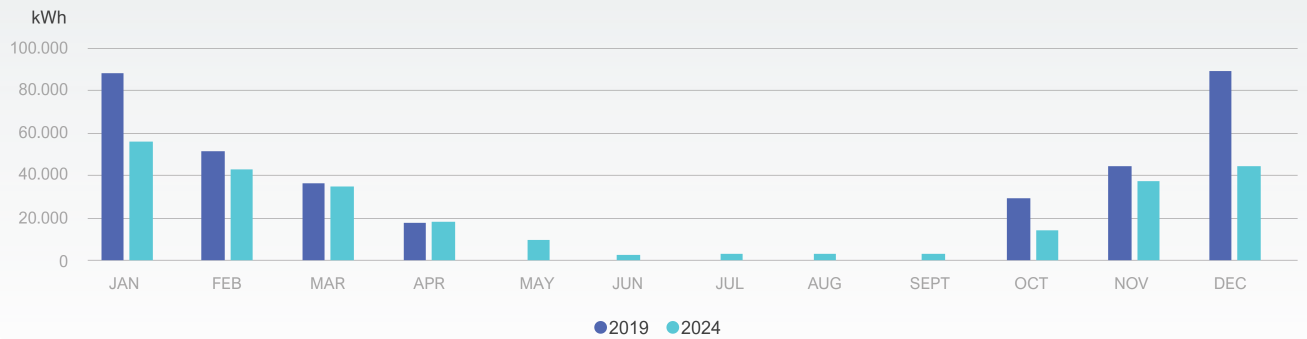
2019

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Consumption [kWh]	87.611	50.939	36.000	17.422	-	-	-	-	-	29.188	43.828	88.461
Cost [lei]	16.298	9.646	6.476	3.134	-	-	-	-	-	5.356	8.042	16.381

2024

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Consumption [kWh]	55.582	42.755	34.387	18.151	9.905	2.839	3.077	3.044	3.210	14.175	36.934	43.925
Cost [lei]	19.000	14.615	12.027	5.049	2.794	802	917	1.016	956	4.900	12.110	15.928

Energy consumption in different years: 2019 versus 2022



CO_2 emissions

CO2 emissions are a key indicator of a building's environmental impact. These emissions are directly influenced by the type of energy used, the efficiency of the building systems, and the quality of thermal insulation in place.

Buildings that primarily rely on conventional energy sources – such as natural gas – typically exhibit significantly higher CO2 emissions compared to those that benefit from substantial input from renewable sources, such as solar panels, wind energy, or green electricity from the national grid.

CO2 emissions are calculated using standardised conversion factors, which correlate energy consumption with the corresponding emissions, in line with national regulations.

Primary and final energy consumption in relation to the amount of CO_2 emissions generated, based on national conversion factors, as well as the share of on-site renewable energy production, and the share of green electricity supplied to the building via the national energy grid:

Total annual energy consumption [kWh/m ,year] *	final -t/e**	30,2	14,2	-	-	CO_2 emissions index [kgCO_2/m^2,year] *	9,1
	primary	**67,0**		**82,7**			

Total annual energy consumption from renewable energy [kWh/m^2 year] *	Solar thermal	Solar electric	Heat pumps	Biomasă	Other RES	**TOTAL RES**
	5,2	0,0	0,0	0,0	7,1	12,3

DETAILED RENOVATION STEPS

Timeline	**Energy class** after implementation of measures	**Measures**	**Energy consumption** after implementation of measures	**CO_2 emissions** after implementation of measures and reduction compared to baseline	**Costs** investment costs and maintenance costs
Year 1	A+	**S1. Enhancement of RES** Installation of monocrystalline solar panels, power of 60 kWp and inverters operating at >97%	**Primary energy consumption** – 47,7 kWh/ m^{2}year **Final energy consumption** – 44,4 kWh/ m^{2}year	**CO2 emissions index** – 5,7 kgCO_2/m$_2$year **Reduction-** aproximativ 37%	**Investment cost:** 210.000 lei (excl. VAT) **Maintenance cost:** approx. 0.5 - 1% of the initial investment cost, covering periodic cleaning and technical inspections
Year 2	A+	**S2. Upgrade of the heating and cooling system (air-to-water heat pumps)** Installation of heat pumps with SCOP > 3,5; auxiliary equipments for distribution and temperature control	**Primary energy consumption** – 39,0 kWh/ m^{2}year **Final energy consumption** –47,6 kWh/ m^{2}year	**CO_2 emissions index** – 2,4 kgCO_2/m^{2}year **Reduction-** approx. 73,6%	**Investment cost:** 212.000 lei (excl. VAT) **Maintenance cost:** estimated at 4-6% of the purchase costs (routine inspections and filter cleaning)
Year 3	A+	**S3. Energy performance monitoring and verification** Installation of smart meters for real-time monitoring of energy consumption, full integration into BEMS. The system will include: smart meters for both electricity and heating/cooling, data analysis software, and automated performance reporting tools.	**Primary energy consumption** – 37,8 kWh/ m^{2}year **Final energy consumption** – 47,1 kWh/ m^{2}year	**CO_2 emissions index** – 2,3 kgCO_2/m^{2}year **Reduction-** approx. 74,7%	**Investment cost:** 12.500 lei (excl. VAT) **Maintenance cost:** estimated at 1-2% of investment cost (subscriptions for monitoring software, technical inspections)

