

0 BUSINESS CASE ANALYSIS: SUMMARY

0.1 Importance of energy supply

Every office or residential building must provide living (or working) conditions of a proper quality. Ensuring a certain level of comfort and meeting other demands (e.g. buildings must be equipped with certain installations, hot water, access to data transfer, etc.) requires utilisation of energy. The energy consumption of a building depends on the building itself, installed equipment, as well as the needs, requirements, and behaviour of the users. Excessive energy consumption is reflected in higher costs and creates a negative impact on the environment. Energy audit of a building serves to collect data on the use of certain types of energy for different purposes, and the costs arising from it. At the same time, the energy consumption indicators reveal where the use of energy is higher than in comparable buildings. Possible measures and investment requirement estimates are discussed below

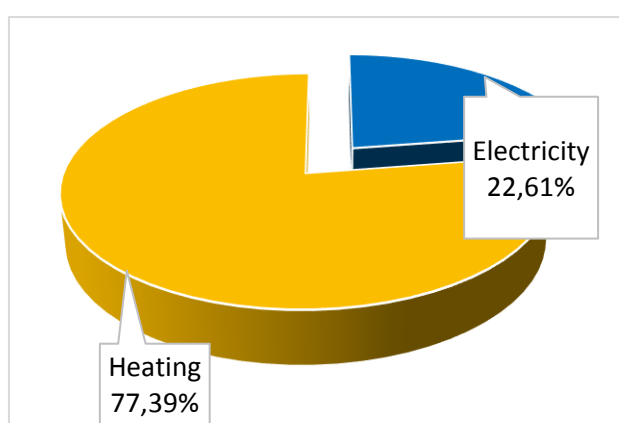
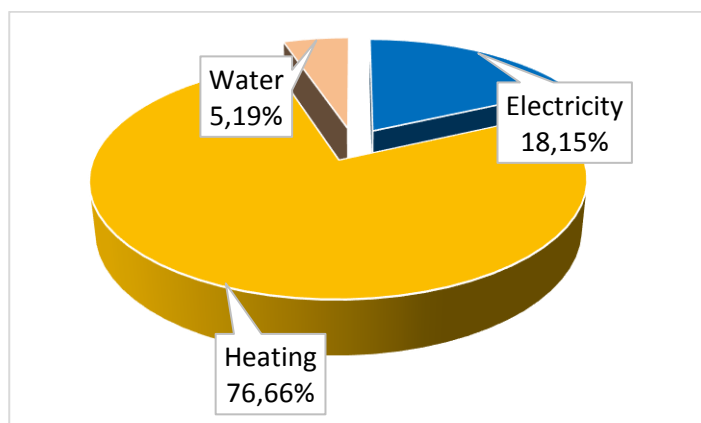
0.2 Consumption and costs of energy and water

The table below lists energy consumption and cost energy products for, as well as CO₂ emissions generated by energy products in 2015. The last column identifies the value of a specific cost of thermal and electric energy. The consumption of heat and electricity is shown in kWh, water consumption is shown in m³.

In 2015, the operation of OŠ Vodmat consumed 85,292 kWh of electricity and 625,570 kWh of thermal energy for space heating (energy product: district heating). In 2015, the water consumption in the building amounted to 1,915 m³.

Table 1: Annual cost and consumption of energy for 2015:

	Consumption	Units	Share [%]	Cost [€]	Share [%]	CO ₂ [kg]	CO ₂ [%]	€/MWh
Electricity	152,857	kWh	16.16	21,315	24.79	85,141	16.16	139.44
Heating	793,040	kWh	83.84	58,860	68.46	441,723	83.84	74.22
Water	4,239	m ³		5,798	6.74			
TOTAL	710,862 1,915	kWh m³		58,660		210,156		



Graph 1: The distribution of costs for energy and water (see left pie chart); CO₂ emissions in 2015 (right pie chart).

The table below lists energy product consumption for 2012–2015. In the given reference period, the electrical energy consumption amounted to 84,382 MWh/year, the thermal energy consumption amounted to 542,760 MWh/year, and the water consumption amounted to 2,083 m³/year.

The conditioned floor area of the building amounts to 3,611 m². The calculated energy rating for heating of the building (standard use) is 173.24 kWh/m², the energy rating for the building's operation (standard use) is 196.84 kWh/m, CO₂ emissions amount to 59.40 kg/m³. The energy rating value exceeds the critical level (240 kWh/m²) and greatly exceeds the recommended values (80 kWh/m²).

