

# Roadmap for Building Renovation. Kyustendil Municipal Polyclinic

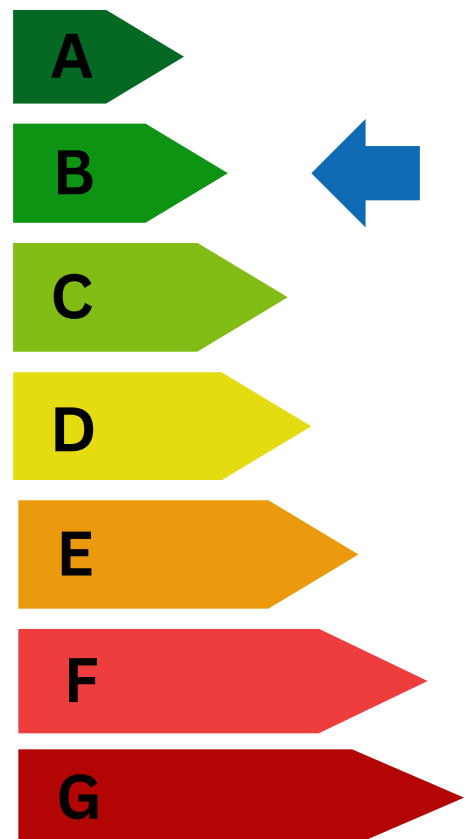
**OUR-CEE**

Overcoming Underperforming Renovations in Central and Eastern Europe

# ROADMAP

## BUILDING RENOVATION


Building name:	Kyustendil Municipal Polyclinic
Address:	Kyustendil, Yavorov Str. 4
GENERAL BUILDING DATA	
Building type:	Healthcare building - polyclinic
Year of construction:	1980-1989
Total build-up area:	5131 m <sup>2</sup>
Occupancy schedule:	Monday-Friday, 10 hours/day
Non-renewable energy sources:	Natural gas, Electricity
Renewable energy sources::	Solar energy – thermal and electrical from PV Environment (outdoor air)
Previous renovation measures:	<ul style="list-style-type: none"> <li>• Photovoltaic installation with a capacity of 25 kWp (2024)</li> <li>• Solar thermal installation for DHW (2011)</li> <li>• Internal thermal insulation of walls (2011)</li> <li>• PVC double-glazed windows with selective coatings (2011)</li> <li>• Current partial improvements: Partial heating with air conditioners Partial replacement of lamps with LED ones</li> </ul>
Total primary energy consumption:	160,1 kWh/m <sup>2</sup>
Total primary non-renewable energy consumption:	136,6 kWh/m <sup>2</sup>



# ROADMAP

## BUILDING RENOVATION

### GENERAL BUILDING DATA

Final energy consumption by sources:	<ul style="list-style-type: none"> <li>· Electrical energy: 108,857 kWh/year; 22.4 kWh/m<sup>2</sup></li> <li>· Natural gas: 375,998 kWh/year; 77.4 kWh/m<sup>2</sup></li> <li>· Solar thermal: 20,595 kWh/year; 4.23 kWh/m<sup>2</sup></li> <li>· Solar electric: 30,375 kWh/year; 6.25 kWh/m<sup>2</sup></li> </ul> Energy with outside air: 41,357 kWh/year; 8.5 kWh/m <sup>2</sup>
Annual energy costs:	105,871 BGN/year
CO <sub>2</sub> emissions:	27.9 kgCO <sub>2</sub> /m <sup>2</sup> year 

### BUILDING RENOVATION STEPS

#### Current status


Energy class:	<b>B</b>
Implemented measures:	Implemented measures: PV installation with a capacity of 25 kWp for own needs; Replaced windows and partial internal thermal insulation - compromising performance; Solar thermal installation for DHW; Partial heating with air-to-air heat pumps; Partial replacement of lamps with LED ones; Energy sources: Natural gas, Electricity; Solar energy – thermal and electric; Energy from the environment (outdoor air)
Total annual final energy consumption:	<b>118,7 kWh/m<sup>2</sup></b>
CO <sub>2</sub> emissions:	27,9 kg/m <sup>2</sup>
Energy costs:	<b>105 871 BGN/year.</b>

