DRAFT version 2.0
11 Jun 2018

Municipality of LEPOSAVIĆ

Municipal Energy Efficiency Action Plan (MEEAP)

2018 – 2020

Contents

List of Tables

List of Figures

Abbreviations

EE	Energy Efficiency
EMS	Energy Management System
KEEA	Kosovo Energy Efficiency Agency
MEEAP	Municipal Energy Efficiency Action Plan
MEEP	Municipal Energy Efficiency Plan
MVP	Monitoring and Verification Platform (an application that assists in measuring progress towards Energy Efficiency targets)
NEEAP	National Energy Efficiency Action Plan
O&M	Operation and Maintenance
RES	Renewable Energy Sources
USAID	United States Agency for International Development

1. INTRODUCTION

The MEEAP of the Municipality of Leposavić aims:

- through the assessment of energy consumption in the Municipality of Leposavić, to identify priority sectors for interventions in order to increase energy efficiency at its territory,
- to assesses energy saving potential in the municipality and to set targets for energy savings,
- to identify the list of priority projects for investments,
- to identify project financing models,
- to describe institutional set-up for development and implementation, as well as post-implementation monitoring/reporting of implemented energy saving measures.

1.1 Context

Based on the Directive on Energy Efficiency 2012/27/EU, entered into force on 5th December 2012, the European Union set its targets for the reduction of primary energy consumption to 20% by 2020. Kosovo, as the signatory of the Energy Community Treaty has decided to contribute towards achieving targets of energy efficiency, creating incentives for energy savings by citizens, also for open markets and new business application of energy efficient technologies and services.

The first Kosovo NEEAP (2010-2018) was approved by the Ministry of Economic Development on 30th September 2011. It provides an indicative target to achieve 9% of 1021.08 ktoe until the end of the period covered by the plan (2010-2018). So, the target remains in effect until 2018 that Kosovo should save 91.89 ktoe.

Activities at the local level play an important role in achieving the above mentioned national level targets.

1.1.1 Legal and policy framework

The LAW ON ENERGY EFFICIENCY (Law No.04/L –016), approved by the Assembly of Kosovo in June 2011 - Article 9 describes the responsibilities of the Municipal Energy Offices in developing Municipal Energy Efficiency Plans and Municipal Energy Efficiency Plan Implementation Progress Reports, as instructed by the KEEA. Both documents have to be adopted by the Municipal Assembly and subsequently delivered to the KEEA.

LAW ON ENERGY – Article 4 states that the Government shall issue sub-legal acts on establishment, funding and operation of municipal energy offices, which shall address issues related to implementation and monitoring at the local level.

ADMINISTRATIVE INSTRUCTION (GRK) No. 09/ 2017 of 6th September 2017, ON MUNICIPAL ENERGY OFFICES - determines duties and responsibilities of municipal energy offices to address issues of planning, implementation and monitoring of energy policies at the local level. Among other duties and responsibilities of Municipal Energy Offices the following main responsibilities are listed:

- to establish a database and to maintain an information system for regular collection of data on energy consumption on a periodic basis, energy expenditures and other relevant data, to maintain a registry that enables the selection of potential energy efficiency indicators of energy-intensive municipal buildings,
- to report on the implementation of the Energy Strategy Program and expected developments in the remainder of the Program,
- to develop energy sector planning activities, based on the Energy Strategy, in order to support sustainable economic and social development of municipalities,
- to provide necessary data for the Ministry for the preparation of the Energy Strategy, its revision and preparation of three (3) year Energy Strategy Implementation Program pursuant to the Law on Energy,
- to continuously monitor the implementation of the Energy Strategy at the municipal level and to report to the Ministry on its implementation.

1.1.2 MEEAP's objectives and benefits

The overall objective of the MEEAP is to reduce energy consumption, increase comfort level and decrease the burden of energy costs on the municipal budget of the Municipality of Leposavić.

The MEEAP is expected to have the following impacts on the state of the Municipality of Leposavić:

- Decrease of energy consumption in the sectors of building construction, transport and public lighting;
- Reduction of energy costs in the municipal budget;
- Improvement of municipal services;
- Refurbishment of energy production installations and buildings;
- Improvement of sanitary conditions and comfort level in public buildings;
- Decrease of CO_2 emissions in all sectors by implementing energy efficiency measures, use of renewable energy sources, management of consumption, training and other measures;
- Raising awareness of energy saving policy makers, operators and end users.

The benefits expected from the implementation of the MEEP are:

- Financial benefits
- Operational benefits, including improved indoor climate
- Environmental benefits

1.2 Executive Summary

The Municipality of Leposavić has the MEEP of 2016-2019 approved by the Municipal Assembly in April 2016. The support in drafting the MEEP is provided by the USAID project – Advancing Kosovo Together – Local Solution. The MEEP provides information on energy consumption in the municipal building stock – administrative, educational and healthcare buildings, as well as in the street lighting sector. The Municipality of Leposavić has implemented several renovation projects with reference to the EE measures – improving insulation of building envelopes and replacing windows. In that Report, energy consumption was analyzed for the period 2012 – 2014.

In this Report, energy consumption in 2017 is used. In addition to updating all data, after analyzing the general situation in the Municipality of Leposavić and after consulting responsible persons in the Municipality, the list of priority projects has been made in accordance with the following criteria:

- The largest energy saving
- The largest reduction of CO_2 emissions
- Great effect of project visibility
- Raising the awareness of citizens
- Opportunities for projects to be repeated within the Municipality
- Considerable social and public effect
- Relatively low investments
- Short payback period
- Possibility to stimulate the development of local firms in the field of EE and RES (design, production of the parts of equipment, mounting or service)

The analysis of energy consumption in the Municipality of Leposavić includes the following sectors: (1) municipal building stock, (2) street lighting, (3) municipal fleet, and (4) water supply system.

Total heating area of all municipal buildings is 19,922 m^2. Total consumption of energy for heating purposes was 4,289 MWh/y or 178 kWh/m^2y in 2017. According to European a standard which is about 80 kWh/m^2y, this is too high consumption of energy for heating. Estimated annual costs for heating are about EUR 126,500. The consumption of electricity is about 557 MWh/y and it is used for lighting and for other electrical devices. The costs of electricity are about 44,600 EUR/y. Total energy costs (heating and electricity) per m^2 are 6.4 EURO/m^2y. Energy costs for buildings amount to over 93.2% in relation to costs for all four sectors together.

