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.

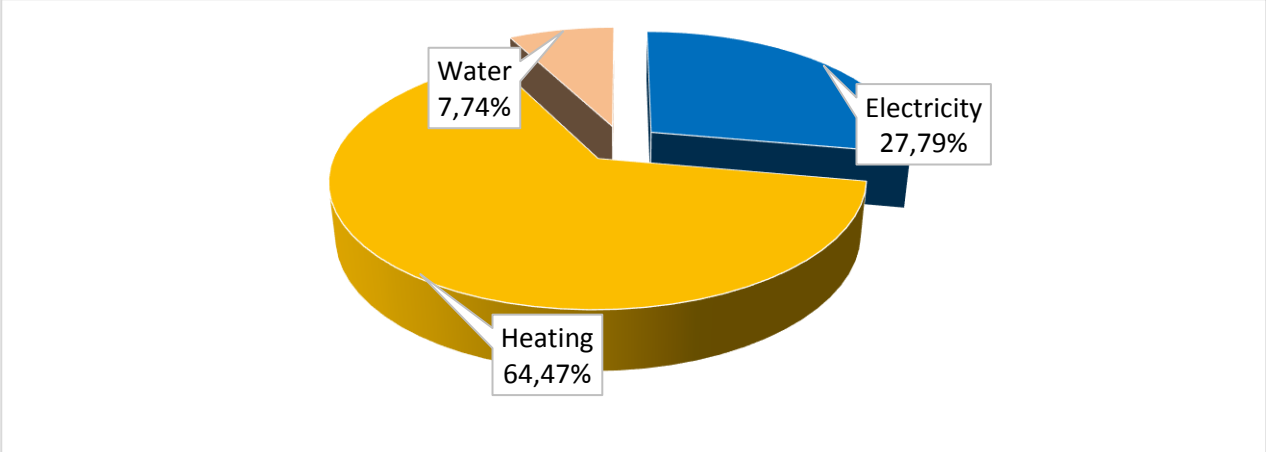
0.2 Consumption and costs of energy and water

The table below lists energy consumption and cost energy products for, as well as CO_2 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 presented in kWh, water consumption is presented in m^3.

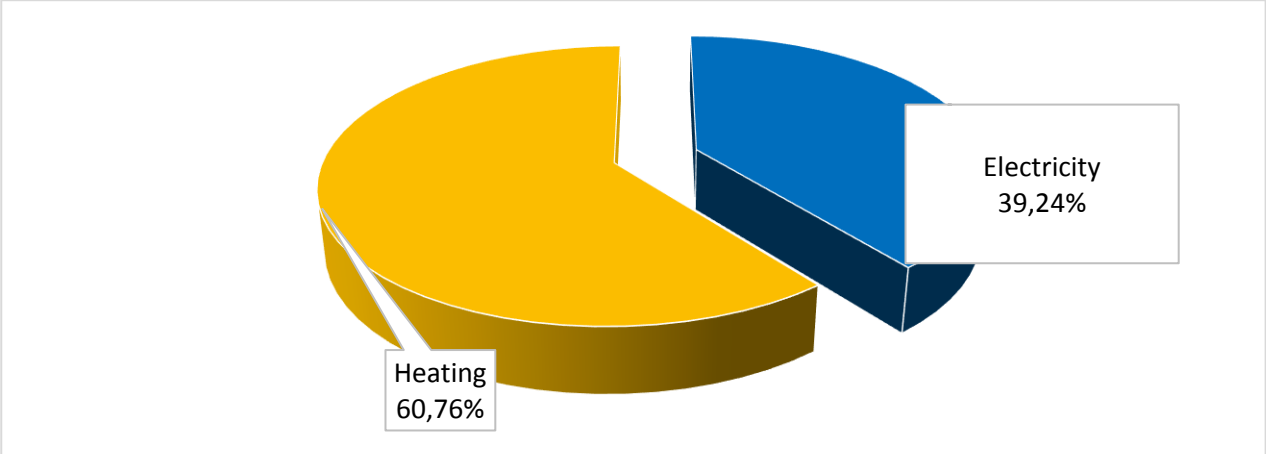
In 2015, the operation of primary school Hinka Smrekarja consumed 170,241 kWh of electricity and 564,670 kWh of thermal energy for heating (energy product: district heating). In 2015, the water consumption in the building amounted to 3,182 m^3.

