0 BUSINESS CASE ANALYSIS: SUMMARY

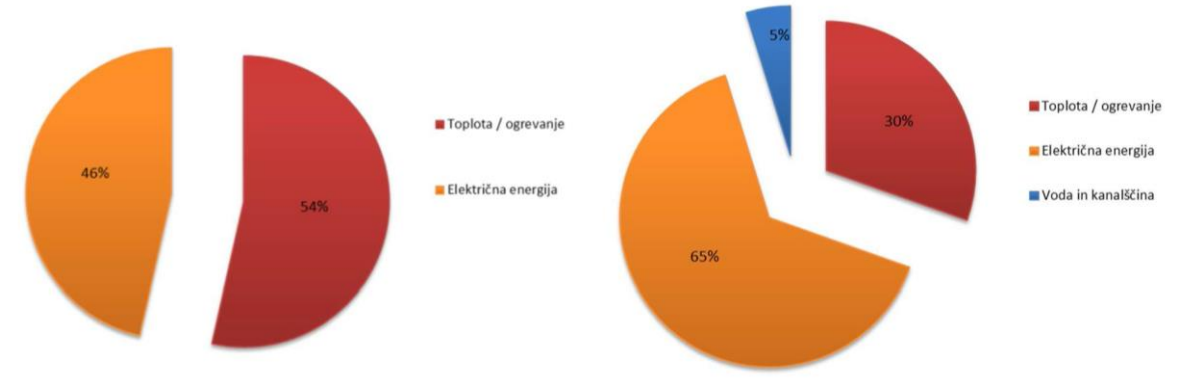
0.1 Importance of energy supply

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).*

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

2013–2015 average	Consumption of energy products	Cost of energy product	CO_2 emissions [t/year]	Primary energy [kWh/m²/yea	Energy rating [kWh/m²/ye
Heating	174,866.6	10,786.6	34.9	72.7	66.1
Electricity	150,017.5	23,377.7	73.5	141.7	56.7
Total:		**34,164.4**	**108.4**	**214.5**	**122.8**
	Consumption		**Cost [EUR/year]**		
Cold water	868		1,683.24		
Total costs 2013–2015					**35,847.6**

The data on energy consumption and costs arising from MOL energy accounting suggest that the building, in order to operate and function, consumes about 54% of thermal energy for space heating and 46% of electrical energy for lighting, hot water, and other devices.

Most of the funds (65%) are spent on electrical energy. The remaining costs are distributed in the following proportions: 30% for thermal energy and 5% 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.

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

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**							
		Heating	**Electricity**	**Water**	**Annual savings**	**Investment**	**Simple payback**	**Priority**	**Reduction in CO_2 emissions**
		MWh/	**MWh/**	**m^3/a**	**€/a**	**€**	**yea**	**/**	**t/a**
A	**ORGANISATIONAL MEASURES**								
1.	- Lighting, devices, and equipment are switched off when not in use. - 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. - Suitable and regular maintenance of devices and equipment. - Appropriate heating, cooling and ventilation regime of the building with an aim to conserve energy and ensure a healthy and comfortable internal environment. - Educating users and technical personnel; introduction of a preventative maintenance system.	6.2	7		1,470	1,500	1	I	5
2.	Centralised automated system and active use of energy system	3	3.5		735	10,000	13.6	I	2
	TOTAL	**9.2**	**10.5**		**2,205**	**11,500**	**5.2**		**7**

Table 3: *Summary table of all investment measures*

No	Description	Potential highest annual							
		Heating	Electricity	Water	Annual savings	Investment	Simple payback	Priority	Reduction in CO_2 emissions
		MWh/	MWh/	m^3/a	€/a	€	yea	/	t/a
B	**INVESTMENT MEASURES**								
2.	Façade insulation	34.4			2,120	63,500	30	I	7
3.	Roof insulation	10.3			630	121,00	191.3	I	2
4.	Renewal of doors and windows	40.1			2,470	123,00	49.8	I	8
5.	Renewal of doors and windows	31.9			1,970	12,500	6.4	I	6
6.	Lighting	–11.4	35.9		4,890	44,000	9	I	15
7.	Installation of climate control with heat recovery	25.5	0.6		1,675	40,000	23.9	I	5
8.	Installation of necessary thermostat valves, frequency regulation of pumps and hydraulic balance	15.9	1.8		1,260	8,000	6.3	I	4
	TOTAL	**146.7**	**38.3**		**15,015**	**412,000**	**27.4**		**47**