Table 2: Consumption of thermal and electric energy for 2012–2015

	Electricity [kWh]	Heating [kWh]	Water [m ³]	Total [kWh]
2012	82,136	608,760	2,230	690,896
2013	84,356	573,060	2,247	657,416
2014	85,743	363,650	1,941	449,393
2015	85,292	625,570	1,915	710,862
Average	84,382	542,760	2,083	627,142

0.3 Potential savings and required investments

0.3.1 Proposed Scenario

The table below displays a summary of individual measures to achieve a better energy efficiency. All measures include a summary. Three scenarios of implementing measures for achieving a better energy efficiency are included into the simplified energy audit:

- Scenario 1 – Implementation of measures with payback period of up to 6 years
- Scenario 2 – Implementation of organisational measures, installation of a targeted monitoring of energy use system, replacement of doors and windows, façade renewal, roof insulation, installation of thermostat valves and hydraulic balance, and renewal of gym lighting (organisational measure 1, investment measures 1, 2, 3, 4, 5, 6)

Table 3: Summary of individual measures

No.	Description of measure	Potential annual savings				Investment €	Payback period [years]
		kWh		€			
		TE	EE	TE	EE		
Organisational measures							
1	Educating users, energy accounting, etc.	31,279	2,557	2,248	305	4,000	1.6
Investment measures							
1	Energy management	37,535	852	2,698	102	12,000	4.3
2	Insulation of the main building and old gymnasium	68,814	0	4,947	0	141,000	28.5
3	Replacement of windows (profiled glass – copelite)	93,837	0	6,745	0	50,500	7.5
4	Roof insulation	75,070	0	5,396	0	108,000	20.0
5	Installation of thermostat valves and hydraulic balance	31,279	0	2,248	0	14,000	6.2
6	Replacement of gym reflectors	0	6,818	0	814	8,000	9.8

Table 4: Summary of measures – Scenario 1

Scenario 1 – implementation of measures with payback period of up to 6 years			% savings on total value
Annual savings in electricity	3,409	kWh	4

Annual savings in heating	68,814	kWh	11
Annual savings in water	/	m ³	/
Total reduction of CO ₂ emissions	19,790	kg	9.4
Total annual reduction in costs	5,353	€	9.1
Total necessary investment	16,000	€	
Average payback period	2.99	years	

The shortest payback period is 2.99 years, namely for the implementation of the organisational measures and energy management.

Table 5: Summary of measures – Scenario 2

Scenario 2 – Implementation of measures: organisational measure 1, investment measures 1, 2, 3, 4, 5, 6			% savings on total value
Annual savings in electricity	3,384	kWh	11.65
Annual savings in heating	272,275	kWh	41.9
Annual savings in water	/	m ³	/
Total reduction of CO ₂ emissions	76,323	kg	35.6
Total annual reduction in costs	20,757	€	35.4
Total necessary investment	337,500	€	
Average payback period	16.3	years	

0.3.2 Proposed Scenario

The proposed Scenario can be defined as:

- A. The optimal scenario, where the anticipated measures include a comprehensive energy retrofit and a harmonised implementation of measures to ensure energy efficiency of the building envelope and the building's technical systems, in order to make full use (if possible) of the economically viable potential for the energy retrofit.
- B. The optimal scenario, where the anticipated measures do not include a comprehensive energy retrofit, in order to make full use (if possible) of the economically viable potential for the energy retrofit.

The measure presented as the optimal measure (A or B, depending on the building) is defined below.

In this case, under item A, Scenario 2 is the optimal scenario; it anticipates implementation of the following measures:

- Installation of a targeted monitoring of energy use system
- Replacement of doors and windows
- Façade insulation
- Roof insulation
- Replacement of gym reflectors
- Installation of thermostat valves and hydraulic balance of heating system

Implementation of these measures will generate savings in thermal energy (heating), and reduce the cost of energy product supply and CO₂ emissions. The table below lists anticipated savings resulting from the implementation of proposed measures in Scenario 2.

Table 5: Effects of proposed Scenario

	Electricity	Heating	Savings	CO ₂ emissions
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	kWh	kWh	[€]	[kg]
Savings	9,931	272,275	20,757	76,323

Total investment cost amounts to € 337,500; payback period amounts to 16.3 years.

0.4 Energy indicators before and after the implementation of measures

In accordance with Energy Act (EZ-1) and Rules on the methodology for the production and issuance of energy performance certificates for buildings, all public buildings must have an energy performance certificate that defines the building's rating (band).