Implementation sequence of the renovation measures

The proposed renovation plan has a phased implementation of measures over 3-year period. This timeline is indicative and may vary depending on the complexity of each measure and availability of funding. The staging of the works should follow a logical sequence of interventions, aimed at progressively improving indoor comfort and reducing energy consumption from one stage to the next.

YEAR 1 Energy class A+

Enhancement of renewable energy sources

The first step is to expand the PV system in order to reduce electricity consumption from the national energy grid and lower operational costs. The generation of on-site energy will establish a sustainable framework for the subsequent renovation measures. At this stage, the PV system should be properly sized to match the projected energy demand, including the anticipated consumption of the equipment and technologies to be integrated as part of the renovation package.

- ***Installation details***: the optimal orientation and tilt of the panels will be assessed; a south-facing placement is recommended. The pitched roof, with a slope of 30-35%, is suitable for maximising solar exposure. The system will be connected to the building's electrical network and integrated into BEMS.
- ***Materials and technical specifications:*** monocrystalline PV panels with a total installed capacity of 60kWp, paired with high-efficiency inverters having a conversion efficiency of over 97%.
- ***Investment and maintenance costs:*** the estimated investment is 210 000 RON (excluding VAT), with low annual maintenance costs due to the high durability of the equipment.
- ***Procurement, permits, and contract requirements:*** procurement of PV panels and inverters, grid connection permits from the distribution system operators, maintenance contracts for the PV system.

YEAR 2 Energy class A+

Upgrade of the heating and cooling system using air-to-water heat pumps

With smart energy control and a well-ventilated indoor environment, the fourth stage of the renovation consists of upgrading the heating and cooling systems. As part of this phase, it is proposed to implement an air-to-water heat pump system, while retaining the existing gas boilers to cover peak demand periods. These heat-pumps systems are less efficient when the distribution system is traditional, based on static radiators, as they require high-temperature operation (typically 70/60°C). Therefore, replacing the existing heat distribution system with high-efficiency floor mounted fan coil units will significantly reduce thermal energy consumption, allowing the heat pumps to operate within their optimal performance range.

- ***Implementation details:*** Retention of the existing wall mounted gas boilers and installation of air-to-water heat pumps, optimised for the local climate. The building service installations will be adjusted to ensure compatibility with the new equipment.
- ***Materials and technical specifications:*** Air-to-water heat pumps, with SCOP > 3,5 auxilliary equipment for heat distribution and temperature control.The equipment will have copper - aluminium heat exchangers for a better thermal performance and will be fully compatible with the building's automation systems.
- ***Investment and maintenance costs:*** investment estimated at 212.000 lei, covering the procurement of equipment, installation, and necessary adaptations to the existing hydraulic network. Maintenance costs are expected to be low, limited to periodic inspections and air filter cleaning.

- ***Procurement, permits, and contracts:*** Procurements will include control and automation devices, as well as the materials required for pipeline adjustments. The implementation will require obtaining technical approvals for modifications to the heating installations, along with installation and maintenance contracts.