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

	Consumption	Units	Share [%]	Cost [€]	Share [%]	CO_2 [kg]	CO_2 [%]	€/MWh
Electricity	170,241	kWh	23.16	17,760	27.79	94,824	39.24	104.32
Heating	564,670	kWh	76.84	41,199	64.47	146,814	60.76	72.96
Water	3,182	m^3		4,946	7.74			
TOTAL	**734,911 3,182**	**kWh m^3**		**63,905**		**241,638**		



Graph 1: The distribution of costs for energy and water, and CO_2 emissions in 2015



Graph 2: CO_2 emissions

The table below lists energy product consumption for 2012–2015. In the given reference period, the electrical energy consumption amounted to 145,634 MWh/year, the thermal energy consumption amounted to 525,505 MWh/year, and the water consumption amounted to 2,921 m^3/year.

The conditioned floor area of the building amounts to 5,227 m^2. The calculated energy rating for heating (standard use) is 102.44 kWh/m^2, the energy rating for the building's operation (standard use) is 130.3 kWh/m, CO_2 emissions amount to 42.15 kg/m^3. The energy rating value exceeds the critical level (240 kWh/m^2) and greatly exceeds the the recommended values (80 kWh/m^2).

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

	Electricity [kWh]	Heating [kWh]	Water [m^3]	Total [kWh]
2012	127,250	457,730	2,507	584,980
2013	136,612	573,000	2,891	709,612
2014	148,433	506,620	3,106	655,053
2015	170,241	564,670	3,182	734,911
Average	145,634	525,505	2,921	671,139

0.3 Potential savings and required investments

0.3.1 Proposed Scenario

The table below displays a summary of individual measures to improve energy efficiency. All measures include a summary. Three scenarios of implementing measures for improvement 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, façade renewal, installation of thermostat valves and hydraulic balance and renewal of gym lighting (organisational measure 1, investment measures 1, 2, 3, 4)

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.	23,357	4,369	1,646	502	5,000	2.33
Investment measures							
1	Energy management	28,028	1,456	1,976	167	12,000	5.60
2	Insulation of the main building and old gymnasium	88,756	0	6,256	0	102,000	16.30
3	Installation of thermostat valves and hydraulic balance	23,357	0	1,646	0	6,000	3.64
4	Replacement of gym reflectors	0	13,107	0	1,505	9,600	6.38

The table below lists measures that have a payback period of up to 6 years.

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	5,825	kWh	4
Annual savings in space heating	51,385	kWh	9.60
Annual savings in water	/	m^3	/
Total reduction of CO_2 emissions	16,605	kg	7.54
Total annual reduction in costs	4,291	€	7.88
Total necessary investment	17,000	€	
Average payback period	3.96	years	

The shortest payback period is 3.96 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			% savings on total value
Annual savings in electricity	18,932	kWh	13
Annual savings in space heating	163,497	kWh	30.54
Annual savings in water	/	m^3	/
Total reduction of CO_2 emissions	53,055	kg	24.08
Total annual reduction in costs	13,698	€	24.08
Total necessary investment	134,600	€	
Average payback period	9.83	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
- Façade insulation
- Replacement of gym reflectors
- Installation of thermostatic 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 CO_2 emissions. The table below lists anticipated savings resulting from the implementation of proposed measures in Scenario 2.

Table 5: Effects of proposed Scenario

	Electricity kWh	Heating kWh	Savings [€]	CO_2 emissions [kg]
Savings	18,932	163,497	13,698	53,055

Total investment cost amounts to € 134.600; payback period amounts to 9.83 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.