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

No	Description	Potential highest annual				Investment	Simple payback	Priority	Reduction in CO_2 emissions
		Heating	Electricity	Water	Annual savings				
		MWh/	MWh/	m^3/a	€/a	€	yea	/	t/a
A	**ORGANISATIONAL MEASURES**								
1.	- Lighting, devices, and equipment are switched off when not in use. - 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. - Suitable and regular maintenance of devices and equipment. - Appropriate heating, cooling and ventilation regime of the building with an aim to conserve energy and ensure a healthy and comfortable internal environment. - Educating users and technical personnel; introduction of a preventative maintenance system.	6.2	7		1,470	1,500	1	I	5
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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.

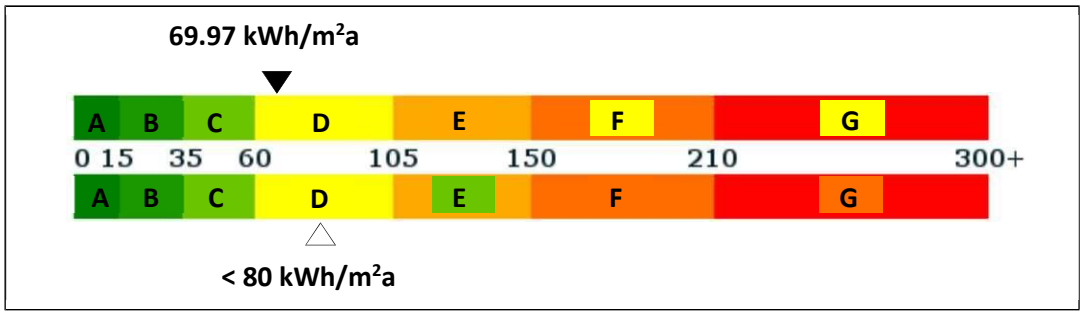

Figure 1: *Thermal energy consumption before proposed measures*

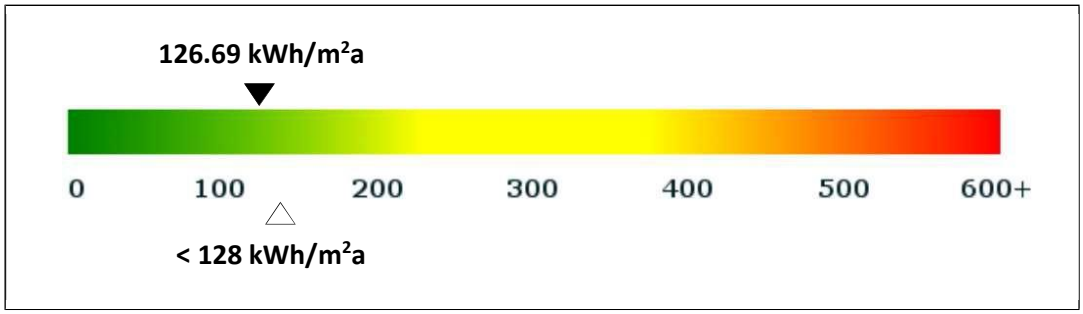

Figure 2: *Energy input before proposed measures*

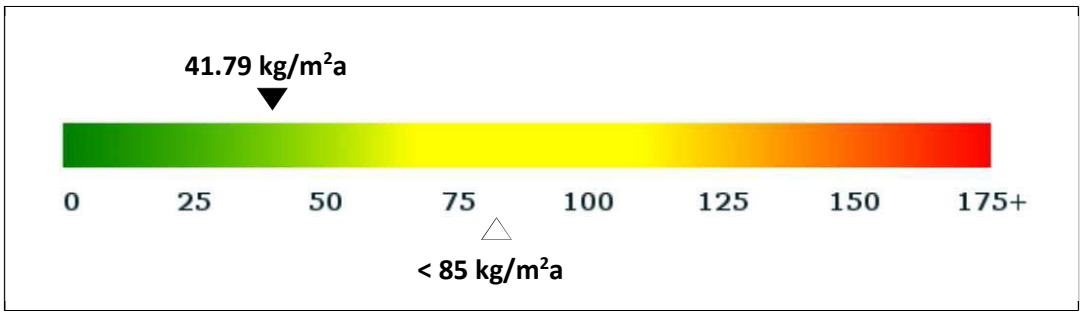

Figure 3: *CO_2 emissions before the implementation of proposed measures*

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.