YEAR 3 | Energy class A+

Energy performance monitoring and verification

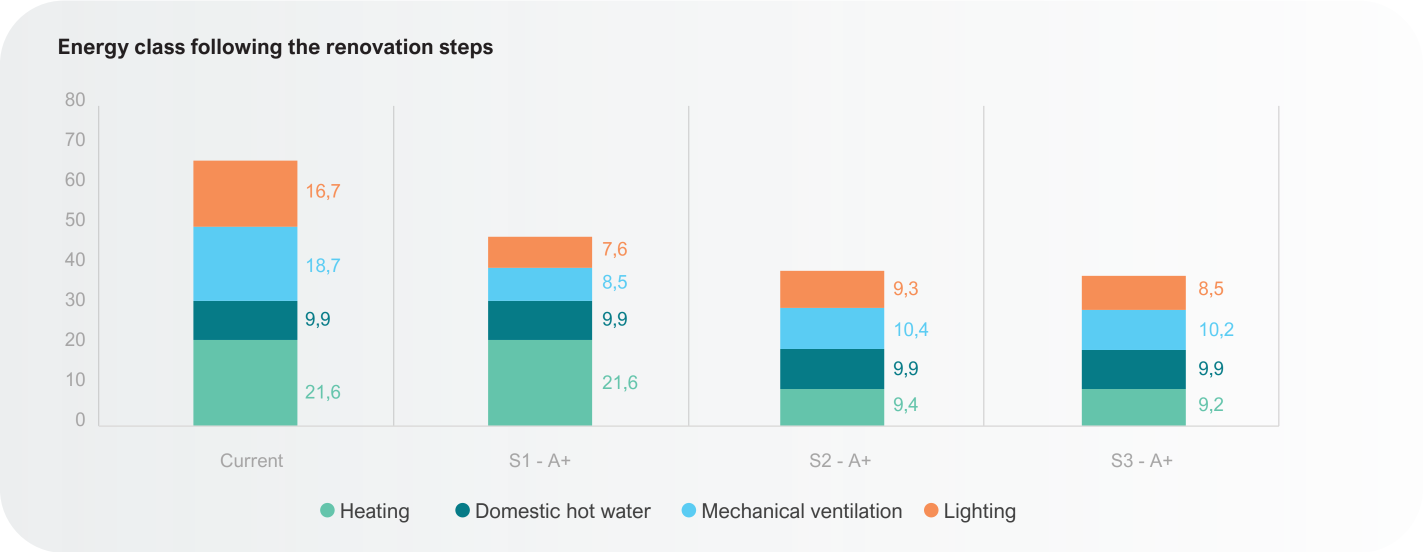
Continuous monitoring of energy performance will enable the assessment of the impact of the implemented measures and identification of necessary adjustments. Data collected from the installed systems will be analysed periodically to optimise equipment operation and maximise energy savings. Regular technical inspections will be carried out, and consumption parameters will be compared against estimated values to ensure that energy efficiency targets are met.

- ***Installation details:*** Installation of smart meters to monitor energy consumption, with integration of data into the Building Energy Management System (BEMS) for continuous performance analysis.
- ***Materials and technical specifications:*** Smart meters for both electrical and thermal energy, accompanied by data analysis software and performance reporting tools.
- ***Investment and maintenance costs:*** Estimated as an annual subscription cost with a specialised service provider. Alternatively, this cost can be reduced or eliminated by training and appointing a staff member for system operation and data analysis.
- ***Procurement, permits, and contracts:*** Procurement of smart metering devices, and a service contract for system integration and configuration.