The proposal of possible measures for the increase of energy efficiency and the use of renewable energy sources in analyzed four sectors is given in the Report. Since this MEEAP refers to the period 2018 – 2020, the focus is given only to those measures that can achieve larger energy savings in the short period of time and that are the most visible. Large saving will result in large reduction of CO_2 emissions.

After detailed review and the analysis of results of the energy audit and on the basis of the assessment of social and economic priorities, the following projects are proposed for implementation in the period until 2020:

Table 1 - List of Priority Investment Projects

No.	Project	Description	Estimated Final Energy Savings [MWh/y]	Avoided CO_2 Emissions [t CO_2/y]	Estimated Total Investment [EURO]
1.	The construction of pellet block thermal power plant	The primary school, secondary school, municipality building and several nearby municipality buildings are heated by individual coal or wood fired boilers. The construction of common pellet fired block boiler house in a special building will enable efficient and high quality heating of several buildings. This block boiler house will be the basis for the establishment of the municipal heating plant as a public enterprise.	548	164.4	625,000
2.	Primary School "Leposavić", Leposavić	Thermal insulation of walls and roof and replacements of windows and outdoor doors	316	94.8	500,000
3.	Secondary School "Nikola Tesla", Leposavić	Installation of PV module with the power of 32 kWp at the roof of the school and a display in the hall of the school for monitoring the production of electricity	35.6	15.3	45,000
		TOTAL	**901.8**	**274.5**	**1,170,000**

2. BASIC INFORMATION ABOUT THE MUNICIPALITY

The Municipality of Leposavić is the northernmost municipality of Kosovo and Metohia (Figure 1). It is located in the valley of the river Ibra. It is confined from the east by the slopes of the mountain Kopaonik, from the west by the slopes of the mountain Rogozna. The today's Municipality was formed in 1960 from the former municipalities of Lešak, Leposavić and Slatina. The Municipality of Leposavić has 7 local neighborhood units, Lešak, Leposavić and Sočanica, Belo Brdo, Vračevo, Bistrica and Šaljska Bistrica and 72 villages.

Figure 1 - Location of the Municipality of Leposavić within Kosovo and Metohia

The climate is moderate continental to the altitude of 800 m. The maximum temperature is 38.5 ° C (in July and August) and the minimum is -28.5 °C in the second half of January and in the first half of February. The subalpine climate is at the heights from 800 m to 1300 m. At the heights above 1300 m, there is mountainous climate (mountains Kopaonik and Rogozna). Snow lasts for 150 days a year and fog for 94 days.

It is located at 43°06'14.00" of the north geographic latitude and 20°48'10.01" of the east geographic longitude.

In the Municipality, there are 4 Primary Schools, 2 Secondary Schools (Agricultural School “Priština” in Lešak, Secondary School “Nikola Tesla”) and 2 Faculties of the University of Priština (Teachers Training College from Prizren and Faculty of Physical Education from Priština) and two Higher Schools of Economics with the seat that used to be in Peć and Higher School of Traffic with the seat

that used to be in Uroševac. In 1999, they were relocated into the Municipality of Leposavić together with the Institute for Serbian Culture — Priština.

There is a Health Center in Leposavić, as well as the outpatient units in villages Sočanica, Lešak, Vračevo and Belo Brdo.

2.1 Population and Settlements

In 2015, the Municipality had the population of 18,550 inhabitants. It covers the area of 750 km^2, and consists of a city, seven counties and 72 villages.

2.2 Organizational Structure of the Municipality of Leposavić

The organizational structure of the Municipality of Leposavić is shown in the Figure 2.

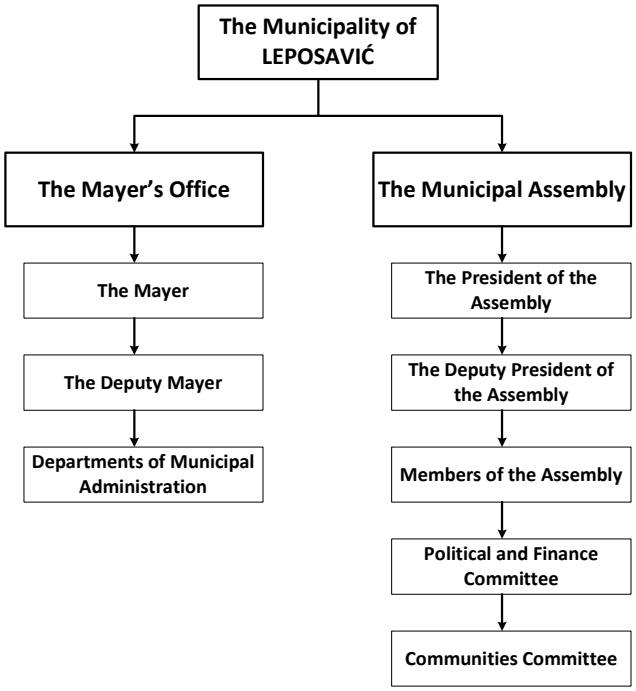

Figure 2 – Organizational Chart of the Municipality of Leposavić

The Municipal Assembly is the legislative body of the Municipality that performs the functions of local authorities established by the Rulebook and the Statute. The Municipal Administration is a body of the Municipal Assembly and it implements decisions of the Assembly. The Municipal Administration is responsible for the implementation of all executive duties specified in the Statute and in other legal documents.

The position of the Energy Efficiency Officer in the Municipality of Leposavić has not yet been established. One technical contact person for energy issues in this Municipality has been appointed by the Department for Urbanism, Environmental Protection, Property Planning and Public Housing.

2.3 Economy

Until 1991, the whole economy was based on industry, that is, DP Kopaonik, which operated within the complex system of Trepča. Now, a significant place is occupied by the wood industry thanks to many forests that occupy almost half of the whole area. Technical wood, firewood and other types of spatial wood are produced, as well as, forest timber. In addition to this, within the metal industry, there are "PPT - Articulated Bearings", the company for the production of articulated bearings, founded in 2000, and the factory "Ivo Lola Ribar" for spare parts for the Thermal Power Plant "Obilić", as well as a large number of small businesses.