0.4.1 Energy indicators before the implementation of measures

The black arrow indicates the current state of the building. The white arrow denotes recommended values for public buildings.

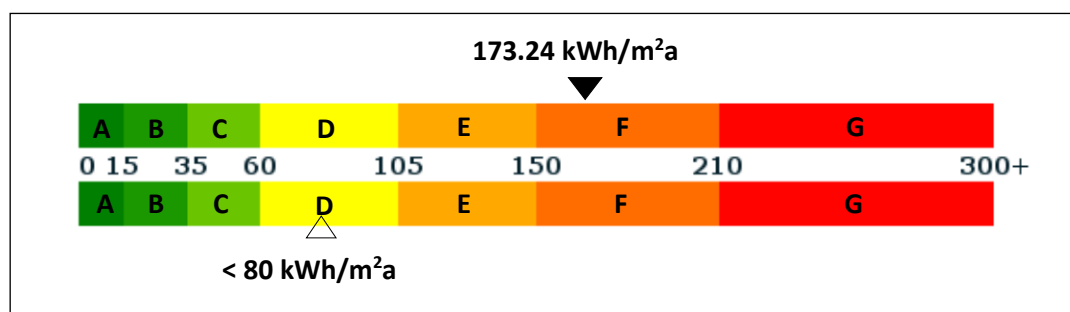


Figure 1: Thermal energy consumption before proposed measures

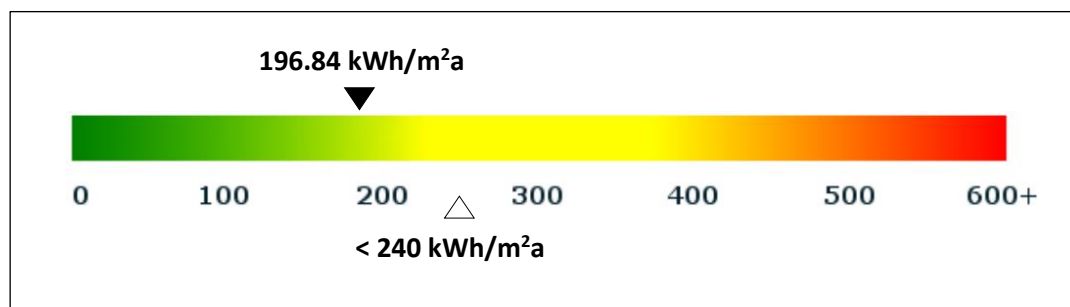


Figure 2: Energy input before proposed measures

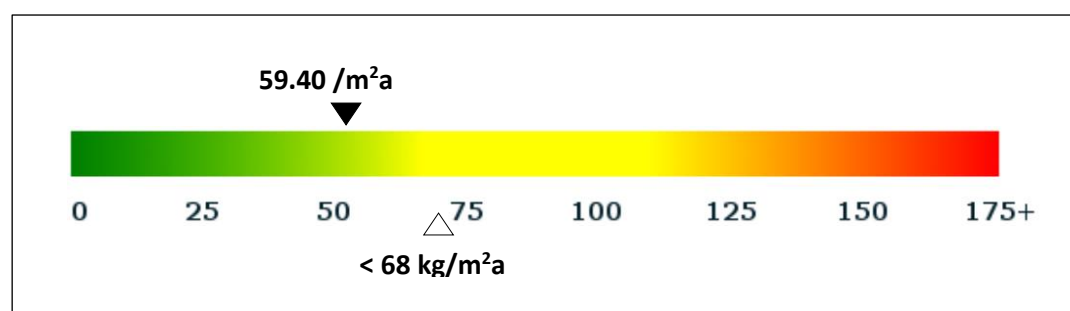


Figure 3: CO₂ emissions before proposed measures

0.4.2 Energy indicators after the implementation of measures

The black arrow indicates the planned state of the building after the measures have been implemented. The white arrow denotes recommended values for public buildings.