Energy class following the renovation steps

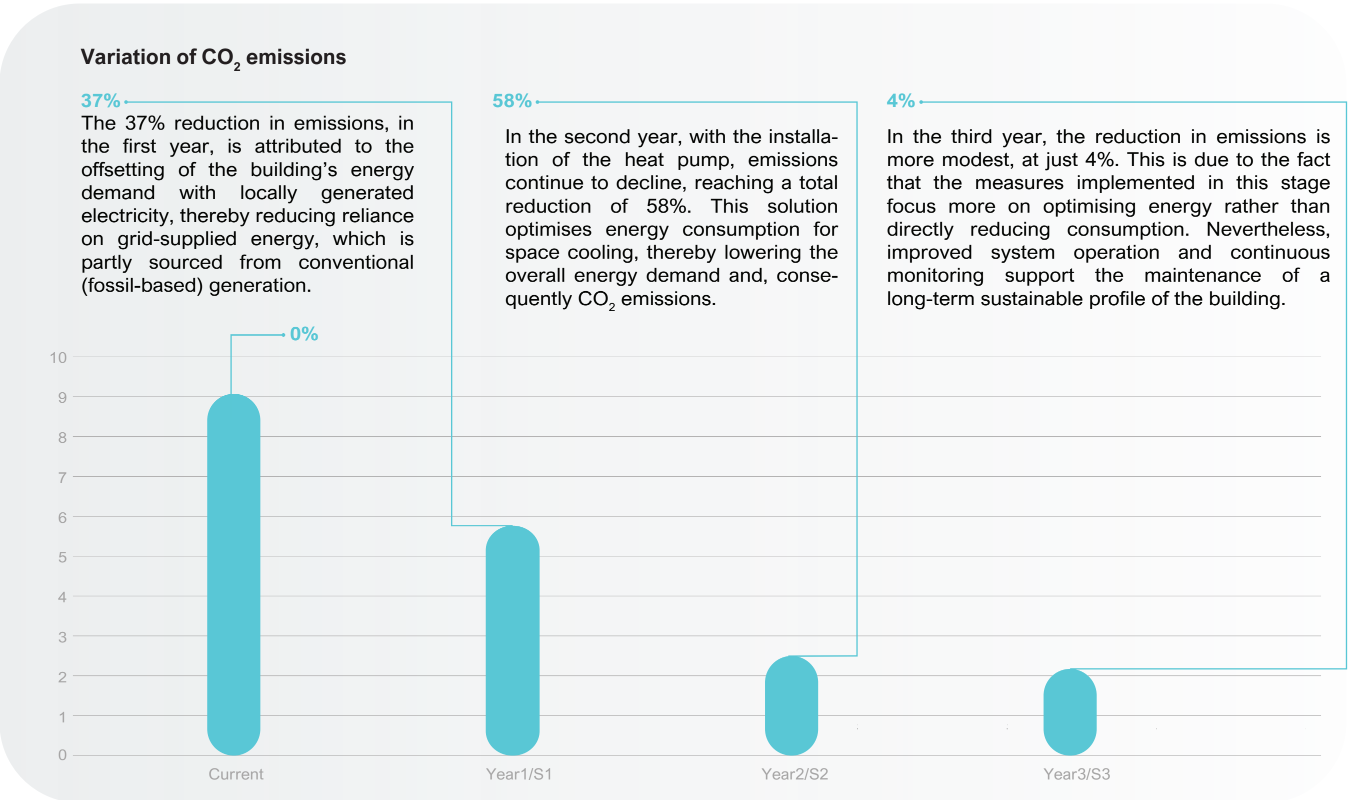
The gradual implementation of the proposed measures will result in a progressive improvement of the building's energy efficiency while significantly contributing to the improvement of the indoor microclimate. Each renovation stage may not necessarily lead to an immediate upgrade in the building's energy rating, but it will enhance indoor environmental quality and contribute to the reduction of the building's carbon footprint. In the table below, the first row presents the evolution of primary energy consumption alongside the variation in the building's energy class as the proposed solutions are implemented.

	Current		Year1 / S1		Year2 / S2		Year3 / S3	
	[kWh/m²y]	Class	[kWh/m²y]	Class	[kWh/m²y]	Class	[kWh/m²y]	Class
Primary energy consumption	67,0	A	47,7	A+	39,0	A+	37,8	A+
Final energy consumption	44,4	-	44,4	-	47,6	-	47,1	-
CO_2 emissions index [$kgCO_2/m^2y$]	9,1	A	5,7	A+	2,4	A+	2,3	A+
Heating	21,6	A+	21,6	A+	9,4	A+	9,2	A+
Domestic hot water	9,9	A	9,9	A	9,9	A	9,9	A
Cooling	-	-	-	-	-	-	-	-
Mechanical ventilation	18,7	C	8,5	B	10,4	B	10,2	B
Lighting	16,7	B	7,6	A	9,3	A	8,5	A
RER	18,30%	-	39,24%	-	71,99%	-	73,12%	-
Renewable energy [kWh/m²y]	5,16	-	18,04	-	37,59	-	37,59	-



CO_2 emissions after the implementation of each step

The phased implementation of renovation measures results in a substantial reduction in CO_2 emissions. However, this reduction does not occur uniformly over time. The chart below illustrates how each intervention stage contributes to the overall decline in emissions, highlighting the specific impact of each solution deployed.



Energy sources post-renovation

Following the implementation of all proposed renovation measures, the building's energy mix will be substantially recalibrated to reduce dependency on conventional energy sources and increase the share of renewables.

PV Solar Energy

A significant portion of the building's electricity demand will be met through the installation of photovoltaic panels on the roof. These panels will generate electricity for lighting, equipment operation, and the powering of the mechanical ventilation system. Any surplus energy generated will be either fed back into the national grid or stored.