Agriculture is also one of the main activities, but the conditions for its development are very modest, mainly due to the lack of agricultural cooperatives and stations for buying up agricultural products.

The conditions for agricultural production are very modest. Agricultural production can be improved by the activation of agricultural cooperatives and stations for buying up agricultural products which will be sold to factories for further processing.

General economic situation in the Municipality is unfavorable. The unemployment rate is high, in particular, in agriculture, taking into account the fact that farmers make the prevailing part of the population in the Municipality. A large number of displaced persons live in the Municipality.

2.4 Infrastructure

A very important 38 kilometer long regional road runs through the Municipality and connects Kosovo and Metohia with southern Serbia. The traffic function in Leposavić is carried out by the transportation company Autoprevoz from Raska. There are also a railway station, a bus stations and a post office.

In Leposavić, there is a Health Center with emergency services, four pharmacies, a Center for Social Work, Pension and Disability Insurance Company for social insurance, National Employment Service, Red Cross, Pensioners' House. There are branches of several banks.

2.5 Basic Climate Data

Outside design temperature in the region around Kosovska Mitrovica is -17 ^{o}C.

SD = 2848	Number of degree day (base temperature for this calculation is 15.5 ^{o}C)
Z = 194	Number of heating days in the heating season
t_{sg} = 4.3 ^{o}C	Average outside temperature in the heating season

More climate data for Leposavić are presented in Annex 3.

3. ENERGY CONSUMPTION IN MUNICIPAL BUILDINGS

3.1 Public Buildings

According to collected data, the average consumption of electricity and heating energy in 2017 was 4846 MWh/y and the specific consumption of energy was 208 kWh/m^2y. This is considerably higher consumption than desirable and points out to the potential for the increase of energy efficiency.

The Table 2 gives data for municipal buildings.

Table 2 – Energy Consumption in Municipal Buildings (in 2017)

	Building	Year of Construction	Heating Area	Number of Employees	Type of Heating	Type of Fuel	Heat Energy Consumption	Specific Heat Energy Consumption	Electricity Consumption	Total Energy Consumption	Total Specific Energy Consumption	Cost Estimate (Heating)	Cost Estimate (Electricity)	TOTAL
			m2				kWh/y	kWh/m2 y	kWh/y	kWh/y	kWh/m2 y	EUR/y	EUR/y	EUR/y
1	Lešak, Agricultural School, Braće Matović 17	2010	2,500	51	District	C+W	456,547	183	25,000	481,547	193	7,501	2,000	9,501
2	Lešak, Primary School, Braće Matović 18	1956	3,460	92+460	District	C+W	429,759	124	10,000	439,759	127	8,251	800	9,051
3	Leposavić, Municipality, JNA 33	1966	1,800	120+30	District	E	108,192	60	27,048	135,240	75	0	2,164	2,164
4	Leposavić, Cultural Center, Nemanjina 11	1996	3,500	30+150	District	LFO	160,464	46	32,000	192,464	55	0	2,560	2,560
5	Leposavić, Primary School, Vojske Jugoslavije bb	1960	3,948	94+25	District	C+W	610,220	155	22,273	632,493	160	8,251	1,782	10,033
6	Leposavić, Committee Building, 24. novembra bb	1978	1,500	50+150	Electric boiler + TA	E	800,000	533	200,000	1,000,000	667	64,000	16,000	80,000
7	Leposavić, Secondary School Nikola Tesla, Nemanjina 29/A	1973	4,000	80	District	C+W	610,220	153	96,000	706,220	177	11,501	7,680	19,181
8	Leposavić, Kindergarten (new building), Vojske Jugoslavije bb	2010	2,838	61+300	District	C+W	514,411	181	92,000	606,411	214	10,626	7,360	17,986
9	Leposavić, Kindergarten (old building), Dositeja Obradovića bb	1979	631	28+175	Boiler + storage heaters	LFO/HFO	81,500	129	41,000	122,500	194	6,120	3,280	9,400
10	Sočanica, Primary School, Kosovskometohijskih brigada 1	1955	2,400	51+350	District	C+W	517,200	216	12,000	529,200	221	10,251	960	11,211
	TOTAL		**26,577**				**4,288,513**	**178**	**557,321**	**4,845,834**	**208**	**126,502**	**44,586**	**171,088**

The Figure 3 shows specific energy consumption for heating purposes and total specific energy consumption for heating and other purposes, appliances, devices and lighting, for all 10 buildings that are within the competences of the Municipality.

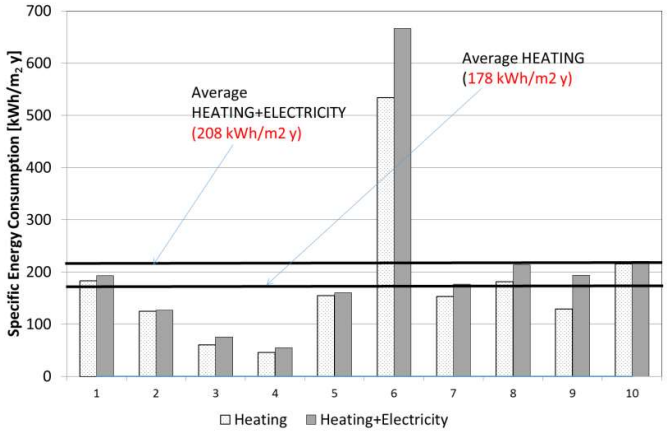

Figure 3 - Share of Energy Used for Heating and Other Purposes in the Buildings Owned by the Municipality

The List of 10 Buildings Owned by the Municipality of Leposavić is shown in the Table below. Numbers accompanying the name of the building are used to connect these buildings with the designations on the abscissa in the Figure 3.

1	Lešak, Agricultural School, Braće Matović 17
2	Lešak, Primary School, Braće Matović 18
3	Leposavić, Municipality, JNA 33
4	Leposavić, Cultural Center, Nemanjina 11
5	Leposavić, Primary School, Vojske Jugoslavije bb
6	Leposavić, Committee Building, 24. novembra bb
7	Leposavić, Secondary School Nikola Tesla, Nemanjina 29/A
8	Leposavić, Kindergarten (new building), Vojske Jugoslavije bb
9	Leposavić, Kindergarten (old building), Dositeja Obradovića bb
10	Sočanica, Primary School, Kosovskometohijskih brigada 1

On the basis of average prices of energy carriers and electricity (Annex 1), it is estimated that for heating of 26,577 m^2 of municipal buildings, 4,289 MWh/y of thermal energy has been used and that expenses for this heating are around 126,500 EUR/y. In the same buildings, some 560 MWh/y of electricity is used and the expenses for electricity are about 44,500 EUR/y. Total consumption of energy is 4,846 MWh/a, and expenses for this energy are 171,088 EUR/y.

