

## 0 BUSINESS CASE ANALYSIS: SUMMARY

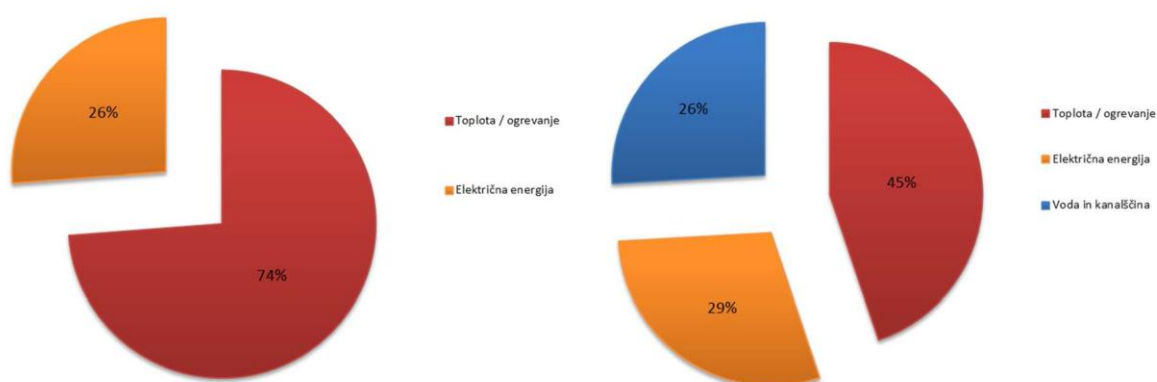
### 0.1 Importance of energy supply

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 following pie charts present the structural analysis of energy consumption and costs over the last three calendar years.

For the purposes of a more simple comparison, all presented energy cost data in simplified energy audit report exclude VAT (the rate of VAT changed in July 2013).



Graph 1: Average three-year share of consumption (left) and costs (right).

The cost of water is unusually high, which may be due to data anomalies in energy accounting.

Table 1: Average cost and consumption of energy products and cold water

Average 2013–2015	Consumption of energy products [kWh/year]	Cost of energy product [EUR/year]	CO <sub>2</sub> emissions [t/year]	Primary energy [kWh/m <sup>2</sup> /year]	Energy rating [kWh/m <sup>2</sup> /year]
Heating	52,097.33	3,651.37	16.67	105.40	105.40
Electricity	18,118.67	2,372.71	8.88	91.64	36.66
Total:	70,216.00	6,024.07	25.55	197.03	142.05
	Consumption [m <sup>3</sup> /year]		Cost [EUR/year]		
Cold water	51		2,101.59		
Total costs 2013–2015 [EUR/year]:					8,125.66

The data on energy consumption and costs arising from MOL energy accounting system suggests that the building, in order to operate and function, consumes about 74% of thermal energy for building heating purposes and 26% of electric energy for lighting and other devices. Most of the funds (45%) are spent on heat. The remaining costs are distributed in the following proportions: 29% for electric energy, and 26% for cold water supply from the water supply network, and communal services.

### 0.3 Potential savings and required investments

The term *comprehensive energy retrofit* applies to a harmonised implementation of measures to ensure energy efficiency (e.g. on façade, roof, flooring) of the building's technical systems (e.g. heating, ventilation, air-conditioning, hot water) in order to make full use (if possible) of the economically viable potential for the energy retrofit. The main advantage of an integrated approach is the possibility of interactive optimisation of individual measures through a single larger-scale operation.

Extended energy audit report lists several scenarios arising from the financial, organisational and strategic capabilities and policies of the investor.

The simplified energy audit includes three scenarios, namely:

- Implementation of organisational measures
- Implementation of energy retrofit measures
- The energy retrofit implementation must follow the requirements of the Ministry of Infrastructure – after the implementation of measures, the building must fulfil the requirements of the Rules on efficient use of energy in buildings with a technical guideline (PURES) on energy efficiency –, and measures with the simple payback period of up to 15 years.