# ROADMAP

## BUILDING RENOVATION

### BUILDING RENOVATION STEPS

#### Step 1

Energy class :	<b>A</b>
Implementation period	until 2030
 Recommended energy-saving measures:	External thermal insulation of walls; Thermal insulation of the flat roof; Thermal insulation of the basement ceiling
Investment costs:	606,834 BGN
Additional maintenance costs:	0 BGN
Energy sources:	Natural gas, Electricity; Solar energy – thermal and electric; Energy from the environment (outdoor air)
Total annual final energy consumption:	<b>47,6 kWh/m<sup>2</sup></b>
CO <sub>2</sub> emissions:	15,1 kg/m <sup>2</sup>
Energy costs:	<b>57,401 BGN/m<sup>2</sup></b>

#### Step 2

Клас на енергопотребление:	<b>A</b>
Implementation period	until 2040
Recommended energy-saving measures:	Installation of LED lighting; Ventilation with heat recovery; Heat pump with natural refrigerant for heating and cooling
Investment costs:	415,200 BGN
Additional maintenance costs:	1500 BGN/year (heat pump maintenance and refrigerant refilling, filter replacement and ventilation system inspection)
Energy sources:	Electricity; Solar energy – thermal and electrical; Energy from the environment (outdoor air)
Total annual final energy consumption:	<b>47,4 kWh/m<sup>2</sup></b>
CO <sub>2</sub> emissions:	9,3 kg/m <sup>2</sup>
Energy costs:	<b>44,980 BGN/year.</b>

## DESCRIPTION OF THE BUILDING RENOVATION STEPS

### Measure 1: External thermal insulation of walls

Installation of new thermal insulation made of EPS or mineral wool with a thickness of 12 cm and a thermal conductivity coefficient  $\lambda \leq 0.036$  W/mK. The insulation is applied using construction adhesive on a cement or polyurethane base and reinforced with plastic dowels with nails. A reinforced putty layer is applied on the outer side, finished with silicone plaster. After installation, the thermal transmittance (U-value) of the walls should not exceed 0.26 W/m<sup>2</sup>K. For external walls below elevation  $\pm 0.00$  and those in close contact with the ground, XPS insulation with a thickness of 10 cm and  $\lambda \leq 0.035$  W/mK is used. It is installed using the same method and finished with a protective layer suitable for ensuring the durability of the plinth.

Investment costs: 307,350 BGN.

### Measure 2: Thermal insulation of the flat roofs

Thermal insulation will be installed on the roofs using XPS or mineral wool with a thermal conductivity coefficient  $\lambda \leq 0.035$  W/mK and a thickness of 20 cm (subject to the load-bearing capacity of the roof structure allowing for the additional weight). A new bitumen waterproofing membrane with mineral granules or a polymer waterproofing membrane will also be installed. The activities include surface preparation for insulation, supply and installation of the thermal insulation (EPS), application of adhesives, fixing elements, joint sealing, and installation of the new waterproofing layer. The investment also includes the disassembly and reinstallation of existing photovoltaic panels on the roofs, adjustment of parapets, and installation of new flashing along the roof perimeter that also covers the wall insulation. Old coping elements will be removed and replaced, and new gutters will be installed. Implementation of this measure requires a detailed design, with particular attention paid to reducing thermal bridging at the connection between the roof and exterior walls. The U-value of the roof after implementation should not exceed 0.25 W/m<sup>2</sup>K.

Investment costs: 228,420 BGN.

### Measure 3: Thermal insulation on the basement ceiling

Thermal insulation will be applied to the basement ceiling using 10 cm thick laminated mineral wool with a thermal conductivity coefficient  $\lambda \leq 0.036$  W/mK. The insulation will be installed by adhering it with construction adhesive on a cement or polyurethane base and reinforced with plastic dowels with nails. For floors exposed to external air, the U-value after insulation should not exceed 0.30 W/m<sup>2</sup>K.

Investment costs: 71,064 BGN.