3.2 Street Lighting

In the Municipality of Leposavić (Leposavić, Lešak, Sočanica and villages), the total number of lighting poles is 210 and the length of lightened streets is only 8.4 km.

The structure of lamps used for lighting is as follows:

- Mercury arc lamps: 125 W; 190 pcs; 23.75 kW
- High pressure sodium lamps: 250 W; 350 pcs; 87.50 kW
  150 W; 70 pcs; 10.50 kW
  100 W; 250 pcs; 25.00 kW
- LED lamps: 100 W; 20 pcs; 2 kW

Total power of street lighting is 148.75 kW. Total consumption of electricity for lighting in 2017 was 111,240 kWh/y (according to information provided by competent authorities). If total capacity of lighting is compared then, the consumption of electricity for street lighting would be much higher. However, it is possible that there is night restriction of lighting, many burnt bulbs, etc.

The expenses for street lighting are estimated to 8,880 EUR/y.

3.3 Transport

The Municipality of Leposavić does not provide public transport services and therefore only municipal fleet of the Municipality of Leposavić has been analyzed.

Relevant data for the analysis of fuel consumption in the municipal fleet are collected from the administration of the Municipality of Leposavić and presented in Table 3.

Table 3 - Municipal Fleet Fuel Consumption (2016)

	Municipal fleet	**Year of production**	**Kilometers per year, [km/y]**	**Consumption, l/y**
1	OPEL Insignia	2011	45,000	3,375
2	ŠKODA Oktavia 1.9	2011	41,000	3,075
3	ŠKODA Oktavia 1.6	2012	47,000	3,520
4	CHEVROLET Calos	2008	24,000	1,920
5	LADA Niva 1.7	2011	11,000	1,100
		TOTAL	**168,000**	**12,990**

The fleet owned by the Municipality of Leposavić includes 5 vehicles used by the municipal council. The consumption of fuel for all vehicles was 12,990 liters/y in 2017.

The energy of this fuel is: 12,990 l/y x 0.9 kg/l x 42 MJ/kg x 1/3600 MWh/MJ = 136 MWh/y

The expenses of this fuel are around 12,990 x 1.25 = 16,237 EUR/year

3.4 Water Supply in Leposavić

The water supply system is gravitational in the whole Municipality. Water is brought from the mountain Kopaonik and by means of two pumps with the capacity of 37 kW each pumped into the tank from which it is distributed to consumers gravitationally. Pumps operate alternately so that it is turned on for half an hour and turned off for one hour (only one pump is in operation). This water supply system provides water for some 60% of population.

Electricity consumption for running water supply pumps is about 37 kW x 365 days/year x 8 hours/day = 108,040 kWh/y or 108 MWh/y. Electricity costs are about 8,640 EUR/y.

In villages, water supply is from individual wells.

3.5 Recapitulation of Energy Consumption per Sectors

Based on scarce data that have been available, the energy consumption and energy costs have been estimated. The results of this assessment are given in the Table 4. This Table shows not only high energy costs in the Municipality of Leposavić but also sectors in which significant savings can be achieved. The objective of the MEEAP is to assess those measures that can realistically be implemented in the period from 2018 to 2020 taking into account the current situation in the Municipality of Leposavić.

Table 4 – Recapitulation of Energy Consumption and Energy Costs

Sector	**Power**	**Energy**	**Cost**
	[kW]	**[MWh/y]**	**EUR/y**
Municipal Building			
- Heating	2,988	4,289	126,502
- Electricity for Appliances	3,586	557	44,586
Street Lighting	130	111	8,880
Municipal Fleet	-	136	16,237
Water Supply	74 (2×37)	108	8,640
Total		**5,201**	**204,845**

4. ANALYSIS OF ENERGY CONSUMPTION BY SECTORS

This analysis will also be done for four observed energy sectors in the Municipality:

a. Municipal public buildings sector,
b. Public street lighting sector,
c. Municipal transport fleet sector,
d. Water supply sector.

According to collected data and estimated consumption and energy costs in these sectors, the Figures 4 and 5 show the percentage of shares. As expected, the largest consumption of energy and the highest costs for it are in buildings which the Municipality owns. The consumption of energy for the municipal passenger fleet is the second largest, followed by the street lighting and water supply system.

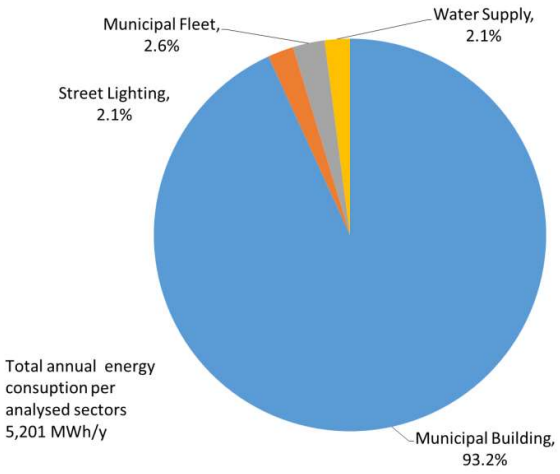

Figure 4 – Energy Consumption

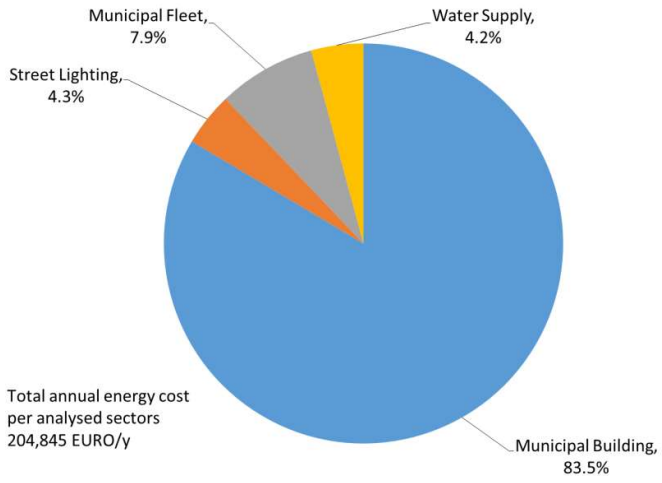

Figure 5 – Energy Costs

There are no doubts that such a result points out to the need to improve energy efficiency in buildings although other sectors should not be ignored, especially if some measures can save money with a short period of investment repayment.