Table 2: *Summary table of organisational measures*

No.	Description	Potential highest annual savings:				Investment	Simple payback period	Priority	Reduction in CO <sub>2</sub>
		Heating	Electricity	Water	Annual savings				
		MWh/a	MWh/a	m <sup>3</sup> /a	€/a	€	years	/	t/a
<b>A</b>	<b>ORGANISATIONAL MEASURES</b>								
1.	<ul style="list-style-type: none"> <li>- Lighting, devices, and equipment are switched off when not in use.</li> <li>- A designated person performs final control of the building at the end of the day and checks if all lighting, devices, and equipment are switched off.</li> <li>- Suitable and regular maintenance of devices and equipment.</li> <li>- Appropriate heating, cooling and ventilation regime of the building with an aim to conserve energy and ensure a healthy and comfortable internal environment.</li> <li>- Educating users and technical personnel; introduction of a preventative maintenance system.</li> </ul>	2.5	1.2		335	500	1.5	I	1
2.	Centralised Energy management System (CEMS)	1.3	0.6		170	10,000	59	I	1
	<b>TOTAL</b>	<b>3.8</b>	<b>1.8</b>		<b>505</b>	<b>10,500</b>	<b>20.8</b>		<b>2</b>

Table 3: Summary table of all investment measures

No.	Description	Potential highest annual savings:				Investment	Simple payback period	Priority	Reduction in CO <sub>2</sub>
		Heating	Electricity	Water	Annual savings				
		MWh/a	MWh/a	m <sup>3</sup> /a	€/a	€	years	/	t/a
<b>B</b>	<b>INVESTMENT MEASURES</b>								
2.	Ceiling insulation towards the attic	2.8	0		180	15,000	77.8	II	1
3.	Renewal of doors and windows	3.6	0		250	1,000	4	I	1
4.	Installation of thermostat valves and heads and hydraulic balance	5	0.2		375	1,800	4.8	I	1
5.	Lighting	0	4.6		600	2,700	4.5	I	2
	<b>TOTAL</b>	<b>11.4</b>	<b>4.8</b>		<b>1405</b>	<b>20,500</b>	<b>14.6</b>		<b>5</b>

Table 4: Summary table of measures: scenario of energy retrofit following the Rules on efficient use of energy in buildings with a technical guidelines (PURES), and the simple payback period of individual measure amounting to up to 15 years.

No.	Description	Potential highest annual savings:				Investment	Simple payback period	Priority	Reduction in CO <sub>2</sub>
		Heating	Electricity	Water	Annual savings				
		MWh/a	MWh/a	m <sup>3</sup> /a	€/a	€	years	/	t/a
<b>A</b>	<b>ORGANISATIONAL MEASURES</b>								
1.	<ul style="list-style-type: none"> <li>- Lighting, devices, and equipment are switched off when not necessary.</li> <li>- A designated person performs final control of the building at the end of the day and checks if all lighting, devices, and equipment are switched off.</li> <li>- Suitable and regular maintenance of devices and equipment.</li> <li>- Appropriate heating, cooling and ventilation regime of the building with an aim to save energy and ensure a healthy and comfortable internal environment.</li> <li>- Educating users and technical personnel; introduction of a preventative maintenance system.</li> </ul>	2.5	1.2		335	500	1.5	I	1
<b>B</b>	<b>INVESTMENT MEASURES</b>								
2.	Ceiling insulation towards the attic	2.8	0		180	15,000	77.8	II	1
3.	Renewal of doors and windows	3.6	0		250	1,000	4	I	1
4.	Installation of thermostat valves and heads and hydraulic balance	5	0.2		375	1,800	4.8	I	1
5.	Lighting	0	4.6		600	2,700	4.5	I	2
	<b>TOTAL</b>	<b>13.9</b>	<b>6</b>		<b>1,740</b>	<b>21,000</b>	<b>12.1</b>		<b>6</b>