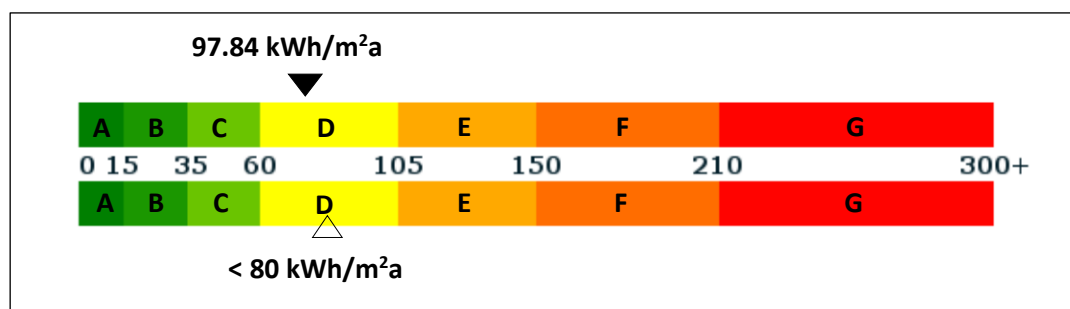


Figure 4: Thermal energy consumption after the proposed measures have been implemented

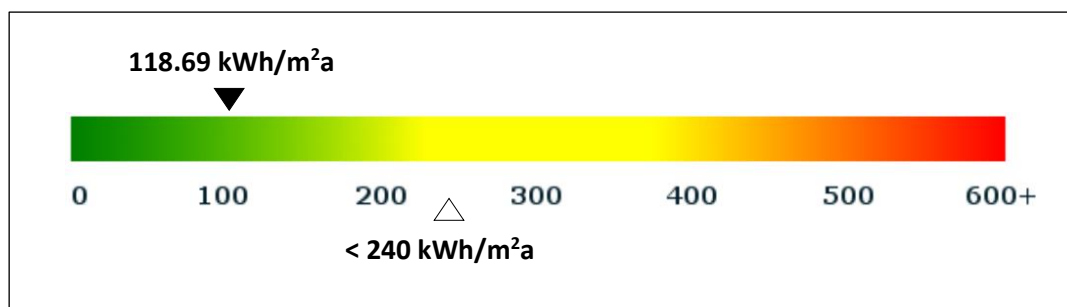


Figure 5: Energy input after the proposed measures have been implemented

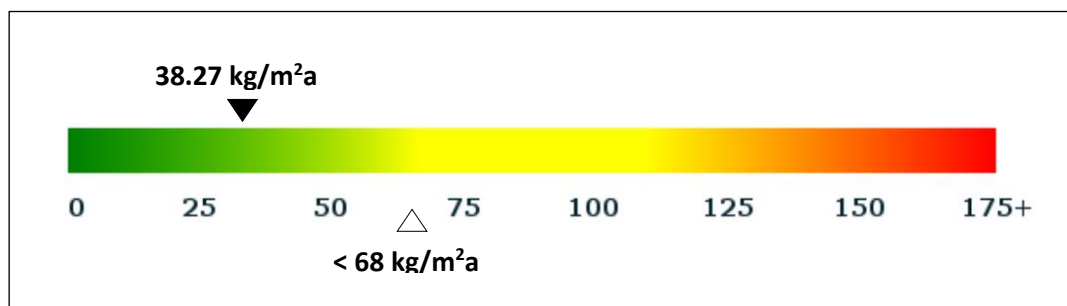


Figure 6: CO₂ emissions after the proposed measures have been implemented

0.5 Guidelines for implementation of measures

The implementation of measures defined by an energy audit is largely dependent upon the organisation's/institution's management; it also requires a qualified person (energy manager). If an organisation/institution does not have such a person at its disposal, it can employ an external contractor who is responsible for achieving energy efficiency. The collaboration between the organisation's/institution's management and the energy manager is crucial.

0.5.1 Organisational measures

Organisational measures can save a considerable amount of energy through relatively low costs. Implementation of organisational measures is the first step towards energy efficiency and represents the basis for all further investment measures.

0.5.2 Investment measures

Investment measures are usually associated with higher costs. Given the costs arising from the need to implement investment measures, they can be arranged as follows:

- Measures relating to simpler works performed by the manager in the context of regular or routine maintenance (e.g. replacement of a thermostatic valve, replacement of toilet tank, etc.);
- Measures that do not require additional documentation (e.g. building permit acquisition project, project to carry out works, etc.) – contracts may be awarded based on the list of works identified by an energy audit;
- Measures that require the preparation of project documentation that guides their implementation.
- This document lists one organisational measure – establishment of an energy management system and implementation of metering equipment (as necessary) with the corresponding control and communication technology to monitor the operation and the use of energy.

