

Roadmap for Building Renovation. “Yordan Petrov-Grafa” Sports Hall

OUR-CEE

Overcoming Underperforming Renovations in Central and Eastern Europe

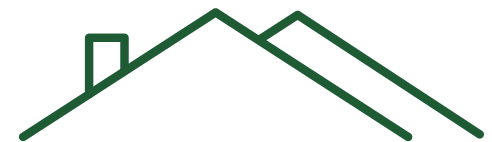
ROADMAP

BUILDING RENOVATION

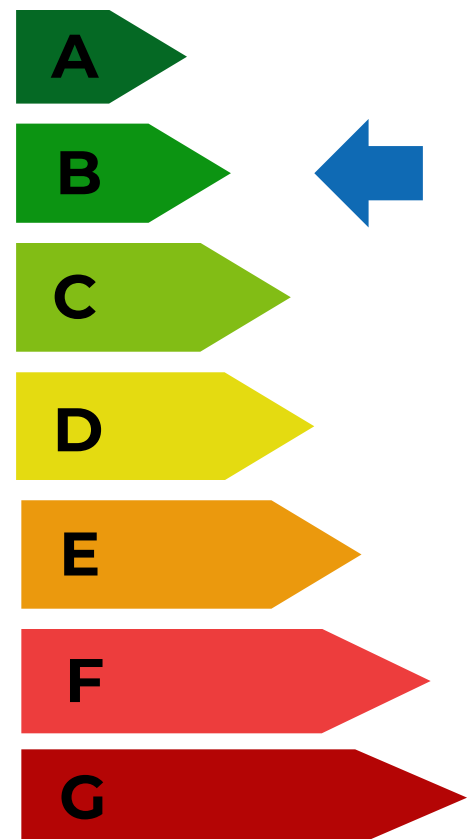
Building name:	"Yordan Petrov-Grafa" Sports Hall
Address:	Pavlikeni town, Rakovski Blvd. No. 2

GENERAL BUILDING DATA

Building type:	Multifunctional sports hall
Year of construction:	1977
Total built-up area:	2085 m ²
Occupancy schedule:	Monday-Sunday, 12 hours/day
Non-renewable energy sources:	Natural gas, Electricity
Renewable energy sources:	Environment (outdoor air)
Previous renovation measures:	<ul style="list-style-type: none"> Photovoltaic installation, 108 kWp (the energy produced is used in another building) (2024) Random partial improvements: <ul style="list-style-type: none"> Partial heating with air conditioners Partial replacement of lighting with LED fixtures– 22 pcs.
Total primary energy consumption:	337,60 kWh/m ²
Total primary non-renewable energy consumption:	292,05 kWh/m ²
Final energy consumption by sources:	<ul style="list-style-type: none"> Natural gas: 285,078 kWh/year; 136.7 kWh/m² Electricity: 128,404 kWh/year 61.6 kWh/m² Absorbed energy from outdoor air: 69,304 kWh; 33.2 kWh/m²



ENERGY CLASS:



Annual energy costs:	87,720 BGN/year.
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CO₂ emissions:

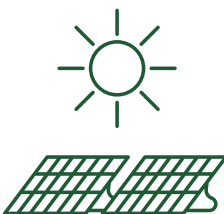
60.0 kg
CO₂/m²year

ROADMAP

BUILDING RENOVATION

BUILDING RENOVATION STEPS

Current status

Energy class:	B
Implemented energy-saving measures:	<p>Photovoltaic installation with a capacity of 108 kWp (the energy produced is used in another building); Partial heating with air-to-air heat pumps; Partial replacement of lighting with LED fixtures- 22 pcs.</p> 
Energy sources:	Природен газ, Електрическа енергия; От околната среда (външен въздух)
Total annual final energy consumption:	219,12 kWh/m²
CO ₂ emissions:	60 kg/m ²
Energy costs:	87,720 BGN/year.

Step 1

Energy class:	A
Implementation period:	As soon as possible
Recommended energy-saving measures:	Replacement of window glazing; Replacement of windows and doors; External thermal insulation of walls; Thermal insulation of the flat roof of the lower part of the building.
Investment costs:	500,388 BGN
Additional maintenance costs:	0 BGN
Energy sources:	Natural gas, Electricity; Energy from the environment (outdoor air)
Final energy consumption:	133 kWh/m²
CO ₂ emissions:	38 kg/m ²
Energy costs:	57 527 BGN/m²

ROADMAP

BUILDING RENOVATION

BUILDING RENOVATION STEPS

Step 2

Energy class:	A
Implementation period:	until 2040
Recommended energy-saving measures:	Thermal insulation of the attic floor; Installation of mechanical ventilation with heat recovery; Installation of LED lamps.
Investment costs:	296 115 BGN
Additional maintenance costs:	1500 BGN/year (inspection and filter replacement)
Energy sources:	Natural gas, Electricity; Energy from the environment (outdoor air)
Total annual final energy consumption:	87 kWh/m²
CO ₂ emissions:	26 kg/m ²
Energy costs:	26,273 BGN/year.

