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

In the building of House of clture Savlje various activities take place: cultural events, catering activities, business activities, etc. The building also hosts a day bar "Okrepčevalnica in gostilnica Kongo (Gostilnica Kongo)" that – by our estimations – consumes the largest share of energy supplied to the building. The owner of the pub was unwilling to provide us with the data on energy consumption; therefore, the sections below list only the actual energy consumption of the part of the building managed by City administration. Since the building has been under GO's management for a short time (2015, 2016), the only data available are monthly energy bills from May 2015 onwards. **Due to the fact that it was impossible to collect data (energy bills) for a longer period of time, the reference period encompasses one calendar year, from May 2015 to April 2016.**

For the purposes of a more simple comparison, all presented energy cost data in energy audit report exclude VAT (the rate of VAT changed in July 2013). Furthermore, the assessments of the investment value for the implementation of the proposed measures and the assessments of cost savings due to implemented measures exclude VAT. In summary, **all values in the report that represent monetary values (EUR, €) exclude VAT.** Due to incomplete data on the actual energy use, the **referential values** of current energy consumption for the purposes of analysis of proposed measures has been generated by the calculation model Gradbena fizika URSA 4.0. Individual reference values for the selected period, and the determination of these values are more closely presented in section 9.1.

Figure 0.1: Average annual energy consumption (left) and costs for the reference period (right) – for the part of the building managed by the Department of local government (without Kongo day bar)

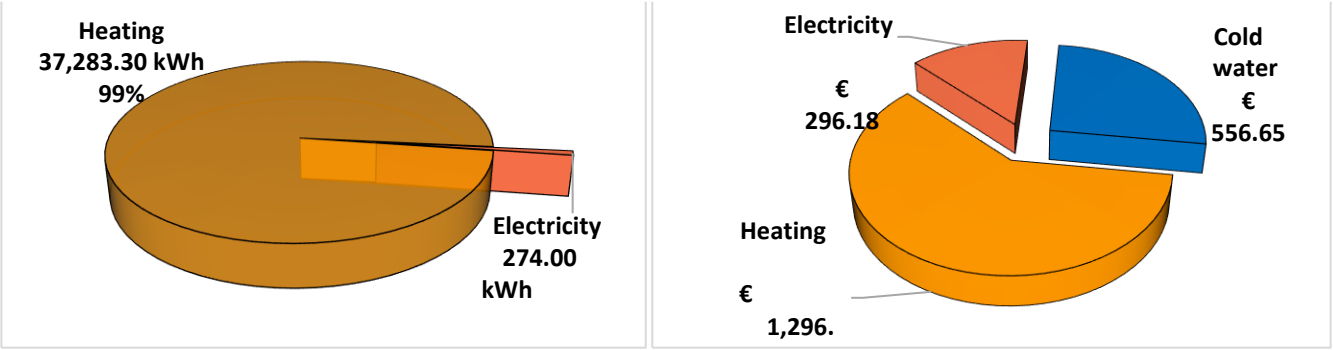


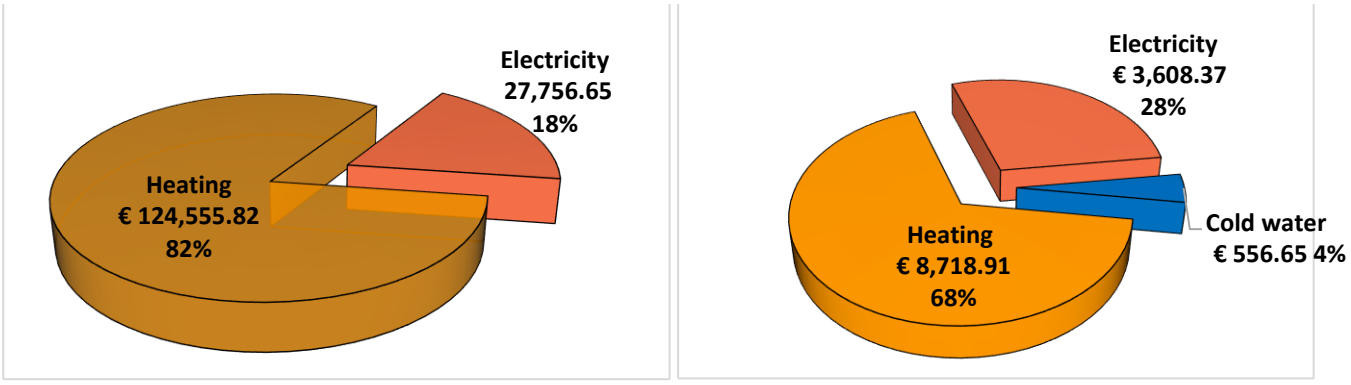
Table 0.1: Average annual energy consumption and costs for the reference period – for the part of the building managed by the City administration (without Kongo day bar)