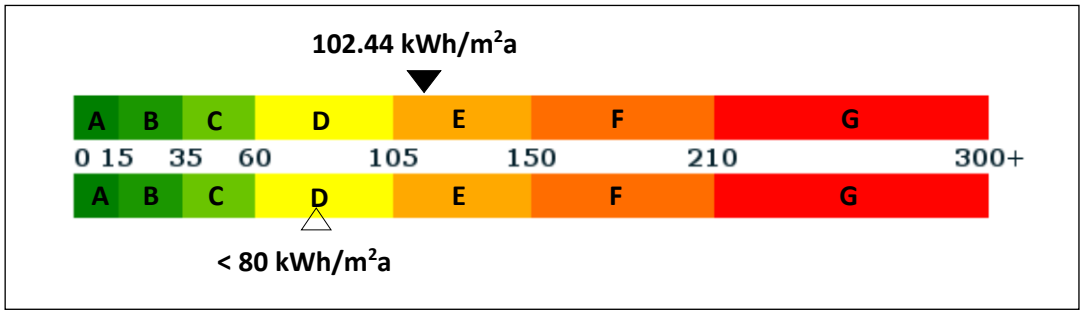


Figure 1: Thermal energy consumption before proposed measures

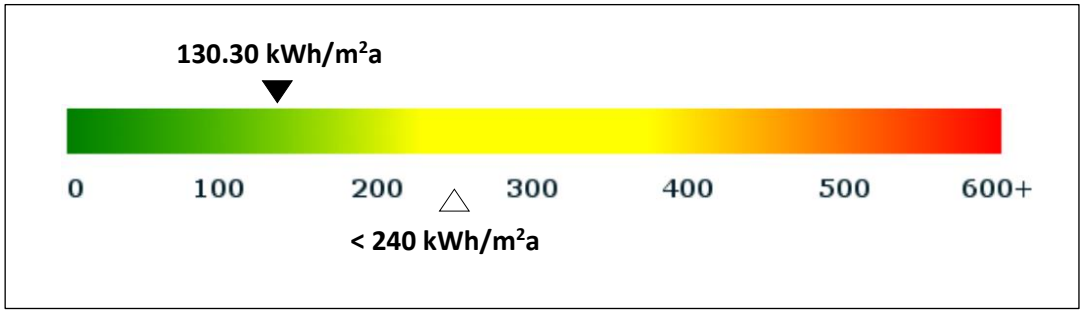


Figure 2: Energy input before proposed measures

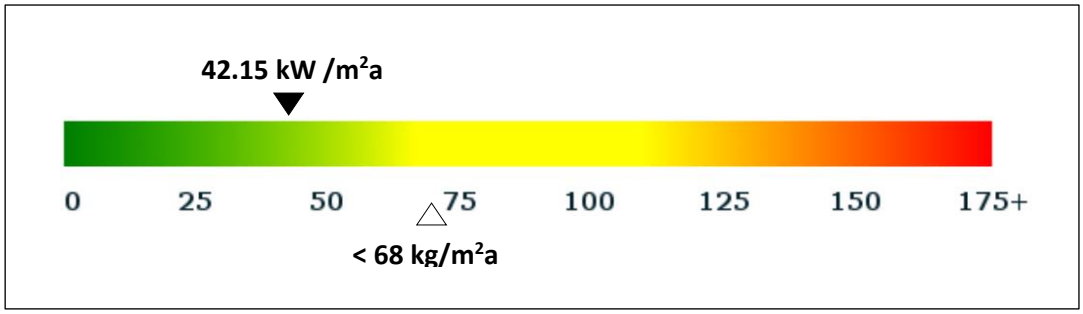


Figure 3: CO_2 emissions before proposed measures

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.

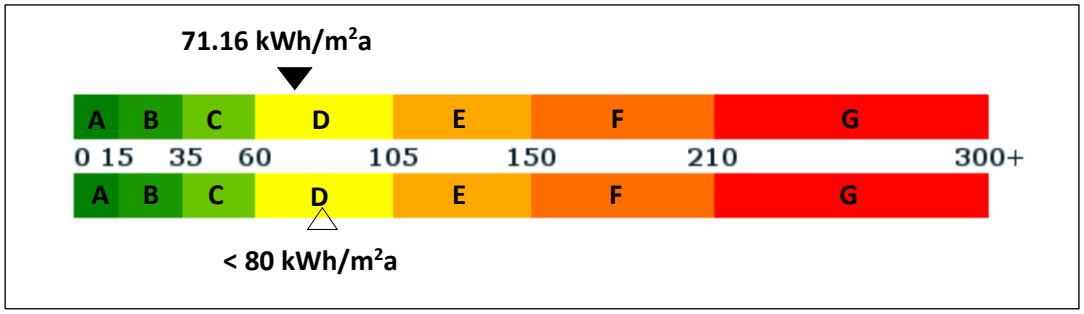


Figure 4: Thermal energy consumption after the proposed measures have been implemented