The average value of total energy consumption (heating + electricity for lighting and appliances) for all buildings was 208 kWh/m^{2}y in 2017. This value only for heating was 178 kWh/m^{2}y. The standard deviation of total specific consumption is 136 kWh/m^{2}y, which is a high number. This points out to the low accuracy of collected data, to the absence of energy management in buildings and to very different technical characteristics of the buildings primarily of the envelope of certain buildings and of the heating system.

The area of these buildings is 26,577 m^2. The average cost for all 10 buildings in Leposavić is 6.4 EUR/m^{2}y.

The consumption of energy for street lighting was 111 MWh in 2017 (according to information provided by competent authorities). The rough estimate of energy costs is around 8,880 EUR/y. It can be said that this is minimum energy consumption because the consumption would be slightly above 500 MWh/y relevant to the capacity and if all lamps were operating 10 hour per day.

The street lighting is technologically obsolete and old.

The power of incandescent lamps is 72 kW and they reflect about 13 lumens per each Watt of nominal power. The power of all HID metal halide lamps is 55 kW and they reflect about 80 lumens per each Watt of nominal power. That means that all lamps reflect about $(72 \cdot 13 + 55 \cdot 80) \cdot 1000 = 5.34 \cdot 10^6$.

If all lamps are replaced by modern LED lamps then, the same degree of illumination can be achieved by the power of only $\frac{5.34 \cdot 10^6}{110} = 48{,}000\ W\ or\ 48\ kW$. The average number of lumens of LED lamps is 110 per each Watt.

Based on this rough calculation, it can be estimated that in case of complete reconstruction of street lighting, it will be possible to achieve savings of as much as 62% in relation to current consumption: $\left(1 - \frac{48}{72+55}\right) \cdot 100\% = 62\%$.

Direct expenses for energy will be then reduced also for 62%. However, the investments in the reconstruction are much higher than possible savings, which means that the repayment period is long. Therefore, it is proposed to conduct this reconstruction gradually and systematically in several years to come.

The transport municipal fleet has 7 passenger cars. Their participation in total costs is limited and of minor importance for overall costs. However, it is necessary to take into considerations and to undertake general organizational measures for cost reduction.

5. ANALYSIS OF ENERGY EFFICIENCY POTENTIAL BY SECTORS

5.1 Municipal Public Buildings Sector

A total of 10 buildings in the Municipality of Leposavić are the subject of the analysis. From that:

- Administrative buildings 2
- Educational buildings 7
- Healthcare buildings 0
- Culture and sports buildings 1

Only buildings that are registered in the Cadaster as owned by the Municipality are taken into consideration. Although the Municipality uses some other building today, they are not owned by the Municipality.

The Table 2 shows energy consumption for heating and electricity for device operation and lighting in all 10 analyzed buildings. Tables 5, 6, and 7 show the analyses by groups: administration; education, culture and sports buildings.

For all buildings in this project, the specific annual energy consumption per square meter of heating is calculated. This is the basic and the only parameter that can be calculated and which indicates the efficiency of the heating system. Minimum technical requirement for all buildings is 80 kWh/m^{2}y. This target value is expected from the heating system (envelope and energy infrastructure) after reconstruction.

For administrative buildings (Table 5), by applying minimum technical requirement, it will be possible to achieve savings of 47%.

Table 5 – Administrative building

	Building	Year of Construction	Heating Area	Heat Energy Consumption	Specific Heat Energy Consumption	Electricity Consumption	TOTAL Energy Consumption	Heating Energy Savings (TARGET 80 kWh/m^{2}y)
			m2	kWh/y	kWh/m2 y	kWh/y	kWh/y	kWh/y
1	Municipality of Leposavić	1966	1,800	108,192	60	27,048	135,240	0
2	Committee Building, Leposavić	1978	1,500	800,000	533	200,000	1,000,000	680,000
	TOTAL		**3,300**	**908,192**		**227,048**	**1,135,240**	**680,000**

The results shown in the Table are not realistic. The building designated as number 1 consumes very little heating energy however this is not as a result of its efficient heating system but because it has not been used. Currently, one part of the building is under reconstruction. The building designated as number 2 uses electricity for heating purposes and uses much more than expected consumption. The information has been obtained from competent authorities, but it should be verified by additional and more detailed measurements in order to establish actual situation (it is possible that the meter is out of order, that the connection to the existing heating system is not legal, etc.).

The case of educational buildings is presented in (Table 6).

Table 6 – Educational buildings

	Building	Year of Construction	Heating Area	Heat Energy Consumption	Specific Heat Energy Consumption	Electricity Consumption	TOTAL Energy Consumption	Heating Energy Savings (TARGET 80 kWh/m^{2}y)
			m^2	kWh/y	kWh/m^2 y	kWh/y	kWh/y	kWh/y
1	Lešak, Agricultural School, Braće Matović 17	2010	2,500	456,547	183	25,000	481,547	256,547
2	Lešak, Primary School, Braće Matović 18	1956	3,460	429,759	124	10,000	439,759	152,959
3	Leposavić, , Primary School, Vojske Jugoslavije bb	1960	3,948	610,220	155	22,273	632,493	294,380
4	Leposavić, Secondary School Nikola Tesla, Nemanjina 29/A	1973	4,000	610,220	153	96,000	706,220	290,220
5	Leposavić, Kindergarten (new building), Vojske Jugoslavije bb	2010	2,838	514,411	181	92,000	606,411	287,371
6	Leposavić, Kindergarten (old building), Dositeja Obradovića bb	1979	631	81,500	129	41,000	122,500	31,020
7	Sočanica, , Primary School, Kosovskometo hijskih brigada 1	1955	2,400	517,200	216	12,000	529,200	325,200
	TOTAL		**19,777**	**3,219,857**	**163**	**557,321**	**4,845,834**	**1,637,697**

Approximate power of heating in seven educational buildings with the heating area of 19,777 m^2 is about 1800 kW. By applying technical requirement for all buildings of 80 kWh/m^{2}y, the saving of 51% is possible. Some of these buildings are proposed in this Project as priority ones and they will be separately considered.