May 2015–April 2016 average	Consumption of energy products	Cost of energy product	CO_2 emissions	Primary energy [kWh/m²/year]	Energy rating [kWh/m²/year]
Heating	37,283.30 kWh	1,296.	7.46	57.20	17.33
Electricity	274.00 kWh	296.	0.13	0.96	0.13
Total:	**37,557.30**	**1,592.**	**7.59**	**58.15**	**17.46**
	Consumption [m³/year]		**Costs [€/year]**		
Cold water	455.00		556.65		
Total average annual cost: May 2015–April 2016 [€/year]:					**2,149.41**

Table 0.2: Average annual energy consumption and costs for the reference period – estimation (calculation)

Reference energy and water consumption	Consumption of energy products [kWh/year]	Cost of energy product [€/year]	CO_2 emissions [t/year]	Primary energy [kWh/m²/year]	Energy rating [kWh/m²/year]
Heating	124,555.82	8,718.91	24.91	191.09	173.72
Electricity	27,756.65	3,608.37	13.60	96.78	38.71
Total:	**152,312.47**	**12,327.27**	**38.51**	**287.87**	**212.43**
	Consumption [m³/year]		**Costs [€/year]**		
Cold water	455.00		556.65		
Total average annual cost: May 2015–April 2016 [€/year]:					**12,883.92**

Figure 0.2: Average annual energy consumption (left) and costs (right) for energy and water – estimation (calculation)



The calculation model suggests that the building, in order to operate and function, consumes about 82% of thermal energy for object heating and heating water, and 18% of electrical energy for lighting, kitchen, and other devices. Most of the funds (68%) are spent on heat. The remaining costs are distributed in the following proportions: 28% for electricity, 4% for cold water supply from the water supply network.

0.3 Potential savings and required investments

The energy audit points out possible measures for a more efficient energy use (EE), i.e., reducing the costs and consumption of heating, electricity and water. We have analysed economically viable measures and predicted the estimated simple payback period of an investment. The proposed measures are divided into two sections: the organisational measures and the investment measures. All proposed

The measures beneficially affect EE and reduction of costs. They differ in payback period of an investment and importance of implementation.

Values and proposed individual investments are indicative, as is usual at the level of simplified energy audits. To present detailed technical solutions for specific measures, it is necessary to create implementation project (PZI), wherein the measures are analysed, and a detailed list of necessary works is provided. The retrofit project must include a description of technical measures, a description of possible risks arising from their individual or interactive influence, and guidelines for users to limit the risks through preventative and corrective measures.

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

The simplified energy audit identifies two scenarios:

- Scenario Zero (0) encompasses measures with minimal investment cost (mostly organisational measures).
- Scenario One (1) encompasses the entire technically feasible and economically viable potential of measures implemented. Scenario 1 represents the set of selected measures, which were identified as the most beneficial in terms of comprehensive energy retrofitting and the state of equipment. The building is in extremely poor condition; we propose a comprehensive retrofit. Only in this manner, it is possible to provide for a suitable microclimate and energy efficiency. This Scenario covers the measures that affect the building's energy efficiency.

Table 0.3: Scenario 0: Proposed measures

No	Description of measure	Potential annual savings				Implement	Payback	Priori
		Heati	Electri	CO_2	Costs	Total		
		MW	MWh	kg CO2	EUR	EUR	years	
ORGANISATIONAL MEASURES								
1.	Organisational measures Education and promoting Maintenance	6.23	0.56	1,518	508	€	1	I I. I.
SPECIFIC ORGANISATIONAL MEASURES								
2.	Monitoring + Energy management	6.23	0.83	1,654	544	5,000.0	9	II.
ALL MEASURES TOTAL		**12.4**	**1.39**	**3,171**	**1,052**	**5,000.0**	**5**	

All prices exclude VAT.