## 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.

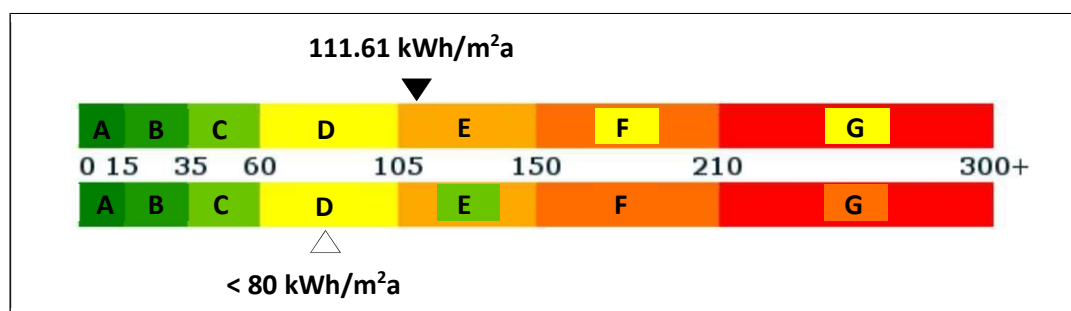


Figure 1: Thermal energy consumption before proposed measures

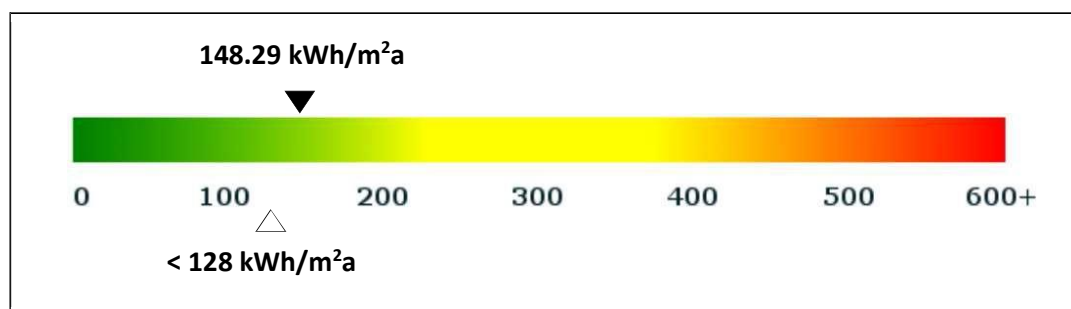


Figure 2: Energy input before proposed measures

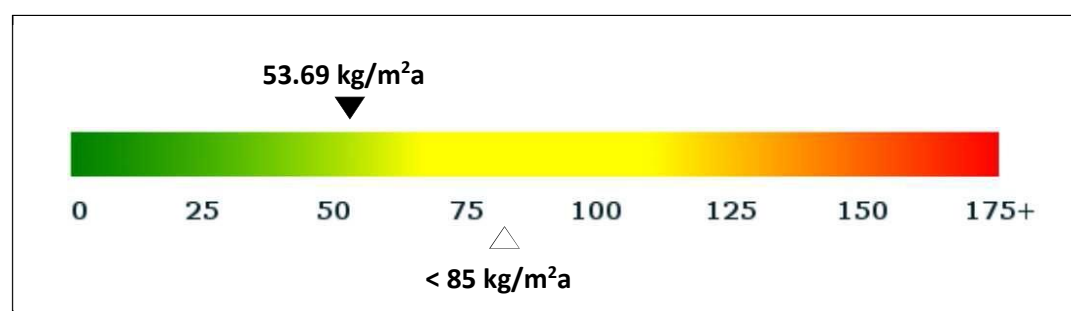


Figure 3: CO<sub>2</sub> emissions before the implementation of proposed measures