Only one building is in the group "Culture and sports buildings". In this multipurpose building (cinema, theatre, library, museum, etc.), different activities are carried out. Heating is provided when necessary and it is zonal. For that reason, the specific energy consumption for heating purposes is about 46 kWh/m^{2}y according to the total heating and useful area, which is less than the required target of 80 kWh/m^{2}y.

Table 7 – ***Culture and Sport Buildings***

	Building	Year of Construction	Heating Area	Heat Energy Consumption	Specific Heat Energy Consumption	Electricity Consumption	TOTAL Energy Consumption	Heating Energy Savings (TARGET 80 kWh/m2y)
			m2	kWh/y	kWh/m2 y	kWh/y	kWh/y	kWh/y
1	Cultural Center - Leposavić, Nemanjina 11	1996	3,500	160,464	46	32,000	192,464	0
	TOTAL		**300**	**31,038**	**103**	**4,500**	**35,538**	**0**

5.2 Public Street Lighting Sector

It is necessary to improve energy management. In particular, it is important to improve maintenance. In the period from 2018 to 2020, there are no substantial investments anticipated in this sector.

Since the reconstruction of the complete street lighting is very expensive compared to expected reduction of costs, gradual and systematic replacement of street lighting with LED technology is proposed. The systematic replacement involves the development of a replacement plan to be implemented section by section in the period of 6-8 years. This will practically be the part of investment maintenance with increased annual budget.

5.3 Municipal Transport Fleet

In organizational respect, it is necessary to optimize the use of the available passenger fleet.

5.4 Water Supply System

There are no short term measures that are proposed for the increase of energy efficiency of the existing water supply system.

6. PROPOSED MEASURES FOR THE PERIOD 2018 -2020

By analyzing the situation in the field of energy efficiency and the use of renewable energy sources in the Municipality of Leposavić and in discussions with relevant persons in charge of these fields in the Municipality, the following projects are proposed as priorities for the implementation in the period from 2018 to 2020. This does not exclude the possibility of opening other projects, as well, but with respect to limited human and financial resources of the Municipality, the focus is put on the following projects (Table 8):

Table 8 – Proposal of Priority Projects in the Municipality of Leposavić

No.	Project	Description
1.	Construction of pellet block thermal power plant	The primary school, secondary school, and several nearby municipality buildings are heated by individual coal or wood fired three old very inefficient boilers. The construction of common pellet fired block boiler house in a special building will enable efficient and high quality heating of several buildings. This block boiler house will be the basis for the establishment of the municipal heating plant as a public enterprise
2.	Primary School "Leposavić", Leposavić	Thermal insulation of walls and roof and replacements of windows and outdoor doors
3.	Secondary School "Nikola Tesla", Leposavić	Installation of PV module with the power of 32 kWp[1] at the roof of the school and a display in the hall of the school for monitoring the production of electricity

1. **Construction of pellet block thermal boiler house.** This project will solve several problems with municipal buildings in Leposavić. The Figure 6 shows satellite photograph of Leposavić with marked 22 buildings and one building in which it is possible to install the boiler house (P).

   By physical inspection of coal and wood fired boilers in the secondary school (1) (three boilers with total capacity of 600 kW), it is determined that they are in a very bad state. They are located in the cellar of the school and do not meet safety standards. This boiler house is also used for heating the primary school (2). The envelope of the primary school is in a very bad condition and the reconstruction of this envelope is the second priority. The small part of the primary school is added annex but its envelope is in good condition.

   Hot water from the boiler house in the secondary school is brought by underground pipeline. Unfortunately, the pipeline is laid down in a concrete canal without inspection holes and it is impossible to check the quality of insulation. However, according to the information provided by the manager of heating, water arrives noticeably colder (in relation to the start temperature) at the entrance of the school and for that reason, heating in completely inadequate in the primary school. In winter periods, classes are shortened due to

[1] *Solar Modules are rated in Watt Peak. Watt peak stands for peak power. This value specifies the output power achieved by a solar module under full solar radiation (under set Standard Test Conditions). Solar radiation of 1,000 watts per square meter is used to define standard conditions.*

cold classrooms. The distance between the primary school and the secondary school (where there is the boiler room) is some 50 meters.

For the purpose of increasing safety in the secondary school, the increase of energy efficiency of the heating system and reduction of CO_2 emissions of the existing system, it is proposed to construct new boiler house that will use PELLET as fuel. The boiler house will be located in the nearby building that is not in use and that is owned by the Municipality. The capacity of the new boiler house will be 1000 kW (2 boilers of 500 kW each). It is proposed to procure two boilers that can be fired both by pellet and wood (RES).

Marking on the Map	Name of Institution	Distance for Start Point (Building designated with Number 1)
P	Starting point marked with yellow color (boiler house that is the part of a department store)	0
1	Secondary School "Nikola Tesla"	40 meters
2	Primary School "Leposavić"	90 meters
3	Kindergarten "Naša Radost" – new building	280 meters
4	Kindergarten "Naša Radost" – old building	210 meters
5	Municipality building	75 meters
6	SDK Building (owned by municipality)	50 meters
7	Shopping Center (owned by the Municipality)	50 meters
8	Building of the Social Service (owned by the Municipality, Social Service, Pension and Invalid Insurance, Health Insurance, National Employment Service ...)	190 meters
9	Cultural Center (owned by the Municipality, Library, Faculty for Sports)	325 meters
10	Sports Hall (owned by the Municipality, Sports and Tourist Organization)	585 meters
11	Youth Club – owned by the Municipality	160 meters
12	Fire Station	370 meters
13	Higher School of Economics Peć in Leposavić	270 meters
14	Teacher Training College	375 meters
15	Healthcare Center	235 meters
16	Students' Dormitories	320 meters
17	Basic Court	150 meters
18	Post Office and Telekom	60 meters
19	Police Station	370 meters
20	Railway Station	490 meters
21	Bus Station	360 meters
22	Department Store	0

Figure 6 – Satellite Photograph of New Boiler House and Buildings than Can Be Connected to It

Two Kindergartens "Naša Radost" (new building) at a distance of 280 meters and "Naša Radost" (old building) at a distance of 210 meter will also be connected to this boiler house.