Price of electricity for 2015:	0.13000	€/kWh
The price of end-use thermal energy in 2015	0.07000	€/kWh

Table 0.4: Scenario 1: Proposed measures

No	Description of measure	Potential annual savings				Investme	Payback	Priori
		Heatin	Electri	CO_2	Costs	Total		
		MWh	MWh	kg CO2	EUR	EUR	years	
SPECIFIC ORGANISATIONAL MEASURES								
0.	Monitoring + Energy	1.19	0.55	650	155	5,000.00	32	II.
TECHNICAL INVESTMENT MEASURES								
1.	Building envelope							
	Thermal insulation of façade	43.50		8,700	3,045	65,760.00	22	I.
	Renewal of doors and windows	8.38		1,675	586	57,538.00	98	II.
	Attic insulation	8.52		1,704	596	22,617.45	38	I.
	Thermal insulation of floors	15.03		3,006	1,052	64,080.00	61	II.
	Total	75.43		15,086	5,280	209,995.4	40	
2.	Heating system							
	Installation of thermostat valves	1.86		371	130	6,300.00	48	I.
	Circulator pump replacement		0.48	235	62	875.00	14	I.
	Installation of central ventilation system	11.50	–2.40	1,124	493	60,000.00	122	
	Condensing boiler installation	12.00		2,400	840	15,000.00	18	I.
	Total	25.36	–1.92	4,130	1,525	82,175.00	54	
3.	Electricity							
	Lighting		11.30	5,537	1,469	17,280.00	12	II.
ALL MEASURES TOTAL		**101.98**	**9.93**	**25,403**	**8,429**	**314,450.4**	**37**	

All prices exclude VAT.

Price of electricity for 2015:	0.1300	€/kWh
Price of heating for 2015:	0.0700	€/kWh

No	Description of measure	Potential annual savings				Investme	Payback	Priori
		Heatin	Electri	CO_2	Costs	Total		
		MWh	MWh	kg CO2	EUR	EUR	years	
Inadmissible measures (The Institute for the Protection of Cultural Heritage of Slovenia)								
1	Thermal insulation of façade protected under the Cultural Heritage	9.17	0.00	2,933				
ALL INADMISSIBLE		**9.17**	**0.00**	**2,933**				

0.4 Energy indicators before and after the implementation of measures

In accordance with Energy Act (EZ-1, OG RS No. 17/4 and 81/1) 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). The building Kulturni dom Savlje (Home of Culture Savlje) is listed in the cultural heritage register under *Ljubljana – Vaško jedro Savlje, EŠD 18709*. In accordance with paragraph 6, Article 334 of the Energy Act, which states that the requirements relating to the energy performance certificate and energy performance statement of buildings shall not apply to buildings that are protected in accordance with the regulations governing the protection of the cultural heritage, the energy performance certificate was not created during the energy audit.

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.

A detailed description of the organisational measures is provided in chapter 10. The most important measures proposed are:

0.5.1.1 Monitoring room temperature during heating period. Room temperature should be continuously monitored and maintained in accordance with the recommended values (21 °C ±2°C), depending on the intended use of the rooms and rules that apply to the building. The implementation of this measure should be easier if some of the rooms are fitted with a thermometer (temperature sensors).

0.5.1.2 Energy management: ISO 50001:2011 Energy management systems specifies requirements for establishing the energy management system, whose purpose is to enable an organisation to follow a systematic approach in achieving continual improvement of energy performance, including energy efficiency, energy use and consumption. ISO 50001:2011 is structurally similar to the Environmental management standard ISO 14001. Energy management system is based on identification and regular review of important energy indicators.