Aero-Thermal Energy (Air-to-Water Heat Pumps)

The building's heating and cooling system will be upgraded through the installation of air-to-water heat pumps, which extract thermal energy from the outside air to provide heating during the cold season and cooling in the versatile, which reduces natural gas consumption and CO_2 emissions. The heat pumps will be integrated with the mechanical ventilation system and the building's automation systems.

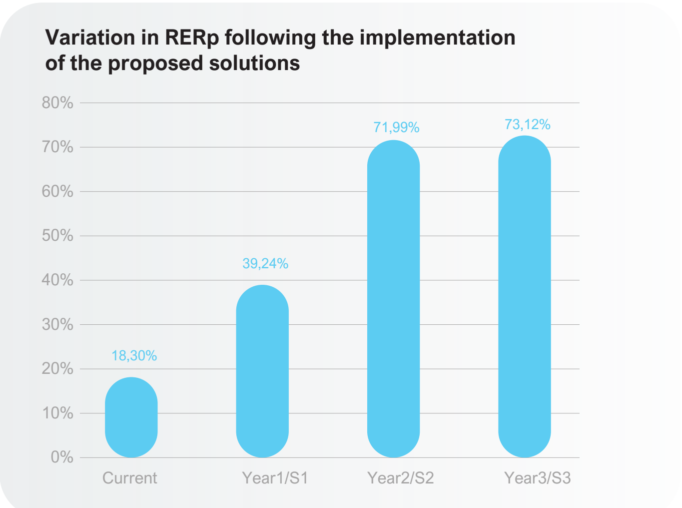
Natural Gas

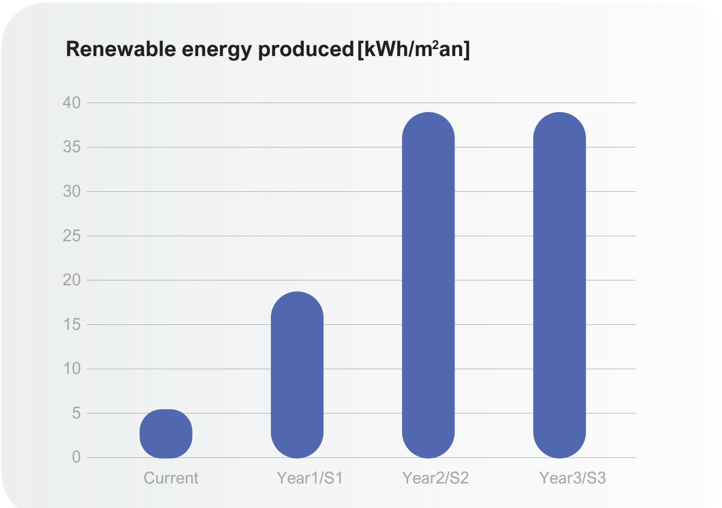
Post-renovation, the use of natural gas will be minimised, serving only as a backup source for exceptional situations. On a regular basis, the operation of the heat pumps and ventilation systems will eliminate the need for intensive natural gas usage.

Electricity from the National Grid

Although a significant portion of the required energy will be covered by renewable sources, the building will remain connected to the national electricity grid to ensure continuity of supply during periods of low production from on-site generation. Suppliers will be selected based on the share of green energy into their energy mix.

- **The installation of photovoltaic panels on the building's roof will enable the generation of electricity from solar energy.** The electricity produced will cover a significant portion of the building's electricity consumption for lighting, equipment, and the operation of automated systems. Any surplus energy can either be stored in batteries or fed back into the national grid, depending on the demand and operational conditions.
- **The existing solar thermal panels will continue to contribute to the production of domestic hot water,** thereby reducing the energy required for heating water. This system will be optimised to work efficiently in conjunction with the new heat pumps and other modern equipment.
- **The air-to-water heat pumps** will harness renewable energy from the ambient air to provide heating and cooling for the building.