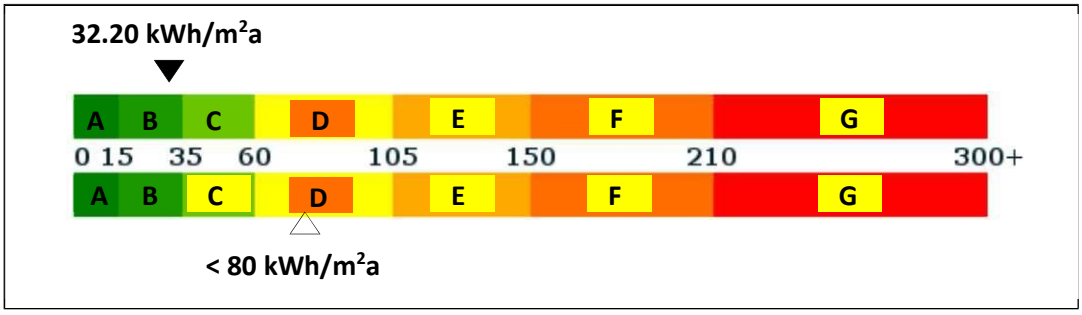

Figure 4: *Thermal energy consumption after the proposed measures have been implemented*

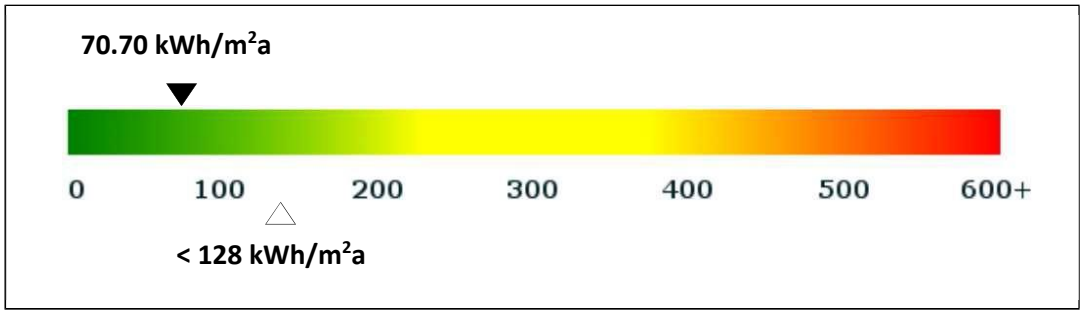

Figure 5: *Energy input after the proposed measures have been implemented*

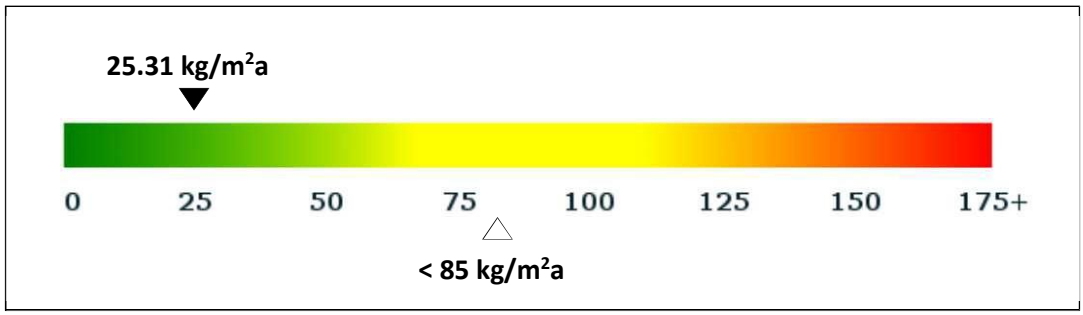

Figure 6: *CO_2 emissions after the proposed measures have been implemented*

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.

