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FEASIBILITY STUDY FOR PHOTOVOLTAIC INSTALLATIONS AT SELECTED SITES WITHIN THE MUNICIPALITY OF RACIECHOWICE

Implementation site

Raciechowice
Municipality
(Poland)

Target sector

Public buildings

Goal

Energy efficiency
improvement

case
study

Municipality name:
Raciechowice



Photovoltaic panels in Raciechowice (PL)

Project objectives

Justification of the Topic and Project Objective:

One of the main challenges faced by the Municipality of Raciechowice — as well as many other municipalities in the Baltic Sea region — is ensuring energy security and financial stability in the face of rising electricity costs and market volatility. In particular, local governments are under increasing pressure to reduce operational expenses, improve energy efficiency, and implement sustainable development policies in line with EU climate goals and national energy and climate plans.

The selected topic of this feasibility study — photovoltaic (PV) installations with energy storage systems—directly addresses these challenges. It enables local renewable energy generation, reduces dependency on external suppliers, and increases control over energy consumption and related costs. Energy storage systems are a key addition to PV installations, allowing for surplus energy to be stored and used during peak demand periods, which increases self-consumption and improves cost efficiency.

For the Municipality of Raciechowice, this project is particularly important due to its rural character, dispersed infrastructure, and limited financial resources. Implementing renewable energy solutions can contribute to improving the quality of life for residents, reducing pollutant emissions, and positioning the region as modern, environmentally responsible, and forward-looking.

Project Objective:

The objective of the project is to analyze the technical, economic, and organizational feasibility of implementing PV installations with energy storage systems within the municipality. The feasibility study aims to:

- identify potential locations and technical conditions for installation,
- evaluate the profitability of the investment and possible funding sources,
- propose a management and operation model for the systems,
- assess the environmental and social impacts of the project.

Regional Importance

The findings of this study may be applicable to other municipalities in the Baltic Sea region with similar demographic and economic profiles. The project aligns with broader climate neutrality efforts and may serve as a model solution supporting local energy transition, enhancing community resilience to energy crises, and fostering cooperation between municipalities in the region.

Feasibility Study for Five Public Utility Facilities in the Municipality of Raciechowice

The feasibility study has been developed for five public utility facilities located in the Municipality of Raciechowice, including:

- the Wastewater Treatment Plant located in the village of Raciechowice – plot no. 543/47 Raciechowice,
- and the following water pumping stations:
- Water Pumping Station Raciechowice APS – plot no. 180/1 Raciechowice,
- Water Pumping Station "Komorniki" – plot no. 530/2 Raciechowice,
- Water Pumping Station Gruszów – plot no. 112/2 Gruszów,
- Water Pumping Station Sosnowa – plot no. 82/2 Raciechowice.

The feasibility study includes the following activities:

- analysis of the energy demand of the facilities,
- assessment of the technical feasibility of PV installation,
- location analysis with respect to solar exposure, shading, and spatial conditions,
- simulation of energy production and potential savings,
- economic analysis (simple payback period),
- analysis of potential funding sources (e.g., EU funds, national programs),
- recommendations on the optimal installation variant.

Implementation

Contemporary challenges related to the climate crisis, rising energy prices, and the need to improve the energy efficiency of public infrastructure are prompting local governments to seek solutions based on renewable energy sources. Guided by the principle of sustainable development, the Municipality of Raciechowice has undertaken efforts to assess the potential for investing in photovoltaic installations combined with energy storage systems, which could supply power to public utility facilities and other designated locations within the municipality.

The municipality benefits from favorable conditions for the use of solar energy – both in terms of solar radiation levels and the availability of rooftop and ground space suitable for PV system installation. The local authorities see the development of renewable energy as an opportunity not only to reduce energy consumption costs in the public sector, but also to increase energy independence and minimize the municipality's negative impact on the environment.

This project also responds to the objectives set out in local strategic documents, such as the Low-Emission Economy Plan and the Development Strategy of the Municipality of Raciechowice, which call for the implementation of environmentally friendly and energy-efficient solutions. Moreover, the initiative aligns with national and EU energy and climate policy directions, which emphasize a significant increase in the share of RES in the energy mix and the development of decentralized energy systems.

As part of this feasibility study, the technical, financial, and organizational feasibility of the investment will be analyzed. The project may, in the future, serve as a model solution for other local governments and contribute positively to the image of Raciechowice as a modern, environmentally friendly, and energy self-sufficient municipality.

Result and Benefits

Taking the above into account, the main issue that the proposed investment aims to address is the low energy efficiency of the region due to continued reliance on traditional energy sources.

The specific problems targeted by the project include:

- air pollution caused by the use of outdated and environmentally unfriendly technologies in the region's energy generation sector,
- the use of energy-intensive and non-renewable sources in the energy production process,
- low local energy security and significant transmission losses due to a high dependence on external energy supply sources,
- the region's low socio-economic attractiveness, including:
 - a continuing decline in local government revenues,
 - low public awareness of energy-saving opportunities and the availability of alternative energy sources,
 - limited regional activity in investing in modern green technologies, particularly in the field of energy.