### 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.

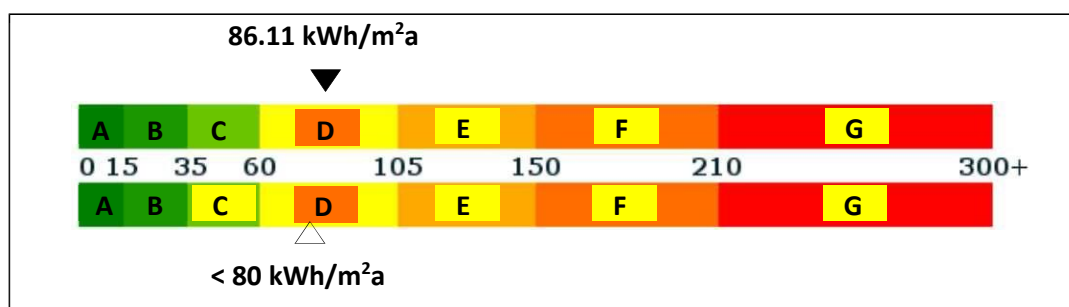


Figure 4: Thermal energy consumption after the proposed measures have been implemented

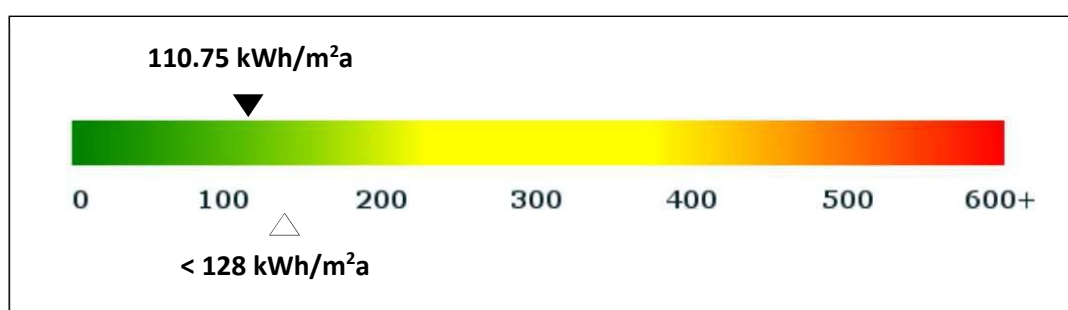


Figure 5: Energy input after the proposed measures have been implemented

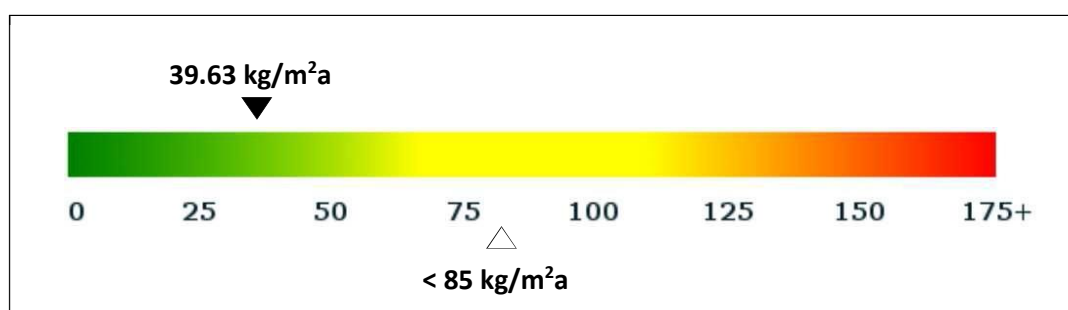


Figure 6: CO<sub>2</sub> emissions after the proposed measures have been implemented

## 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.

According to practical experience, the effects of soft organisational measures participates 5 to 15 % decrease of annual energy consumption. Assessment of the investment for the introduction of soft measures is from 3% to 5% of the annual energy cost (basic: monitoring the consumption, which requires metering and monitoring).

Organisational measures are interesting mainly due to the fact that additional investments are not required – internal reserves of the institution are employed. With suitable organisation and motivation, the organisational measures can generate substantial energy savings. Below are some basic organisational measures that may generate lower energy consumption with minimum investment or no investment at all.

**Measure 1** Establishing an archive for documentation and energy consumption data

Based on the experience, in the case of numerous public and private institutions no archives on technical documentation for buildings and installed systems are available; data are not accessible through public databases.

This information is crucial for planning measures, preparing analyses for investment documentation, as well as energy and system management.

In accordance with the Energy Act, all public institutions should establish at least energy accounting system.