According to practical experience, the effects of soft organisational measures accumulate between 5 and 15% lower 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 because 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

Based on the experience, some public and/or private institutions do not own an archive that holds technical documentation for buildings and installed systems; 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 energy accounting or at least collect invoices for energy and water expenses.

Measure 2 Presenting results of energy audit

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

Measure 3 Improved cooperation between the technical maintenance department and other departments

The technical department 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 smooth functioning of devices.

Measure 5 Raising environmental awareness of employees

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

Measure 6 Energy policy – introduction of standards

The organisation's energy policy is an umbrella document in which the organisation or institution undertakes to meet all the requirements of ISO 50001, defined in point 4.3, paras. A-H.

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 achieve greater energy efficiency in all its buildings and activities, wherever it is cost efficient.

Active approach and continuous improvements in sustainable energy solutions.

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 routine 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.

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 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.

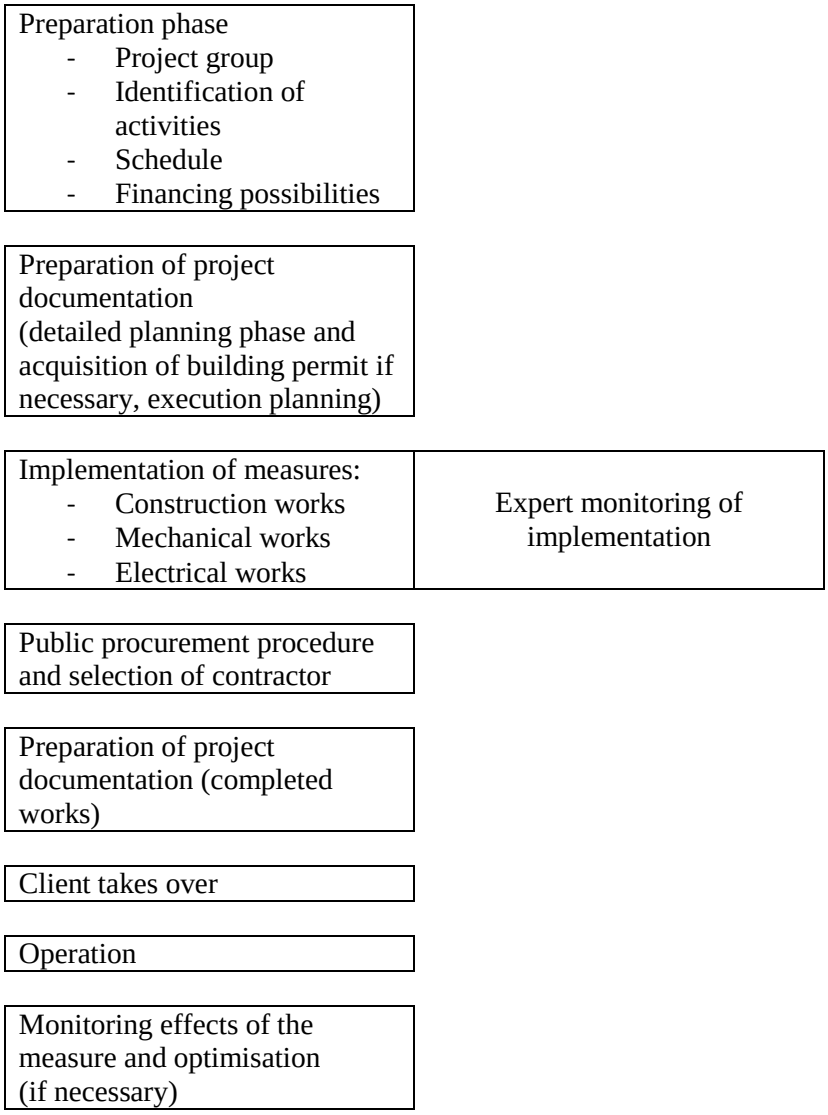

Figure 7: *Measure implementation process*