In addition to the increase of energy efficiency, this block boiler house will also accomplish the second objective of this project and that is the use of renewable energy sources. In the Municipality of Leposavić, there is factory for the production of pellet. In addition to that, as can be seen in the Figure 6, there are many buildings that can be connected to such block boiler house and after some time, this municipal boiler house can grow into public enterprise MUNICIPAL HEATING PLANT. This will be yet another useful benefit of this Project.

The energy efficiency of the boiler house in the Secondary School (coal and wood) is as freely estimated about 50% (many welded pipes in the boiler, uninsulated parts of the pipeline, the inspection of the chimney showed huge quantity of soot, collectors are not insulated, there is no regulation of start water temperature, etc.). Modern pellet boilers have the efficiency of about 90-92%. Taking into account that seasonal efficiency of new boilers (mean value during heating season) is equal to 80%, then the expected reduction of energy consumption will be $\frac{\Delta F}{F_{old}} = 1 - \frac{0.5}{0.8} = 0.375\ (37.5\%)$.

The boiler is intended for the production of hot water in operating regime of 110/90 ^{o}C and 90/70 ^{o}C with maximum operating pressure of 3 – 5 bar.

It is assumed that the following building will be connected to the block boiler house (see Table 2 too):

Leposavić, Secondary School Nikola Tesla, Nemanjina 29/A	4,000
Leposavić, Primary School, Vojske Jugoslavije bb	3,948
Leposavić, Kindergarten (new building), Vojske Jugoslavije bb	2,838
Leposavić, Kindergarten (old building), Dositeja Obradovića bb	631
TOTAL	**11,417 m^2**

If it is assumed that these buildings will achieve the situation of target which is 80 kWh/m^{2}y, then annual energy consumption of all these building will be 913 MWh/y. With old boilers, energy consumption will be 1461 MWh/y.

Overview of activities, assessment of investments and possible effects of this project are shown in the Table 9.

Table 9 – Assessment of Savings and Investments (Project 1)

	Project Description	Estimated Final Energy Savings [MWh/y]	Avoided CO_2 Emissions [kg CO_2/y]	Total Investments EURO
1	Detailed energy audit of all buildings and possible connection between buildings and block boiler house	-	-	5000
2	Preparation of project documentation	-	-	20,000
3	New boiler house location preparation	-	-	100,000
4	The construction of common pellet fired block boiler house in a special building and connection the planned building with pre-	548	164.4	500,000

	insulated pipes.			
	TOTAL	**1,369**	**410.7**	**625,000**

2. **Primary School, Leposavić**. The age of the building is 58 years. The annex is of some more recent date and as opposed to the old building, its envelope is in good condition. The total area of the building is 3,948 m^2 and it has ground floor + 1 floor. The envelope of the building and the roof are in very bad thermal condition and they should be reconstructed (Figure 7). The Table 10 gives the summary of the results of estimates of energy savings, reduction of CO_2 emissions and investments in anticipated works on the reconstruction of the envelope of the primary school building (without the annex).

Figure 7 – View of the Primary School Façade

Table 10 – Assessment of Savings and Investments (Project 2)

	Project Description	Estimated Final Energy Savings [MWh/y]	Avoided CO_2 Emissions [kg CO_2/y]	Total Investments EURO
1	Installation of insulation on walls (80 mm Styrofoam) and the roof (100 mm Styrofoam) and replacement of windows and entrance door (PVC)	316	94.8*	500,000
	TOTAL	**316**	**94.8**	**500,000**

**The reduction of CO_2 emissions is calculated as the reduction of coal consumption that is used for heating of the school*

3. **Secondary School, Leposavić** – Installation of the PV panel with the capacity of 32 kWp on the roof of the school and a display in the hall of the school to monitor electricity consumption.

The Figure 8 shows the secondary school where the PV panels have to be installed (this is only one of options).

Figure 8 – View of the Secondary School in Leposavić

The simplified calculation of the surface of PV panels (Annex 4) has determined that with reference to the conditions of solar radiation in Leposavić (Annex 3), it will be possible to produce 35.6 MWh (356 W/p ×100 panels) with 100 panels with the unit capacity of 320 Wp. Panels will be mounted on the roof with the fixed slope of some 31° and south orientation. Data for one of possible panels are given in Table 11.

Table 11 – Basic Data of Possible PV Panel (Panel 320 W – 24 V)

Power	320 W
Solar Cell	Monocrystalline
Power Tolerance	±3
Size	1950×992×40 mm
Working Voltage	34.4 V
Working Current	9.42 A
Open Circuit Voltage	43.2 V
Short Circuit Current	10.77 A
Operating Temperature	-40℃~+85℃
Weight	20.6 kg

The block diagram of the solar PV system is given in the Figure 9.

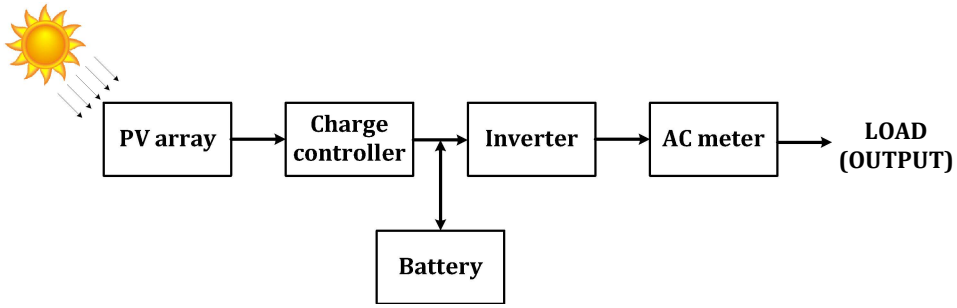

Figure 9 – Block Diagram of the Solar PV System

For mounting of panels, the area of some 260 m^2 is required and the weight of these panels is about 2 tons.

Since mounting of PV panels is planned for the secondary school, it is compulsory to also install a display in the hall of the school for the purpose of on-line monitoring electricity production and integral consumption for the period from the beginning of its work.