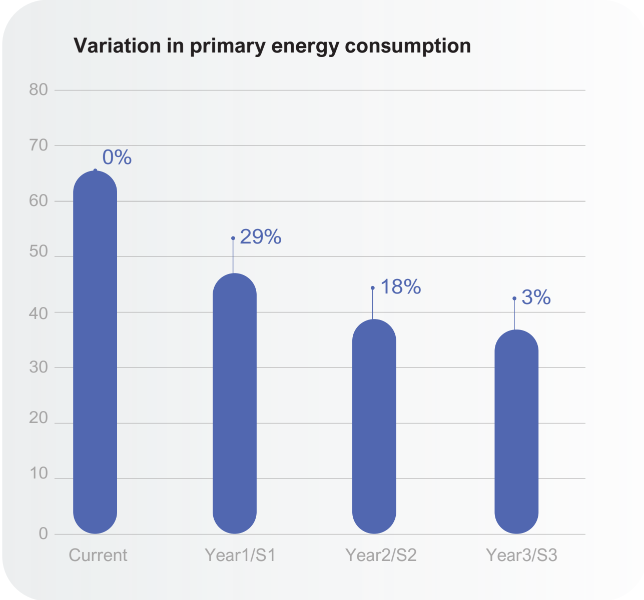
Energy demand after each renovation step

Primary energy demand

Following the completion of all proposed renovation measures, the building's primary energy demand will be substantially reduced. This improvement will result from both enhanced energy efficiency and the integration of renewable energy sources. The adoption of advanced systems and high-performance equipment will ensure better energy transfer and utilisation, minimising losses and reducing the overall demand for primary resources.

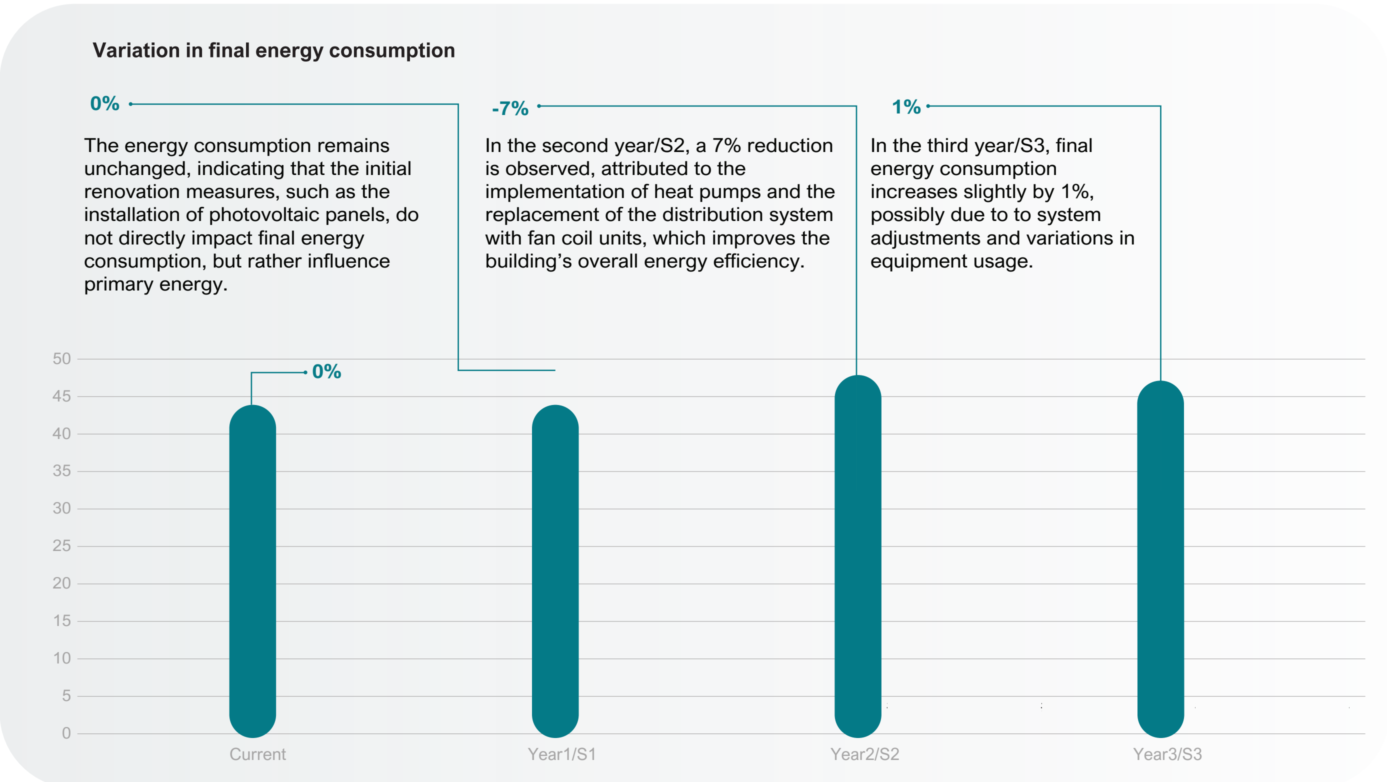
The systems proposed in the renovation plan will enable more precise control and dynamic adjustment of energy flows, ensuring that a significant portion of the energy used originates from renewable sources.