0.5.1.3 Establishing proper and controlled natural ventilation: opening windows several times during the day for a short time (5 min). The most common manner of ventilation is opening windows, exercising long-term or short-term airing. Long-term airing is performed by opening a window at an angle for a longer period, usually for most of the day or night. In this manner, fresh air and room air will change from 1 to 4 times. In cold days, this manner of ventilation can cause significant heat loss. Due to colder and less humid air, the relative air humidity in a room is quickly reduced, promoting the movement of dust. In addition, surfaces around the window cool down. Short-term (intensive) airing is much more appropriate: at regular intervals (e.g. every three hours) open the windows wide for a short time (5 to 10 minutes). During this time, the air changes from 9 to 15 times, which means that the entire air in the room will be replaced by fresh air in 4 to 8 minutes.

0.5.1.4 Constant monitoring and metering the energy consumption (all energy products): Such works must be performed by a qualified person (energy manager), who monitors and controls the energy consumed, thereby indirectly implementing energy management. At the end of the year, the energy manager prepares and presents an annual report on the consumption and cost of energy for the past year (by individual months), and introduces an indicative plan of energy use for next year. EM proposes possible organisational, technical and investment measures that might reduce energy consumption.

0.5.1.5 Devices should be switched off when not needed: In this aspect, it is recommended that electrical devices be used only when they are used and switching them off during holidays, on weekends, and days off.

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 technical 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.

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.

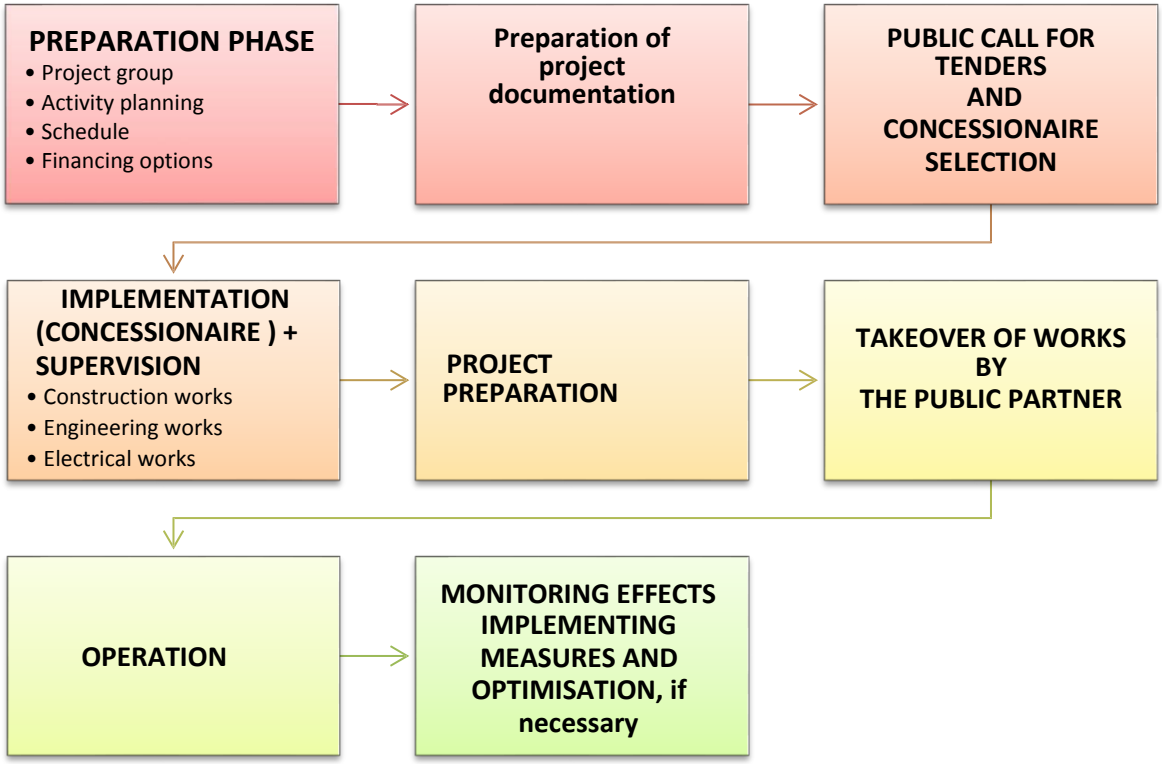


Figure 0.3: Process of implementing individual measures