Parameter	Plot 559/2 Raciechowice	Plot 82/2 Raciechowice	Plot 212/2 Gruszów	Plot 530/2 Raciechowice	Plot 180/1 Raciechowice
PV system capacity [kWp]	40.59 kWp	14.76 kWp	14.76 kWp	11.7 kWp	11.7 kWp
Annual energy production [MWh/year]	34.55	13.723	12.797	5.465	5.964
Self-consumption [MWh/year]	17.76	6.614	5.157	2.85	4.427
Energy exported to grid [MWh/year]	16.78	7.109	7.64	2.616	1.537
Energy imported from grid [MWh/year]	25.25	12.175	8.712	8.421	16.942
Building electricity demand [MWh/year]	43.015	18.789	13.869	11.271	21.369

Parameter	Plot 559/2 Raciechowice	Plot 82/2 Raciechowice	Plot 212/2 Gruszów	Plot 530/2 Raciechowice	Plot 180/1 Raciechowice
Cost of grid electricity (after self-consumption & sales revenue) [PLN/year]	21,457	9,702	6,600	6,348	48,436
Cost of grid electricity without PV installation [PLN/year]	36,930.09	16,131.1	12,028.14	9,676.6	64,733.57
Installation price [PLN gross]	132,000	53,000	53,000	42,000	42,000

Estimated Cost Analysis of Photovoltaic Installation

The table below presents the estimated costs of installing photovoltaic systems on the indicated plots. Prices are provided in two variants:

- **Without energy storage** – a standard photovoltaic installation that exports surplus generated electricity to the power grid.
- **With energy storage** – an extended installation equipped with an energy storage system, enabling increased self-consumption and ensuring electricity availability during power outages.

All prices include VAT (gross). Costs may vary depending on on-site technical conditions, roof type, distance to the grid connection point, and the components used.

Summary of Estimated Photovoltaic Installation Costs

	Plot 559/2	Plot 82/2	Plot 212/2	Plot 180/1	Plot 530/2
Estimated price without energy storage (gross)	132,000 PLN	87,000 PLN	87,000 PLN	75,000 PLN	75,000 PLN
Estimated price with energy storage (gross)	165,000 PLN	53,000 PLN	53,000 PLN	42,000 PLN	42,000 PLN

Financial Analysis – Simple Payback Period

The table below presents the estimated payback period for photovoltaic installations located on selected plots, both in the variant without energy storage and with energy storage. The values were determined based on the planned level of self-consumption, grid connection capacity, and the projected costs and energy yields for each location.

For most plots, the use of an energy storage system results in a longer payback period. This is due to the additional investment costs, which are not always fully offset by the increase in self-consumption.

Profit and Loss Account / Energy and Financial Balance

Plot Number	Payback Period (without storage)	Payback Period (with storage)
543/47	~8.5 years	~9.1 years
82/2	~8.2 years	~9.9 years
112/2	~9.8 years	~11.1 years
530/2	~15.9 years	~15.4 years
180/1	~2.6 years	~3.6 years

Analysis of Funding Opportunities

In the face of rising energy costs and obligations resulting from the European Union's climate policy, local government units (LGUs) are increasingly undertaking measures aimed at improving energy efficiency and increasing the share of renewable energy sources in the local energy mix. One of the most перспектививе solutions is photovoltaic installations integrated with energy storage systems, enabling more efficient management of electricity production and consumption in public buildings.

However, the implementation of such investments requires significant financial outlays. Therefore, obtaining support from available funding programs becomes crucial. Under the current European Union financial perspective for 2021–2027, a number of instruments are available to support renewable energy projects, including PV installations with energy storage systems. In addition, national and regional funds are also accessible, from which LGUs may benefit either directly or indirectly (e.g., through municipal companies).

Below is a detailed analysis of the main funding sources available to LGUs, with particular emphasis on the 2021–2027 European Funds.

European Funds 2021 – 2027

a) *European Funds for a Modern Economy (FENG)*

- A program supporting innovative and development-oriented projects, including RES installations with energy storage.
- LGUs may participate indirectly, e.g., through municipal companies.
- Possible support for smart grids, PV installations with storage, and energy management systems.

b) *European Funds for Social and Regional Development (Regional Programs)*

- Each voivodeship has its own operational program (e.g., FERS, European Funds for Mazovia).
- Funding available for RES projects, including PV installations with energy storage for public buildings.
- LGUs apply directly.

National Recovery Plan (KPO)

- Provides support for investments in the energy transition.
- Possible funding for LGUs for RES micro-installations with energy storage and energy management systems.
- Calls for proposals are conducted by national institutions (e.g., BGK, NFOŚiGW).

National Fund for Environmental Protection and Water Management (NFOŚiGW)

- Programs include:
 - “Energy for Rural Areas” – grants and loans for RES projects, including municipal companies.
 - “RES Priority Programs” – support for LGUs and their subordinate units.
- Funding available for the purchase and installation of energy storage systems and PV installations.
- Form of support: grants (up to 50–80%) or preferential loans.