Step 3

Energy class:	A
Implementation period:	until 2050
Recommended energy-saving measures:	Sequence of operation in case of different DHW generators; Air-to-water heat pump; Photovoltaic installation.
Investment costs:	318 150 BGN
Additional maintenance costs:	500 BGN/year (inspection and cleaning, refilling with refrigerant)
Energy sources:	Natural gas, Electricity; Energy from the environment (outdoor air)
Total annual final energy consumption:	84 kWh/m²
CO ₂ emissions:	17 kg/m ²
Energy costs:	23,980 BGN/year.

DESCRIPTION OF THE BUILDING RENOVATION STEPS

Measure 1: Replacing the window glazing

Replacement of the existing double-glazed units in already installed PVC and aluminum window frames with new double-glazed units featuring one low-emissivity (low-E) coating and argon gas filling. The existing double-glazed units will be dismantled and replaced with new ones with a U-value $\leq 1.4 \text{ W/m}^2\text{K}$.

Investment costs: 12,600 BGN.



Measure 2: Replacement of windows and doors

Replacement of all metal doors, windows with metal frames and single glazing, and the existing roller door, in accordance with the following requirements: Windows will be replaced with aluminium frames fitted with double or triple glazed units, including one pane with a selective "four seasons" coating to ensure optimal thermal performance in summer and protection against overheating in winter. Warm edge spacers will be used. The U-value for the complete unit (frame, glazing, and spacer) will be $\leq 1.5 \text{ W/m}^2\text{K}$; The metal door will be replaced with a thermally insulated metal door with a U-value of $\leq 2.0 \text{ W/m}^2\text{K}$; The roller door will be replaced with a sectional door with thermal insulation and a U-value of $\leq 2.0 \text{ W/m}^2\text{K}$.

Investment costs: 143,706 BGN.

Measure 3: External thermal insulation of walls

Thermal insulation with EPS or mineral wool, 15 cm thick (area: 1,291 m²), with a thermal conductivity $\lambda \leq 0.036 \text{ W/mK}$, will be applied. The insulation will be fixed using cement- or polyurethane-based construction adhesive and reinforced with plastic dowels with nails. On the exterior side, a reinforced plaster layer will be applied and finished with silicone render. Upon completion, the U-value will be $\leq 0.20 \text{ W/m}^2\text{K}$. For external walls below ± 0.00 elevation and those in contact with the ground, XPS insulation with a thickness of 12 cm (area: 155 m²) and a $\lambda \leq 0.035 \text{ W/mK}$ will be used. It will be applied in the same manner and finished with a base-layer-appropriate render to ensure durability. Upon completion, the U-value will be $\leq 0.24 \text{ W/m}^2\text{K}$. The investment includes the cost of materials and labour for façade preparation before insulation (including removal of damaged plaster), temporary removal and reinstallation of gutters, lamps, air conditioning units and brackets, as well as other elements attached to the façade. It also includes the application of thermal insulation, exterior plastering, scaffolding installation, and disposal of construction waste.

Investment costs: 227,010 BGN.

Measure 4: Thermal insulation of the flat roof of the lower part of the building

Thermal insulation of the roof over the lower section of the building (area: 622 m²) will be installed using XPS or mineral wool with $\lambda \leq 0.035 \text{ W/mK}$ and a thickness of 20 cm (subject to verification that the roof structure can bear the additional load). A new bitumen waterproofing layer with a mineral-surfaced finish or a polymer-based waterproofing membrane will also be applied. The scope of work includes surface preparation for insulation, delivery and installation of the thermal insulation, application of adhesives, mechanical fasteners, joint sealing, and installation of the new waterproofing layer. Additional works include the dismantling and reinstallation of photovoltaic panels, parapet detailing and new metal flashing around the roof perimeter (covering also the wall insulation), removal and replacement of old parapet caps, and installation of new gutters. The implementation of this measure requires design work, with particular attention to reducing thermal bridges at the roof-to-wall connection. Upon completion, the U-value of the roof shall be $\leq 0.19 \text{ W/m}^2\text{K}$.

Investment costs: 117,072 BGN.

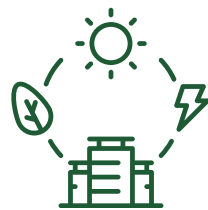
DESCRIPTION OF THE BUILDING RENOVATION STEPS

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.