### Required administrative and legal procedures and documents:

- Preparation of application documentation for funding in accordance with the Guidelines for Application of the Regional Development Program, Priority 2 "Integrated Territorial Development of the Regions", Procedure "Support for Integrated Urban Development in 40 Urban Municipalities" in line with the energy audit of the building / submission of a funding request to EERSF, NTEF or commercial bank together with the documentation from the energy audit of the building / development of an energy performance contract with ESCO.
- Signing a contract with the financing institution / ESCO.
- Assignment of a designer opinion regarding the admissibility of loading the roof slab in connection with the implementation of Measure 4.
- Preparation of tender documentation in accordance with the energy audit of the building and conducting public procurement procedures for selecting: a designer for the energy renovation; a contractor for the construction and installation works and a company for construction supervision (not applicable if ESCO is contracted).
- Conclusion of contracts: for energy renovation design; construction and installation works; construction supervision (not applicable if ESCO is contracted).
- Acceptance of project design documentation.
- Appointment of an investor supervision representative.
- Appointment of an acceptance committee for the construction works.
- Signing of acts of acceptance of construction and civil engineering works.

## DESCRIPTION OF THE BUILDING RENOVATION STEPS

Total investment costs:	606 834 BGN
Additional maintenance costs:	0 BGN
Sources of funding:	Regional Development Program, Priority 2 "Integrated Territorial Development of the Regions", Procedure "Support for Integrated Urban Development in 40 Urban Municipalities" / Energy Efficiency and Renewable Sources Fund (EERF) / National Trust Ecofund (NTEF) / ESCO / Commercial bank loan / Own funds
Non-renewable energy sources:	Natural gas, Electricity
Renewable energy sources:	Solar energy – thermal; Solar energy – electricity from PV; Environment (outdoor air)
Total primary energy consumption:	90,4 kWh/m <sup>2</sup> 
Total primary non-renewable energy consumption:	72,7 kWh/m <sup>2</sup>
Final energy consumption by sources:	<ul style="list-style-type: none"> <li>• Electricity: 96,846 kWh/year; 19.9 kWh/m<sup>2</sup></li> <li>• Natural gas: 118,618 kWh/year; 24.4 kWh/m<sup>2</sup></li> <li>• Solar thermal: 20,595 kWh/year; 4.2 kWh/m<sup>2</sup></li> <li>• Solar electric: 30,375 kWh/year; 6.3 kWh/m<sup>2</sup></li> <li>• Absorbed energy from outside air: 15,657 kWh/year; 3.2 kWh/m<sup>2</sup></li> </ul> 
Annual energy costs:	<b>57,401 BGN/year</b>
CO2 emissions:	15.1 kg /m <sup>2</sup>
Energy class:	<b>A</b>
Additional benefits:	Improved thermal comfort in the building; Improved presence of the building in the urban environment
Monitoring and verification:	<ul style="list-style-type: none"> <li>• The following values are measured and archived: <ul style="list-style-type: none"> <li>- Indoor temperature in the building (daily, three times)</li> <li>- Outdoor temperature (daily, three times and determination of daily average value)</li> <li>- Total monthly and annual electricity consumption, kWh (once a week, at regular intervals, from the commercial electricity meter (Smart meter in the future))</li> <li>• During the heating seasons, an "Energy-Temperature" curve shall be drawn (similar to the one found in the Energy Performance Certificate). If the weekly data point significantly deviates from the average curve, consultation with energy auditors should be sought.</li> </ul> </li> </ul> <p>Once a year, on the same date, the annual consumption of natural gas and electricity should be compared to the baseline values from Step 1. In case of significant deviations, an energy auditor should be consulted. One year after implementing the measures an energy audit to be conducted, and an up-to-date EPC to be issued.</p>

## DESCRIPTION OF THE BUILDING RENOVATION STEPS

### Measure 1: Natural refrigerant heat pump

The installation of an air-to-water heat pump system is proposed, with a nominal cooling capacity of  $Q_{cool} \geq 250$  kW using a 40% glycol-water solution as the refrigerant, with operating parameters of 5/10 °C (ambient temperature 35 °C), and a nominal heating capacity of  $Q_{heat} \geq 200$  kW with a 40% glycol-water solution as the heat carrier, with parameters of 40/45 °C (ambient temperature -12 °C). The system is designed to operate with a high SCOP > 4 (kWh/kWh). Additionally, the heating system will be reworked, including the flushing and replacement of the radiators with two-pipe fan coil units.

Investment costs: 295,000 BGN.