By combining renewable energy generation with energy-efficient technologies, the building's primary energy demand will be reduced to a level compliant with current energy efficiency and sustainability standards. Depending on actual performance outcomes, the building may qualify for NZEB classification.



Final energy demand

Following the implementation of the proposed renovation measures, the building's final energy consumption exhibits notable variation. The rate of reduction is not linear and does not directly mirror the decline in primary energy demand.



It is important to note that variations in final energy consumption do not directly affect the calculation of normalised final energy, which is used in the building's energy performance analysis. However, these fluctuations are reflected in the energy bills, having an economic impact on operational costs. This points to the need for constant monitoring and adjustments of operational parameters in order to optimise energy consumption and costs.

Energy costs following the implementation of the renovation plan

Following the implementation of the proposed measures, the energy bill will gradually decrease, although not in a strictly linear fashion. The evolution of energy costs is influenced by several factors, including the integration of renewable energy sources, the efficiency of upgraded systems, fluctuations in market energy prices, and most significantly, by the operational efficiency and usage patterns of the equipment by the building's occupants.

- **In the first year**, the energy bill remains relatively stable, as the initial investments focus primarily on the installation of photovoltaic panels.
- **In the second year**, a noticeable reduction in energy costs is observed, coinciding with the replacement of the thermal distribution system with a fan coil-based solution. This upgrade allows for more precise indoor temperature control and optimises the use of energy generated by the heat pumps, resulting in substantial savings. However, the reduction in billing is not directly proportional to the decrease in primary energy consumption, as a portion of the building's demand is met through electricity, the cost of which may fluctuate according to market.
- **By the third year**, ongoing monitoring and adjustment of operating parameters lead to further cost optimisation. Nevertheless, the impact on the energy bill is less significant compared to earlier interventions. This is due to the fact that energy savings reach a saturation point, while the building's base load remains relatively constant.

Overall, the energy bill is expected to decrease after the completion of all renovation phases, although the pace of reduction is determined by the balance between achieved savings and the associated cost of electricity use. The efficiency of the system relies heavily on a sufficiently high SCOP for the heat pumps, particularly given the recent price ratio between electricity and natural gas, which has been around 3. To maintain energy bills at an optimal level, the heat pumps should achieve a SCOP of at least 3.

Costs per renovation step

A phased cost assessment for each proposed measure is important for effective financial planning and for identifying potential funding streams. The estimated costs below encompass materials, labour, and where applicable, the acquisition and installation of specialised equipment.

Measure	Cost per unit RON/unit	Measurement unit	Power/demand	Total cost excl. VAT	Total cost incl. TVA
Photovoltaic monocrystalline panels, power of 60 kWp, inverters operating at >97%	3.500	kWp	60	210.000	249.900
Air-to-water heat pumps	-	unit	1	212.000	252.280
Energy performance monitoring and verification	5	annual	2.500	12.500	14.875
Total				434.500	517.055

These value are indicative and may be subject to variation based on market fluctuations in construction materials and service rates. Additionally, certain measures may qualify for grant funding or financial incentives through nation al and EU-level schemes aimed at promoting energy efficiency in buildings.

The *annual maintenance costs* reflect the requirement for regular servicing to ensure the optimal opera tion of the systems and to maintain the desired level of energy performance.

Enhancement of renewable energy sources (PV panels)

Approx. ***0.5–1% of the initial investment cost***, covering the periodic cleaning of the panels and technical inspections.

Upgrade of the heating and cooling system (air-to-water heat pumps)

Technical inspections and preventive maintenance, estimated at ***4–6% of the equipment value.***

Energy performance monitoring and verification

Subscriptions for monitoring software and potential technical inspections, estimated at ***1–2% of the purchase cost.***

Securing funding for the renovation measures

In order to financially support the implementation of the proposed renovation measures, it is important to identify and leverage a range of diverse funding sources. These may derive from both public and private streams, depending on the specific requirements of each renovation phase and the availability of financial resources

a. European and National funding schemes

European financing programmes such as the Modernisation Fund, the Regional Operational Programme (ROP), or the National Recovery and Resilience Plan (NRRP) offer financial support for energy efficiency projects. Additionally, national schemes like the Environmental Fund Administration (AFM) provide grants for the installation of photovoltaic systems and other renewable technologies.

b. Public–Private Partnerships (PPPs)

Collaborative arrangements between public authorities and private sector investors can facilitate the delivery of complex renovation projects by attracting private capital in exchange

c. Green Loans and Bank Financing

Financial institutions offer tailored credit products for energy efficiency investments, often under the “green loan” framework, with preferential interest rates and flexible repayment terms. However, access to commercial financing is subject to specific eligibility criteria, such as creditworthiness, debt capacity, and collateral requirements.