Voivodeship Funds for Environmental Protection and Water Management (WFOŚiGW)

- Local funding programs for LGUs supporting RES installations with energy storage.
- Regional programs differ in details – it is recommended to monitor current calls for proposals on the relevant WFOŚiGW websites.

Government Programs and Other Initiatives

a) Polish Deal – Strategic Investment Program

- LGUs may submit RES projects (including those with energy storage) for funding.
- High probability of covering the majority of costs (grants of up to 95%).

b) "Green Public Transport" Program (for municipalities with public transport systems)

- Possibility of funding RES-powered infrastructure, e.g., PV installations with storage for depots or public utility buildings.

What Can Be Funded?

LGUs may obtain funding for, among others:

- Purchase and installation of photovoltaic systems – PV modules, inverters, mounting structures, installation works.
- Purchase and installation of energy storage systems – batteries and storage management systems.
- Energy Management Systems (EMS) – intelligent control and energy consumption monitoring.
- Modernization of existing RES installations – expansion or replacement of components.
- Construction of grid connections and energy infrastructure – power lines, switchboards, metering systems.
- Energy audits and project documentation – feasibility studies, technical designs.

The level and scope of support depend on the specific program and its conditions.

Recommendations and Guidelines

1. Replacement of Water Pumps

It is recommended to modernize existing water pumps by replacing them with modern, energy-efficient units. This brings measurable technical, economic, and environmental benefits:

1.1. Energy Savings and Lower Operating Costs

Modern pumps feature higher energy efficiency – they require less energy to pump the same volume of water. They are often equipped with variable frequency drives (VFDs/inverters), which automatically adjust power to current demand. This can reduce energy consumption by up to 50% compared to outdated models.

1.2. Greater Reliability and Reduced Risk of Failure

Older units are prone to frequent failures (worn bearings, seals, impellers) and generate higher service costs. New pumps are made of more durable materials (e.g., stainless steel), operate more steadily and predictably, and reduce the risk of downtime and costly repairs.

1.3. Better Adaptation to Water Supply Network Needs

Modern systems allow automatic control of pressure and flow depending on current demand. They help prevent harmful pressure fluctuations in the network and are compatible with inverter-based control systems.

1.4. Lower Maintenance Costs

New pumps require less frequent technical inspections. They are easier to service thanks to modular design and good availability of spare parts.

1.5. Environmental Benefits

Lower energy consumption results in reduced CO₂ emissions. Modern units are quieter, safer, and better protected against leakage of operating substances.

1.6. Remote Monitoring and Supervision Capability

New systems are often integrated with SCADA platforms or remote management applications. They enable real-time monitoring of operating parameters without the need for physical supervision, increasing management efficiency and allowing faster response to irregularities.

2. Removal of Shading from Photovoltaic Installations

It is recommended to remove obstacles casting shadows on existing or planned photovoltaic (PV) installations, such as trees, structural elements, chimneys, or other objects.

2.1. Increased PV System Performance

Shading can significantly reduce panel output (by 30–80%, depending on technology and degree of shading). Removing shading sources improves solar exposure, resulting in higher energy yield.

2.2. Improved Investment Profitability

Better solar exposure leads to higher energy production and a shorter return on investment (ROI). Increased self-consumption translates into tangible financial savings.

2.3. More Stable Power Supply for Infrastructure (e.g., Pumping Stations)

PV energy production can cover a significant portion of pumping station demand, particularly during peak hours. This reduces the risk of overloads and voltage fluctuations when supplied from the grid.

2.4. Reduced Electricity Costs

Higher self-generation means lower electricity consumption from the grid and reduced utility bills. This is particularly important given current rising energy prices.

2.5. Better Access to Funding Opportunities

Efficient photovoltaic installations (without shading issues) have a higher chance of obtaining grants from programs such as “Energy for Rural Areas” or those offered by the National Fund for Environmental Protection and Water Management.

2.6. Increased Durability and Reliability of the PV System

Removing shading reduces uneven heating of cells and thermal losses. It also decreases inverter load, positively affecting the lifespan of the entire system.

Summary

The conducted feasibility study demonstrated that the implementation of an investment project involving the construction of photovoltaic installations with energy storage systems at selected facilities and sites owned by the Gmina Raciechowice is technically feasible, economically viable, and organizationally achievable.

The analyses confirmed that the use of renewable energy sources, particularly photovoltaic systems supported by energy storage, can bring numerous benefits to the municipal government. The most significant advantages include a reduction in electricity costs, improved energy security of public facilities, and a positive impact on the natural environment, while supporting the achievement of local climate objectives.

The investment aligns with the long-term strategies for sustainable development and the region's energy transition. It is recommended to continue the project through further investment planning, including the preparation of detailed technical and financial documentation, as well as securing external funding (e.g., EU funds or national renewable energy support programs).

In conclusion, the project represents a valuable and forward-looking initiative that may significantly contribute to increasing the energy independence of the Gmina Raciechowice and improving the quality of life of its residents.



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