### Measure 2: Installing mechanical ventilation with heat recovery

To ventilate the premises, one or more heat recovery ventilation systems will be installed, with a minimum heat recovery efficiency of 75%. The ventilation system should have a total airflow capacity of 7,500 m<sup>3</sup>/h under normal operating conditions, with the option for bypass, EC (electronically commutated) fans, and control of the building's systems. The system should include filter sections for both supply and exhaust air before the heat exchanger. The ventilation system will be equipped with sound attenuators, flexible connections at the points of attachment to the ventilation unit, and insulated ductwork between the ventilation unit and the hall, as well as for the supply air ducts. External grilles will be equipped with insect protection.

Investment costs: 109,000 BGN.

### Measure 3: Installing LED lamps

It is recommended to replace the existing lighting throughout the building with LED lighting, and to implement a lighting control system that includes light sensors and time-based control based on the building's operating hours.

Investment costs: 19,000 BGN.

### Required administrative and legal procedures and documents:

- Preparation of documentation in accordance with the application guidelines of the funding program or the requirements of another suitable financial institution, and in line with the documentation from the building's energy audit.
- Signing a contract with the funding institution.
- Preparation of tender documentation in accordance with the building's energy audit and conducting public procurement to select: A contractor for designing the implementation of the measures; A contractor for construction and installation works; A selection of construction supervision.
- Signing contracts for: Design of the implementation of the measures; Construction and installation works; Construction supervision.
- Acceptance of the project documentation for the implementation of the measures.
- Appointment of investor supervision.
- Appointment of an acceptance commission for construction and installation works.
- Signing acceptance certificates for the completion of construction and installation works.



## DESCRIPTION OF THE BUILDING RENOVATION STEPS

Total investment costs:	423,000 BGN.
Additional maintenance costs:	1500 BGN/year. Inspection, cleaning and refilling of the heat pump with refrigerant; Filter replacement and inspection of the ventilation system.
Sources of funding:	Conduct a study of possible sources of funding in the year before the implementation date of the step.
Non-renewable energy sources:	Natural gas; Electricity
Renewable energy sources:	Absorbed energy from the outdoor air
Total primary energy consumption:	94,1 kWh/m <sup>2</sup>
Total primary non-renewable energy consumption:	55,4 kWh/m <sup>2</sup>
Final energy consumption by sources:	<ul style="list-style-type: none"> <li>• Electricity: 117,136 kWh; 24.1 kWh/m<sup>2</sup></li> <li>• Absorbed energy from outside air: 94,205 kWh; 19.4 kWh/m<sup>2</sup></li> <li>• Solar thermal: 20,595 kWh/year; 4.23 kWh/m<sup>2</sup></li> <li>• Solar electric: 30,375 kWh/year; 6.25 kWh/m<sup>2</sup></li> </ul>
Annual energy costs	<b>44 980 BGN/year</b>
CO <sub>2</sub> emissions:	11,7 kg/m <sup>2</sup>
Energy class:	<b>A</b> 
Additional benefits:	Improving air quality in the building; Improving lighting; Improving thermal comfort in summer
Monitoring and verification:	<ul style="list-style-type: none"> <li>• The following values are measured and archived: <ul style="list-style-type: none"> <li>- Indoor temperature in the building (daily, three times)</li> <li>- Outdoor temperature (daily, three times and determination of daily and weekly average values)</li> <li>- Total weekly, monthly and annual natural gas consumption, kWh (from the commercial gas meter)</li> <li>- Total monthly and annual electricity consumption, kWh (from the commercial meter)</li> <li>- All data from the heat pump monitoring system.</li> <li>- Data on produced and consumed photovoltaic energy, kWh <ul style="list-style-type: none"> <li>• For the heating seasons, an "Energy-Temperature" curve (similar to the one in the energy performance certificate) is drawn based on the heat pump and natural gas energy consumption and the outdoor temperature. If the weekly point deviates significantly from the average curve, consult HVAC specialists.</li> <li>• Once a year, on the same date, a comparison of the annual consumption of natural gas and electricity is made against the values for Step 2. If there are significant deviations, consultation with an energy auditor is sought.</li> <li>• One year after implementing the measures an energy audit to be conducted, and an up-to-date EPC to be issued.</li> </ul> </li> </ul> </li> </ul>