Not all Local Authorities (UAT) may be eligible to access these funds directly, and conditions should be negotiated individually with financial institutions. For optimal results, UAT may also organise competitive tendering procedures to obtain the most advantageous financing offers.

d. Own-source Financing

Institutional budgets can be allocated to cover specific components of the renovation, particularly where the required capital investment is relatively modest.

e. Sponsorships and donations

In some instances, contributions from private entities or philanthropic donations may provide additional financial support, particularly for projects with strong community or social value.

Blended Financing Approach

Combining these multiple funding sources—grants, loans, PPPs, and internal resources—can enable the implementation of the proposed renovation plan.

Monitoring and verification

The monitoring and verification of each renovation stage are the necessary to ensure that the implemented measures meet their intended energy efficiency targets. The proposed approach is systematic and data-driven, involving the continuous collection and analysis of performance data at every phase of implementation.

Performance indicators to assess the impact of each measure:

- ***Final and primary energy consumption (kWh/m^2/year)***
- ***Efficiency of heating, cooling, and ventilation systems***
- ***CO_2 emissions (kg CO_2/m^2/year)***
- ***Indoor thermal comfort and air quality parameters (temperature, humidity, CO_2 levels)***
- ***Financial savings achieved through reduced energy consumption***

Smart meters and environmental sensors will be installed to enable real-time monitoring of electrical consumption, indoor climate parameters, and the operational efficiency of installed equipment. This will not only track system performance but will also facilitate early detection and prevention of faults or system failures. All monitoring data will be integrated into a Building Energy Management System (BEMS), enabling prompt identification of deviations from expected performance and optimisation of system operation.

Energy performance testing

- ***Thermographic imaging to detect heat loss and potential thermal bridging***
- ***Airtightness testing of the mechanical ventilation system***
- ***Verification of lighting and automation system efficiency***

Technical Reporting. Each renovation step will be documented in a technical report that includes:

- ***A description of the works carried out***
- ***Baseline and post-implementation performance data***
- ***Evaluation of performance outcomes and achieved savings***
- ***Recommendations for further improvements***

Following the completion of all renovation phases, ongoing performance monitoring will be maintained for a period of 2–3 years to assess the persistence of the benefits achieved and to recommend corrective actions if needed. After this initial period, the monitoring process may transition to a passive mode, involving periodic inspections.

This monitoring and verification plan ensures that investments lead to measurable and lasting results, maximising the energy, financial, and occupant comfort benefits of the renovation programme.

Additional benefits of implementing the renovation measures

In addition to reducing energy consumption and lowering CO_2 emissions, the implementation of renovation measures brings a wide range of secondary benefits that significantly improve the quality of life for building occupants and enhance the asset value of the property.

The introduction of a mechanical ventilation system with heat recovery (MVHR) ensures a constant supply of fresh air, main taining optimal indoor temperatures and appropriate humidity levels. This contributes to the prevention of mould growth, supports healthier indoor environments, and enhances both thermal comfort and indoor air quality.

The integration PV panels and air-to-water heat pumps helps reduce reliance on conventional energy sources, thereby lowering exposure to volatile energy prices and improving energy independence. These measures decrease dependency on traditional energy infrastructure and increase building resilience. Upgrading the lighting system to high-efficiency LED technology, along with the implementation of BEMS, contributes to the optimisation of energy use, leading to lower utility bills and easier equipment maintenance. These improvements help reduce operational and maintenance costs in the long term. An energy efficient building, equipped with modern technologies become more attractive on the property market, benefitting from higher capital value and extended service life.

Through the use of renewable energy sources and optimised consumption patterns, the building also helps reduce its carbon footprint, aligning with EU-level sustainability objectives and contributing positively to environmental protection.

The BEMS facilitates smart control of building systems, allowing for automatic adjustment of operating parameters based on user needs and real-time conditions. This leads to more efficient resource use and better operational performance. The added benefits show that renovation process not only improves energy efficiency, but also greatly enhances the user expe rience by creating a healthier, more comfortable, and more sustainable environment.