Total investment costs:	500 388 BGN
Sources of funding:	Rural Development Program, Energy Efficiency Procedure – "Reconstruction, repair, equipment and/or furnishing of municipal buildings in which public services are provided, in order to improve their energy efficiency" / 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:	Absorbed energy from the environment – outdoor air
Total primary energy consumption:	207,8 kWh/m ²
Total primary non-renewable energy consumption:	185,6 kWh/m ²
Final energy consumption by sources:	<ul style="list-style-type: none"> • Natural gas: 155,951 kWh/year; 74.8 kWh/m² • Electricity: 93,627 kWh/year; 44.9 kWh/m² • Absorbed energy from outdoor air: 27,572 kWh; 13.2 kWh/m²
Annual energy costs:	57,527 BGN/year.
CO ₂ emissions:	38,3 kg/m ²

<p>Energy class:</p>	<p>A</p>
<p>Additional benefits:</p>	<p>Improved thermal comfort in the building; Improved presence of the building in the urban environment; Potential increase in attendance.</p>
<p>Monitoring and verification:</p>	<ul style="list-style-type: none"> • The following values are measured and archived: <ul style="list-style-type: none"> - Indoor temperature in the building (daily, three times) - Outdoor temperature (daily, three times and determination of daily and weekly average values) - Total weekly, monthly and annual natural gas consumption, kWh (from the commercial meter (smart meter in the future)) - Total monthly and annual electricity consumption, kWh (from the commercial meter (smart meter in the future)) • 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. • 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 1. In case of significant deviations, consultation with an energy auditor is sought. <p>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: Thermal insulation of the sports hall ceiling

The existing suspended ceiling in the hall will be dismantled and replaced with a new one (area: 945 m²), featuring an impact-resistant and sound-absorbing layer. The supporting structure will be either modified or newly constructed. A vapor barrier membrane will be installed between the structure and the new suspended ceiling, sealed with adhesive tape. A 10 cm layer of mineral wool thermal insulation ($\lambda \leq 0.036$ W/m·K) will be placed directly above the membrane. If necessary, a vapor-permeable membrane will be applied above the insulation layer. Ventilation will be provided to allow moisture to escape from the air cavity above the ceiling—either through wall openings or another suitable method. The implementation of this measure requires detailed design work.

Investment costs: 130 410 BGN

Measure 2: Installing mechanical ventilation with heat recovery

A ventilation unit with an airflow capacity of 7,000 m³/h will be installed to provide ventilation and heating for the hall. The unit will include a high-efficiency heat recovery system (either a counterflow or rotary heat exchanger) with a minimum efficiency of 75%, and a bypass option. It will be equipped with EC (electronically commutated) fans, an air recirculation system for the hall, a heating section connected to the building's central heating system, and integration with the building management system. Filter sections will be installed on both the supply and exhaust air before the heat exchanger. Air will be supplied through ceiling-mounted ducts and diffusers directed toward the playing area, while exhaust air will be extracted from both sides of the hall at ceiling level. The ventilation system will include silencers and flexible connectors at the connection points with the ventilation unit. The supply air duct between the ventilation unit and the hall will be thermally insulated. External grilles will be equipped with insect screens.

Investment costs: 79,200 BGN.

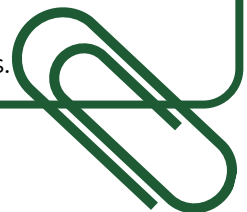
Measure 3: Installing LED lamps

All lighting in the building will be replaced with LED fixtures. In the corridors, lighting will be controlled by motion sensors, while in offices and training rooms, it will be operated by standard switches. It is also recommended that the lighting in the main hall be replaced with LED fixtures. The implementation of this measure requires detailed design work.


Investment costs: 38,109 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:	247 719 лв.
Additional maintenance costs:	1500 BGN/year. Inspection and replacement of filters of the mechanical ventilation system – once a year.
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:	152,8 kWh/m ²
Total primary non-renewable energy consumption:	132,0 kWh/m ²
Final energy consumption by sources:	<ul style="list-style-type: none"> • Natural gas: 83,524 kWh; 40.1 kWh/m² • Electricity: 79,683 kWh; 38.2 kWh/m² • Absorbed energy from outdoor air: 27,572 kWh; 13.2 kWh/m²
Annual energy costs:	42,862 BGN/year.
CO ₂ emissions:	27,4 kg/m ² 
Energy class:	A
Additional benefits:	Improving the air quality in the sports hall. Improving the lighting in the hall and other rooms. Strengthening the ceiling of the hall against damage from ball impacts.
Monitoring and verification:	<ul style="list-style-type: none"> • The following values are measured and archived: <ul style="list-style-type: none"> - Indoor temperature in the building (daily, three times) - Outdoor temperature (daily, three times and determination of daily and weekly average values) - Total weekly, monthly and annual natural gas consumption, kWh (from the commercial meter (smart meter in the future)) - Total monthly and annual electricity consumption, kWh (from the commercial appliance (smart appliance in the future)) • 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 HVAC specialists should be sought. • 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. In case of significant deviations, consultation with an energy auditor is sought. • One year after implementing the measures an energy audit to be conducted, and an up-to-date EPC to be issued.