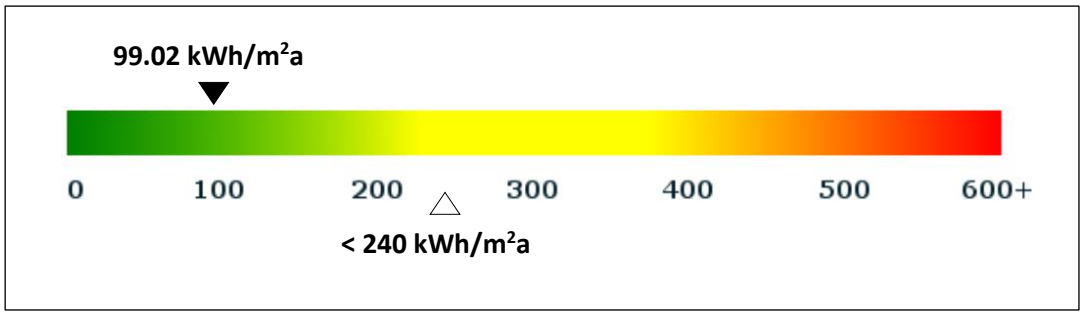


Figure 5: Energy input after the proposed measures have been implemented

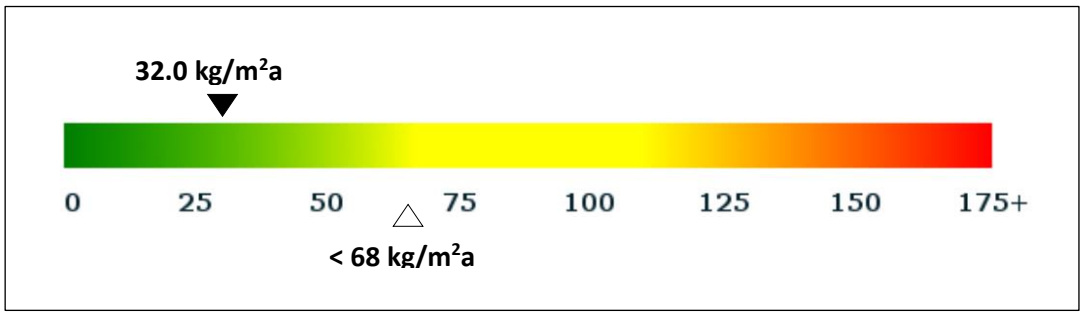


Figure 6: CO_2 emissions after the proposed measures have been implemented

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 simple works performed by the tehhnical maintenance staff 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 centralised 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 and corrective actions are to be explored and applied.

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.

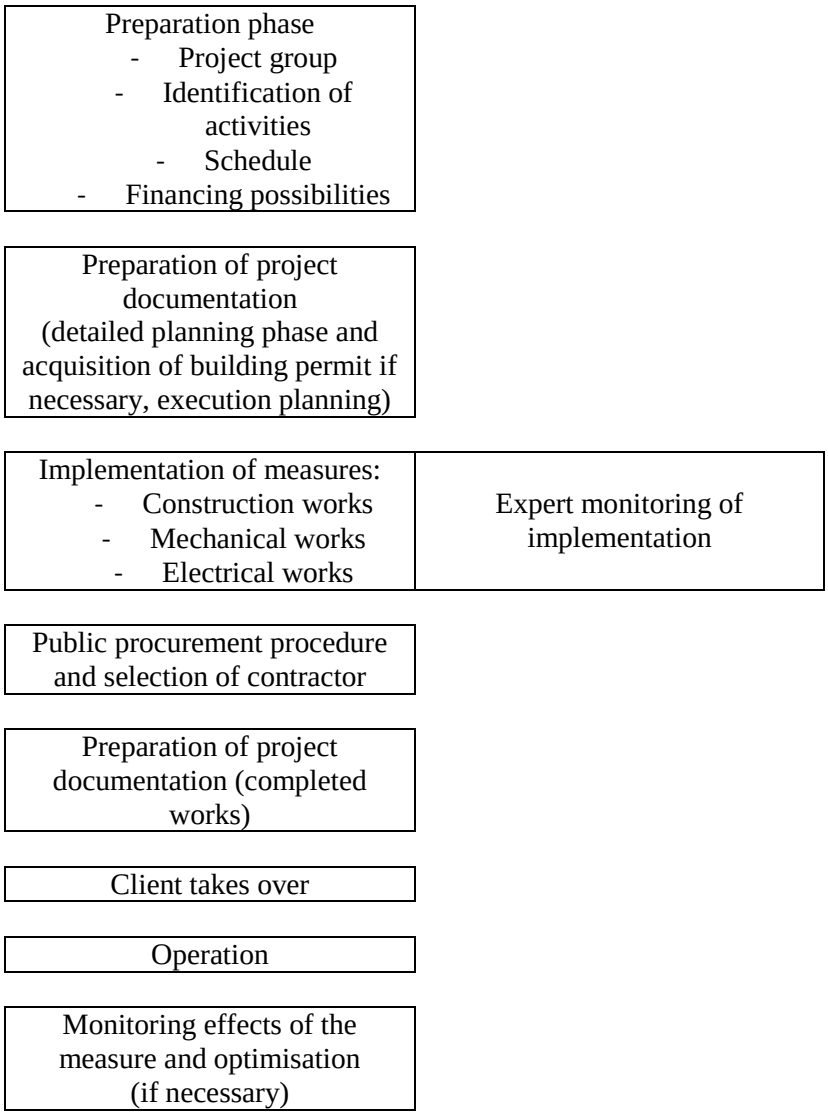


Figure 7: Measure implementation process