When the best scenario of investment measures is selected, the implementation of each individual measure requires a suitable preparatory phase, where all activities that are needed for the implementation are identified (e.g. preparation of project documentation, acquisition of building permit, award of a public contracts for the execution of works, selection of expert supervision: monitoring construction works, mechanical works, electrical works, formation of a project group responsible for the implementation of a measure, etc.), a detailed works schedule is produced, and all possible financing options are examined.

After a successful implementation of each measure is achieved, it is important to monitor its results/effects. If the desired results/effects are not reached, then the optimisation possibilities are to be explored.

For a better understanding of how to approach the implementation of an investment measure, the figure below shows the principal steps of implementing a measure.

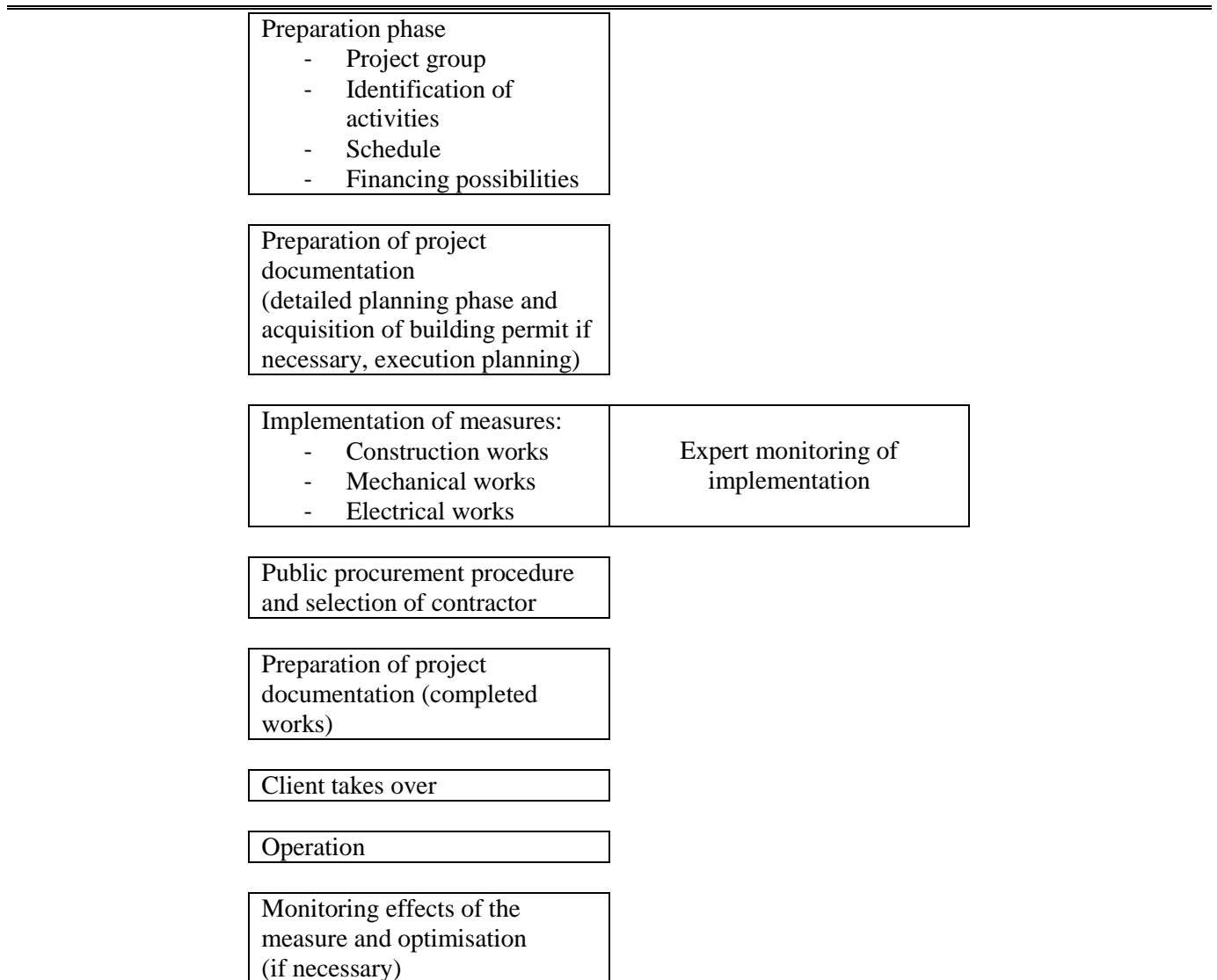


Figure 7: Measure implementation process