DESCRIPTION OF THE BUILDING RENOVATION STEPS

Measure 1: Hot water production and heat recovery from the water of the showers

Two storage water heaters with built-in heat exchangers will be installed on level (-1), positioned as close as possible to the shower areas to eliminate the need for a recirculation pump during shower use.

Depending on the room capacity and required volume, one or two heaters will be installed. They will be connected to the central heating system via heat exchanger coils and equipped with electric heating elements. The system will be integrated with the building's centralized control system. Additionally, a shower water heat recovery unit will be installed on level (-1). This passive system will be located one floor below the locker room showers. Wastewater from the floor drains will pass through the heat recovery unit, transferring heat to the cold water supply feeding the water heaters. The implementation of this measure requires detailed design work.

Investment costs: 16,300 BGN.

Measure 2: Air-to-water heat pump

An air-to-water heat pump unit, or a cascade of heat pump units, with a total heating capacity of no less than 150 kW will be installed to provide heating for the main hall and adjacent spaces. The heat pump system will be supported by the existing gas boiler during colder periods. The hybrid system will require modifications to the boiler room, connecting both systems in parallel. The heat pump will operate when the outdoor temperature is above 0–5°C, after which the boiler will activate to assist. The system will operate with a lower temperature heating medium to maximize the efficiency of the heat pump—ideally maintaining a supply temperature not exceeding 45–50°C. To ensure efficient operation, existing radiators will be replaced with fan coil units, which can also be used for cooling during warmer months. In areas where no heating system currently exists or the existing one is non-functional (e.g., in the hall), a new heating installation will be constructed for instance, bench heating that is only activated during events with spectators. Where the current heating system does not function optimally, it will also be upgraded or modified as needed. The heating system will serve all usable areas of the building and will be divided into several independent zones to allow for more efficient and economical operation: Heating for the main hall; Heating for the hall's ventilation system;

Boxing/functional training room; Fitness room; Table tennis room (if not currently in use, only a connection outlet will be provided for future upgrades); Administrative block; Locker rooms and entrance foyer. Final technical decisions, including the exact layout and specifications of the system, will be made during the design phase, and changes may be made from the parameters described above. However, the following criteria must be met: A minimum seasonal coefficient of performance (SCOP) of ≥ 4.0 W/W. Zoning of the building for easier and more economical system management.

Investment costs: 308,550 BGN.

Measure 3: Photovoltaic installation

A shared photovoltaic installation is located on the roofs of the sports hall and swimming pool. The system is connected solely to the pool's electricity meter, with any excess electricity being sold. If the electricity meters of the two buildings are combined, the unused electricity from the pool can be utilized by the sports hall - for heating water for showers, cooling in the summer, and other needs. According to the system's performance data so far, it is possible to use 6,315 kWh per year in the sports hall, which would save approximately 0.10 BGN per kWh, totalling 631.5 BGN per year at current rates.

Investment costs: 8000 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.

DESCRIPTION OF THE BUILDING RENOVATION STEPS

Required administrative and legal procedures and documents:

- 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.

Total investment costs:	336,150 BGN.
Additional maintenance costs:	500 BGN/year. Inspection, cleaning and refilling the heat pump unit with refrigerant
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 surrounding air; Solar energy
Total primary energy consumption:	109,3 kWh/m ²
Total primary consumption of non-renewable energy:	65,9 kWh/m ²
Final energy consumption by sources:	<ul style="list-style-type: none"> • Natural gas: 44,857 kWh; 21.5 kWh/m² • Electricity: 38,246 kWh; 18.3 kWh/m² • Absorbed energy from outside air: 76,643 kWh; 36.76 kWh/m² • Photovoltaic energy: 3.0 kWh; 6,315 kWh/m²
Annual energy costs:	21,164 BGN/year.
CO ₂ emissions:	14 kg/m ² 
Energy class:	A
Additional benefits:	Modernization of the building.
Monitoring and verification:	<ul style="list-style-type: none"> • The following values are measured and archived: <ul style="list-style-type: none"> - Indoor temperature in the building (daily, three times) - Outdoor temperature (daily, three times and determination of daily and weekly average values) - Total weekly, monthly and annual natural gas consumption, kWh (from the commercial appliance) - Total monthly and annual electricity consumption, kWh (from the commercial appliance) - All data from the heat pump monitoring system. - Data on produced and consumed photovoltaic energy, kWh <ul style="list-style-type: none"> • 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. • 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 3. In case of significant deviations, consultation with an energy auditor is sought. • One year after implementing the measures an energy audit to be conducted, and an up-to-date EPC to be issued.