**Measure 2** Presenting results of energy audit

The results of an energy audit must be presented primarily with the aim of recognising the existing problems and critical points that were discovered during the audit.

**Measure 3** Improved cooperation between the technical maintenance services and other services/departments

The technical service personnel, responsible for maintenance, must give consent for each device or system that is to be installed in the building. In this manner, the new device is compatible with other systems, as well as technically and technologically conforming. In addition, suitable documentation and archiving must be established.

**Measure 3** Planning preventative and regular maintenance and repair works

Planning preventative and regular maintenance and repair works permits for planning of costs in advance, thereby avoiding unplanned expenditure and ensure full functioning of devices.

**Measure 5** Raising environmental awareness of employees (object users)

The employees must be informed about the measures and projects implemented, and educate them about energy saving possibilities.

**Measure 6** Energy policy – introduction of standards

The organisation's management decides to introduce energy policy in accordance with ISO 50001.

The entire organisational structure undertakes (e.g.) the following:

In accordance with the policy of environmental responsibility and orientation towards sustainable development, the organisation undertakes to use energy responsibly and improve energy efficiency in all its buildings and activities, wherever it is cost efficient.

Active participation in sustainable energy improvements.

### 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 maintenance services 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.

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 prepared, and all possible financing options are examined.

After a successful implementation of each measure is completed, it is important to monitor the results/effects. If the results/effects are not reached, the optimisation possibilities are to be analysed and adopted.

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.

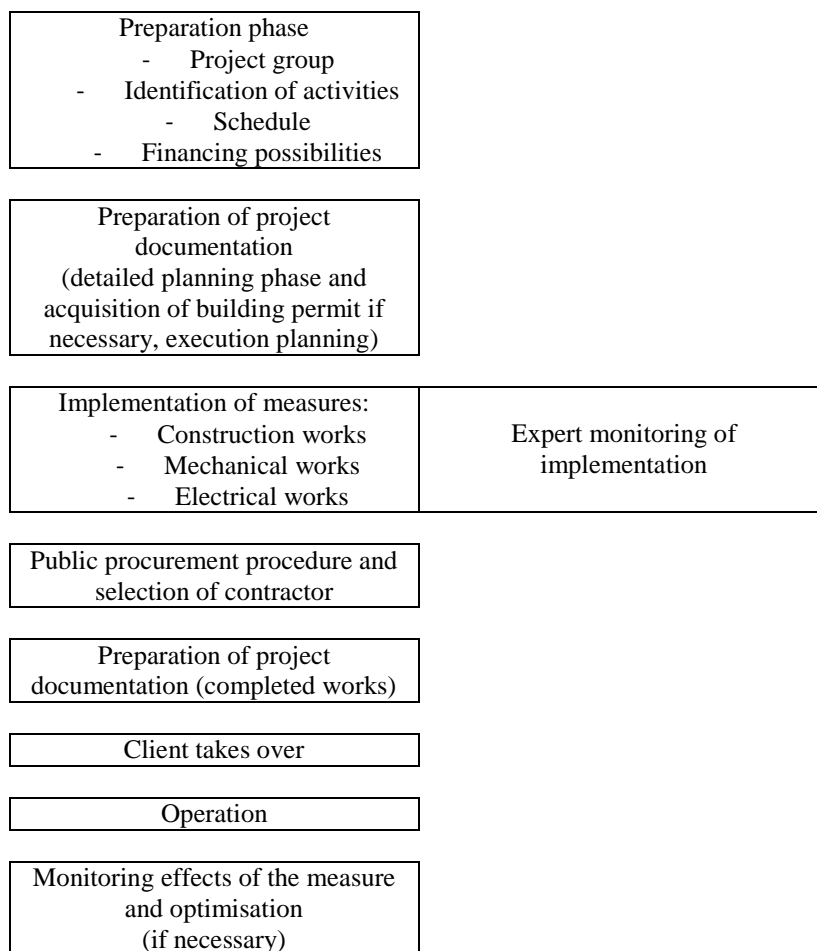


Figure 7: *Measure implementation process*