Generated electricity should be sold to the local distribution network and achieved revenues should be registered on the installed display.

The approximate price of panels with accompanying equipment and installation is about EUR 45,000.

The costs of preparing the roof for panel mounting and for design are not counted.

7. MONITORING THE IMPLEMENTATION OF THE ACTION PLAN

ADMINISTRATIVE INSTRUCTION (GRK) No. 09/ 2017 of 6 September 2017, ON MUNICIPAL ENERGY OFFICES – Art 8 determines that the Municipal energy offices shall prepare and submit to the MED periodic and annual reports as well as other information as requested, on issues under their responsibility.

The Municipality of Leposavić should establish an energy efficiency team that will be comprised of technical staff of the municipality. This team would be responsible for:

- implementation monitoring of the MEEAP,
- collecting data on energy consumption, inserting collected data in EMS,
- analyzes of data collected and determination of priority areas for further interventions and/or renovation,
- reporting into MVP.

Once a year a progress report on the implementation of the MEEAP shall be submitted to the Assembly of the Municipality of Leposavić.

ANNEXES

1. Coefficients for the estimation of energy consumption and of energy costs at the annual level

Due to the insufficient data on the types of energy carriers and their energy characteristics, and especially in the absence of their prices, their estimated values obtained from several sources are adopted. These values are applied in all MEEAP reports and therefore, their results become comparable.

Table 12 - Coefficients for Unique Calculation of Energy Consumption and Energy Costs

LIGNITE	WOOD	PELLET	DIESEL-HEATING OIL	HFO	DISTRICT HEATING	ELECTRICITY
kWh/t	kWh/m^3	kWh/t	kWh/t	kWh/t		
1860.4	2120.9	5138.9	10697.6	9055.6		
EURO/MWh	EURO/MWh	EURO/MWh	EURO/MWh	EURO/MWh	EURO/MWh	EURO/MWh
13.44	21.22	48.65	98.15	75.09	70	80
	t/m3		kg/l	kg/l		
	0.7		0.9	0.9		

2. Energy Conversion Factors

Energy conversion factors used here refer to the total directly emitted quantity of carbon dioxide (kg CO_2e) created at the place at which fuel is used or, in case of electricity, at the place where it is production (Table 13) (http://www.inteltect.com/transfer/CT_Carbon_Conversion_Factsheet.pdf).

Table 13 - Energy Conversion Factors (ε)

Fuel	kg C/kWh	kg $C0_2$/kWh
Grid electricity Delivered *The carbon emission factor for delivered electricity should be used when taking consumption as read from the meter*	0.117	0.43
Primary *The carbon emission factor for primary electricity should be used in calculations where all energy use is reported in terms of primary energy.*	0.0453	0.1661
Natural gas	0.0518	0.19
Coal	0.0817	0.3
LFO, diesel	0.068	0.25
HFO (Heavy fuel oil)	0.0709	0.26
Wood pellets	0.011	0.039

3. Climate data for Leposavić

	Unit	Climate data location
Latitude	°N	43.104
Longitude	°E	20.803
Elevation	m	649
Heating design temperature	°C	-6.83
Cooling design temperature	°C	26.09
Earth temperature amplitude	°C	19.32
Frost days at site	day	102

Month	Air temperature	Relative humidity	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days	Cooling degree-days
	°C	%	kWh/m^2/d	kPa	m/s	°C	°C-d	°C-d
January	-1.9	84.3%	1.64	94.4	3.1	-2.0	620	0
February	-0.5	79.9%	2.39	94.2	3.4	-0.4	525	0
March	3.9	71.8%	3.36	94.1	3.0	4.7	433	4
April	8.9	65.9%	4.11	93.8	3.0	9.9	269	28
May	14.3	60.8%	4.96	94.1	2.6	15.7	119	137
June	17.9	57.4%	5.63	94.1	2.6	19.5	41	229
July	20.5	52.8%	5.92	94.1	2.6	22.1	13	312
August	20.7	51.3%	5.26	94.2	2.7	22.2	10	327
September	15.8	59.0%	3.85	94.3	2.8	17.0	78	180
October	10.5	70.3%	2.64	94.5	3.0	11.1	227	68
November	4.2	81.5%	1.60	94.3	3.0	4.3	416	6
December	-0.8	84.6%	1.32	94.4	3.3	-0.9	588	0
Annual	**9.4**	**68.3%**	**3.56**	**94.2**	**2.9**	**10.3**	**3339**	**1291**
Measured at (m)					10.0	0.0		

4. Photovoltaic module calculation

JRC EUROPEAN COMMISSION

Photovoltaic Geographical Information System

European Commission
Joint Research Centre
Ispra, Italy

Performance of Grid-connected PV

Leposavic

PVGIS estimates of solar electricity generation

Location: 43°6'8" North, 20°48'36" East, Elevation: 554 m a.s.l.,
Solar radiation database used: PVGIS-CMSAF

Nominal power of the PV system: 0.3 kW (crystalline silicon)
Estimated losses due to temperature and low irradiance: 15.6% (using local ambient temperature)
Estimated loss due to angular reflectance effects: 2.8%
Other losses (cables, inverter etc.): 14.0%
Combined PV system losses: 29.5%

	Fixed system: inclination=31 deg., orientation=0 deg.			
Month	Ed	Em	Hd	Hm
Jan	0.52	16.1	2.12	65.7
Feb	0.68	19.0	2.80	78.4
Mar	1.03	31.9	4.42	137
Apr	1.13	34.0	5.01	150
May	1.24	38.3	5.56	172
Jun	1.32	39.6	6.08	183
Jul	1.36	42.3	6.38	198
Aug	1.36	42.2	6.39	198
Sep	1.09	32.6	4.93	148
Oct	0.91	28.3	3.98	124
Nov	0.59	17.7	2.53	75.8
Dec	0.46	14.1	1.86	57.6
Year	0.98	29.7	4.35	132
Total for year		356		1590

Ed: Average daily electricity production from the given system (kWh)
Em: Average monthly electricity production from the given system (kWh)
Hd: Average daily sum of global irradiation per square meter received by the modules of the given system (kWh/m2)
Hm: Average sum of global irradiation per square meter received by the modules of the given system (kWh/m2)

Page 1/1